

# BIOLOGY

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YEAR 11 ATAR COURSE – UNITS 1 & 2

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THIRD EDITION



**Peter Walster**



WACE Study Guide

# BIOLOGY

YR 11 ATAR COURSE

Peter Walster



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## About the Author:

Peter Walster was Head of Science in several WA government schools. With a science degree and Masters in Education, he has taught biology and human biology both in Western Australia and in the UK. Peter has been a WACE examiner whilst serving on a number of syllabus committees and reference groups.

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## TO THE STUDENT

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This study guide has been written for the new Year 11 Biological syllabus (ATAR course), Units 1 and 2.

The guide is divided into five sections:

- Terminology and Review Questions
- Trial Tests
- Answers to Terminology and Review Questions
- Answers to Trial Tests
- Glossary

Each unit begins with the section called “Science Understanding”. Careful attention has been given to cover each understanding listed. This is followed by the two sections Science Inquiry Skills and Science as a Human Endeavour. You may complete the guide in whichever order you choose depending on the order that is appropriate to you.

### Review Questions and Answers

It is recommended that you work through the review questions consistently through the year as you cover the material in class. There is probably too much work in them to leave to do just prior to semester exams.

Each section begins with a list of terms that will be useful, if not essential, to know. Check the answers to all the questions. These are given towards the end of the guide; make corrections where necessary and add material to your answers in order to improve them. This activity will help you to better answer questions in your tests.

### Trial Tests and Answers

This section has also been expanded and improved in this new guide. There are now more trial tests. Each test has 20 multiple choice questions, a short answer section and an extended answer question.

The answers in the guide are often given in more detail than is normally required. This is intended to expand your understanding. With the answers to the extended answer questions, each dot point generally represents one mark. This marking scheme will give you a good guide to the depth that is required in answering these questions in exams. Pay particular attention to the extended answers as this is an area in which many students can improve their answers with a little care and practice.

### Glossary

This is an updated and comprehensive list of terms with their meanings. It represents a good proportion of the biological vocabulary that you need to be familiar with in the course. Consult the glossary frequently. Whenever you encounter a term that you are not quite sure about, use the glossary to check its meaning. In doing this you will become more familiar with the language used in this course and a more competent student of biology.

Good luck in your studies!

Peter Walster

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# BIOLOGY

## UNIT 1



# DESCRIBING BIODIVERSITY



## SYLLABUS CHECKLIST

This is the knowledge that you should understand upon completing this section:

### 1.1 BIODIVERSITY

- Biodiversity includes the diversity of genes, species and ecosystems; measures of biodiversity rely on classification and are used to make comparisons across spatial and temporal scales.

### 1.2 CLASSIFICATION

- Biological classification is hierarchical and based on molecular sequences, different levels of similarity of physical features and methods of reproduction and molecular sequences.
- Biological classification systems reflect evolutionary relatedness between groups of organisms.
- Most common definitions of species rely on morphological or genetic similarity or the ability to interbreed to produce fertile offspring in natural conditions – but, in all cases, exceptions are found.

### 1.3 ECOSYSTEMS

- Ecosystems are diverse, composed of varied habitats, consisting of a range of biotic and abiotic factors and can be described in terms of their component species, species interactions and the abiotic factors that make up the environment.
- Relationships and interactions within a species and between species in ecosystems include predation, competition, symbiosis (mutualism, commensalism and parasitism), collaboration and disease.
- In addition to biotic factors, abiotic factors including climate and substrate can be used to describe and classify environments.

## 1.1 BIODIVERSITY

Study these terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) classification

---

(ii) diversity

---

(iii) ecosystem

---

(iv) gene

---

(v) genetic characteristic

---

(vi) species

---

### Review Questions

1. The number of animal species in an ecosystem is dependent on the number of plant species. Explain why this is so.

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---

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2. Explain what is meant by:

(i) genetic diversity

---

---

(ii) species diversity

---

---

(iii) ecosystem diversity

---

---

3. Name the two main processes that must firstly be undertaken in order to determine the species diversity in an ecosystem?

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4. One broad definition of biodiversity often used is to describe biodiversity as the total number of genes in an ecosystem. Explain why this definition is useful.

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5. (i) Biodiversity is generally greatest in ecosystems near the equator and least in ecosystems near the poles. Explain why there is this trend.

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(ii) There are regions on Earth which have unexpectedly high biodiversity. The south-west of Western Australia is one such area. Propose a hypothesis to explain why the biodiversity of flowering plants in this area is much greater than expected.

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(iii) Some areas of Earth have ecosystems in which the biodiversity is rapidly decreasing. Where are these 'hotspots' most likely to be found?

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6. How might measures of biodiversity be useful in comparing:

(i) two similar ecosystems?

---

---

---

(ii) the same ecosystem over a long period of time?

---

---

---

## 1.2 CLASSIFICATION

Study these terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) binomial nomenclature

---

(ii) common ancestor

---

(iii) criterion

---

(iv) dichotomous key

---

(v) morphology

---

(vi) taxonomic key

---



## Review Questions

1. Complete the following.

Organisms are divided. First into:

K \_\_\_\_\_

These are then subdivided into:

P \_\_\_\_\_

Then

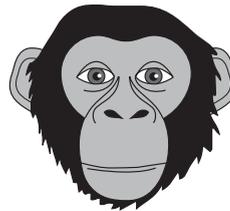
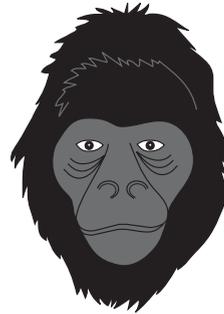
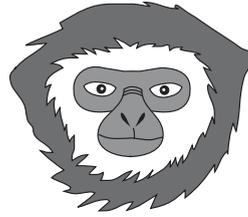
C \_\_\_\_\_

O \_\_\_\_\_

F \_\_\_\_\_

G \_\_\_\_\_

S \_\_\_\_\_



2. The living world has traditionally been divided into animal (animalia) and plant (plantae) kingdoms. However a more recent approach is to split the living world into five kingdoms. What are these five kingdoms? Give one example of each and describe its main characteristics.

KINGDOM	EXAMPLES	CHARACTERISTICS

3. On what basis are organisms generally classified? Use examples to illustrate your answer.

---

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---

4. Outline the limitations of the following criteria when classifying organisms:

(i) size

---

---

(ii) colour

---

---

(iii) behaviour

---

---

---

5. Give an example where these same criteria may be useful in classification:

(i) size

---

---

(ii) colour

---

---

---

(iii) behaviour

---

---

---

6. Crayfish and birds are both animals but which of the following criteria are useful in classifying them into their respective phyla (i.e. Arthropoda and Chordata.)

- Type of skeleton
- Kind of body symmetry
- Position of nerve cord
- Number of paired appendages
- Gill slits present in embryo

(i) Explain why you chose these criteria.

---

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(ii) Honeyeaters and dogs belong to the same phylum, Chordata. Which of the following criteria are useful for separating them into their respective classes (i.e. Aves, Mammalia)?

- Type of skeleton
- Position of nerve cord
- Kind of body covering
- Number of heart chambers
- Body temperature compared to environmental

Explain why you have made your choices.

---

---

---

7. (i) When are two animals or plants said to belong to the same species?

---

---

---

(ii) What kind of problems are evident in this definition?

---

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(iii) How might these problems be overcome?

---

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8. (i) What is a dichotomous key?

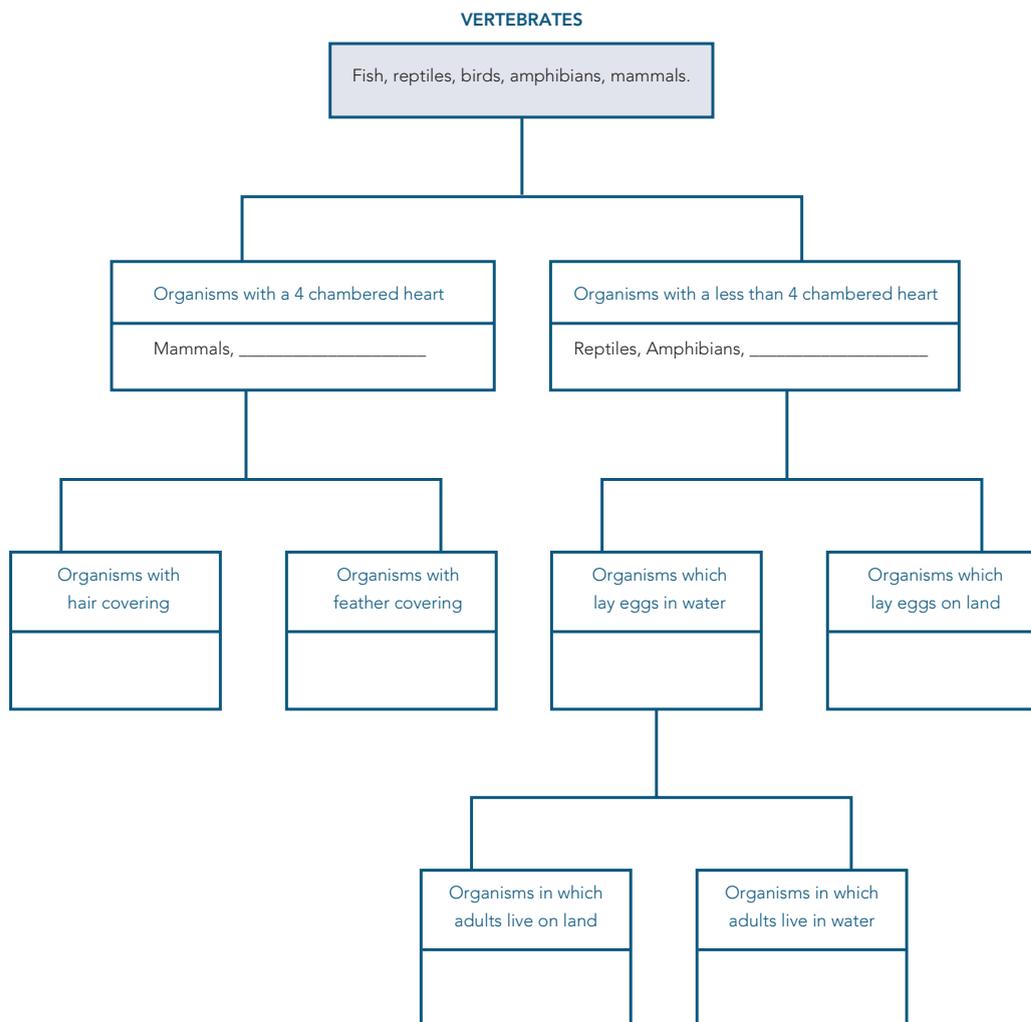
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(ii) Complete the following dichotomous key by adding the necessary missing names.





10. Four trees commonly found in Jarrah forests include Jarrah, Marri, Blackbutt and Bull Banksia. The Marri (or Red Gum) was, until recently, classified as belonging to the genus *Eucalyptus* but it has now been reclassified by botanists in the genus *Corymbia*. The scientific names of these four trees are shown in the table below:

COMMON NAME OF TREE	SCIENTIFIC NAME OF TREE
Jarrah	<i>Eucalytus marginata</i>
Marri	<i>Corymbia calophylla</i>
Blackbutt	<i>Eucalyptus patens</i>
Bull Banksia	<i>Banksia grandis</i>

- (i) Which trees in the table are likely to be most similar in their structure and appearance? Explain.

---

---

- (ii) Considering the recent reclassification which one of the trees is likely to be most distantly related to the others? Explain.

---

---

- (iii) Draw a sketch to indicate the evolutionary tree with only these four trees shown.

- (iv) Why might botanists have reclassified the Marri (in 2009)?

---

- (v) On what type of evidence was this reclassification of the Marri species likely to have been based?

---

- (vi) Discuss how this reclassification has affected the biodiversity of the Jarrah forests.

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## 1.3 ECOSYSTEMS

Study these terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) abiotic

---

(ii) biosphere

---

(iii) biotic

---

(iv) community

---

(v) decomposer

---

(vi) habitat

---

(vii) heterotroph

---

(viii) interspecific

---

(ix) intraspecific

---

(x) productivity

---

(xi) substrate

---

(xii) symbiosis

---

## Review Questions

1. Which of the following factors are biotic and which are abiotic (write them under the appropriate column in the table below): *predators, parasite, temperature, mates, light, water, competitors, prey, oxygen, humidity, pH, wind, soil type, offspring, pathogens.*

BIOTIC	ABIOTIC

2. The abiotic factors affecting life in the marine intertidal zone (i.e. between high and low tides) are very different from those which affect life in a lake. Discuss **four** abiotic factors that may be different in these two environments.

(i)

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(ii)

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(iii)

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(iv)

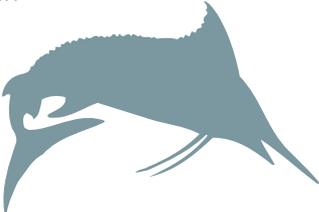
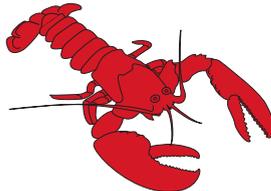
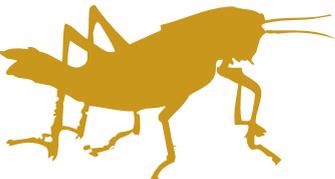
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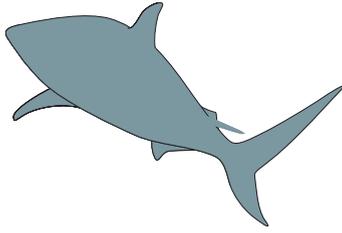
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3. Describe the biotic environment of the following organisms:

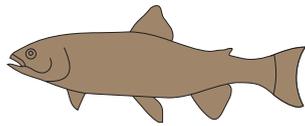
ORGANISM	BIOTIC ENVIRONMENT
i) Marine fish 	<hr/> <hr/> <hr/>
ii) Freshwater crustacean 	<hr/> <hr/> <hr/>
iii) Grasshopper 	<hr/> <hr/> <hr/>

4. How does the biotic environment of each of the following affect their survival?

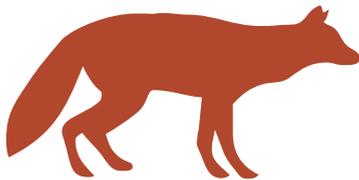
i) Shark




ii) Freshwater fish




iii) Fox




5. Contrast the following abiotic factors of a marine fish with those of a freshwater fish living in a lake.

(i) Salt concentrations

---

---

(ii) Temperature variations

---

---

(iii) Turbidity

---

---

(iv) Light penetration

---

---

(v) Water currents

---

---

6. Describe briefly how a semi arid woodland ecosystem is likely to be different from a tropical rainforest ecosystem in its:

(i) biotic factors

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---

---

---

---

(ii) abiotic factors

---

---

---

---

---

7. Describe the role of each of the following organisms in a community and give examples of each.

(i) Producer

---

---

(ii) Herbivore

---

---

(iii) Carnivore

---

---

(iv) Scavenger

---

---

(v) Parasite

---

---

(vi) Saprophyte

---

---

(vii) Consumer

---

---

(viii) Competitor

---

---

(ix) Detritivore

---

---

(x) Pathogen

---

---

8. Describe the following relationships between organisms. Give an example in each case.

(i) Mutualism

---

---

---

(ii) Commensalism

---

---

---

(iii) Predator/prey

---

---

---

(iv) Competition

---

---

---

(v) Parasitism

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9. Classifying environments – the following names have been used to describe particular environments:

(i) *Karri forest* (ii) *Coastal heath* (iii) *Freshwater lake* (iv) *Granite outcrop*

For each example discuss how the name has been derived and what limitations each name may have.

(i) Karri forest

---

---

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---

(ii) Coastal heath

---

---

---

---

(iii) Freshwater lake

---

---

---

---

(iv) Granite outcrop

---

---

---

---

10. Distinguish between “woodland” and “forest”.

---

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11. Conditions in a forest are likely to be different from those in open woodland.

(i) Describe some of the abiotic factors that are likely to differ in these environments.

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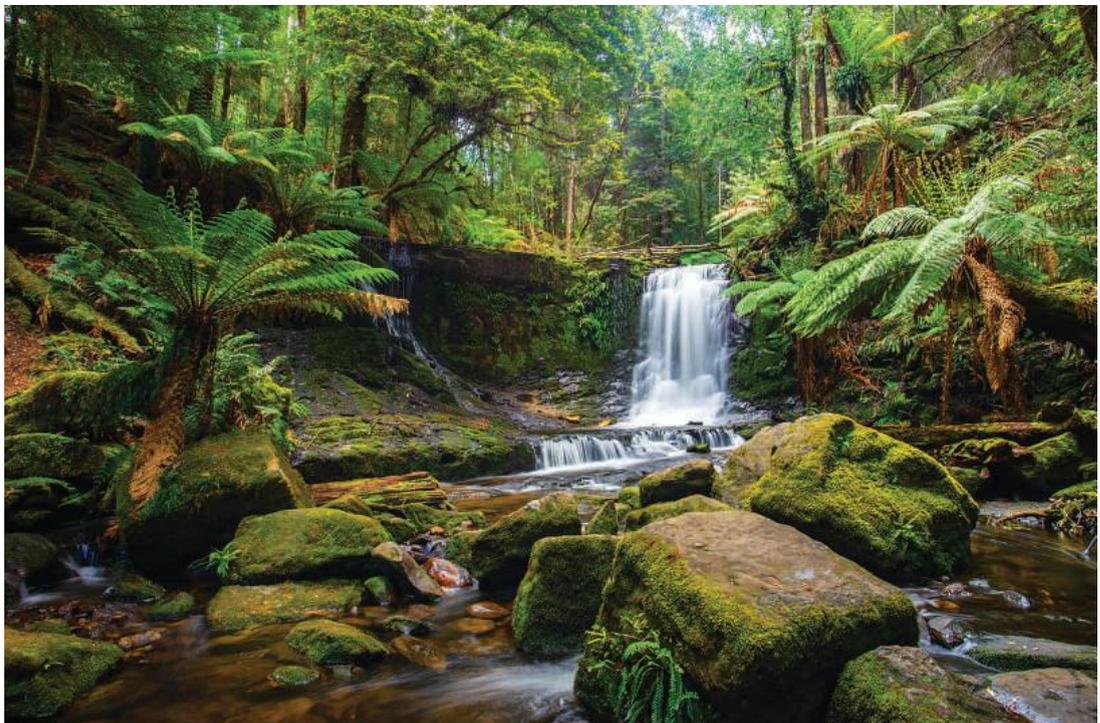
(ii) What impact are these abiotic factors likely to have on the community in each environment?

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## SYLLABUS CHECKLIST

**This is the knowledge that you should understand upon completing this section:**

### 2.1 ENERGY AND MATTER

- The biotic components of an ecosystem transfer and transform energy originating primarily from the sun and matter to produce biomass, and interact with abiotic components to facilitate biogeochemical cycling, including carbon and nitrogen cycling; these interactions can be represented using food webs, biomass pyramids.

### 2.2 POPULATIONS AND COMMUNITIES

- Species or populations, including those of microorganisms, fill specific ecological niches; the competitive exclusion principle postulates that no two species can occupy the same niche in the same environment for an extended period of time.
- The dynamic nature of populations influence population size, density, composition and distribution.

### 2.3 ECOSYSTEM CHANGE

- Keystone species play a critical role in maintaining the structure of the community; the impact of a reduction in numbers or the disappearance of keystone species on an ecosystem is greater than would be expected based on their relative abundance or total biomass.
- Fire is a dynamic factor in Australian ecosystems and has different effects on biodiversity.
- Ecosystems have carrying capacities that limit the number of organisms (within populations) they support and can be impacted by changes to abiotic and biotic factors, including climatic events.
- Ecological succession involves changes in the populations of species present in a habitat; these changes impact the abiotic and biotic interactions in the community, which in turn influence further changes in the species present and their population size.

## 2.4 HUMAN ACTIVITIES AND CONSERVATION

- Human activities that can affect biodiversity and can impact on the magnitude, duration and speed of ecosystem change include examples of:
  - habitat destruction, fragmentation or degradation, including erosion and dryland salinity
  - the introduction of invasive species
  - unsustainable use of natural resources
  - the impact of pollutants including biomagnification and eutrophication
  - emissions contributing to enhanced greenhouse effect which impact climate change.
- Conservation strategies used to maintain biodiversity are:
  - genetic strategies including gene/seed banks, captive breeding programs
  - environmental strategies including revegetation and control of introduced species
  - management strategies including protected areas and restricted commercial and recreational access.

## 2.5 PREDICTING ECOSYSTEM CHANGE

- Models of ecosystem interactions (for example, food webs, successional models) can be used to predict the impact of change and are based on interpretation of and extrapolation from sample data (for example, data derived from ecosystem surveying techniques); the reliability of the model is determined by the representativeness of the sampling.

## 2.1 ENERGY AND MATTER

Study these terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) bacteria

---

(ii) biosphere

---

(iii) decomposer

---

(iv) inorganic

---

(v) organic

---

(vi) productivity

---

## Review Questions

1. Use the diagram below to explain the concept of an **ecosystem** by discussing each of the arrows.



(A)

---

---

---

(B)

---

---

---

(C)

---

---

---

(D)

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(E)

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---

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(F)

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---

---

(G)

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---

---

(H)

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2. (i) Referring to the diagram in question 1, which organisms bring about the process labelled C?

---

- (ii) Explain (i).

---

- (iii) Which organisms bring about the process labelled F?

---

- (iv) Explain (iii).

---

---

- (v) What would be the consequence to the processes C and F if the organisms involved disappeared?

C

---

---

F

---

---

- (vi) If plants ceased to absorb light energy, how would this affect the flow of energy through the system?

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3. (i) How is the light energy absorbed by green plants used by the plants?

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(ii) Where do animals obtain their energy from and what happens to the energy?

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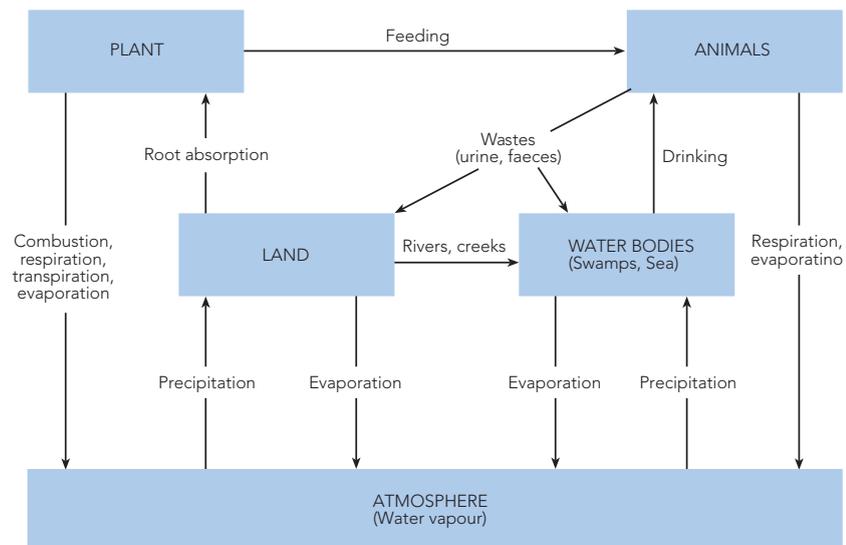
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4. The water cycle shown below illustrates how water may move in an ecosystem.



(i) Define the following terms.

(a) transpiration

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---

(b) evaporation

---

---

(c) precipitation

---

---

(d) respiration

(ii) From what parts of a terrestrial animal's body does water evaporation take place?

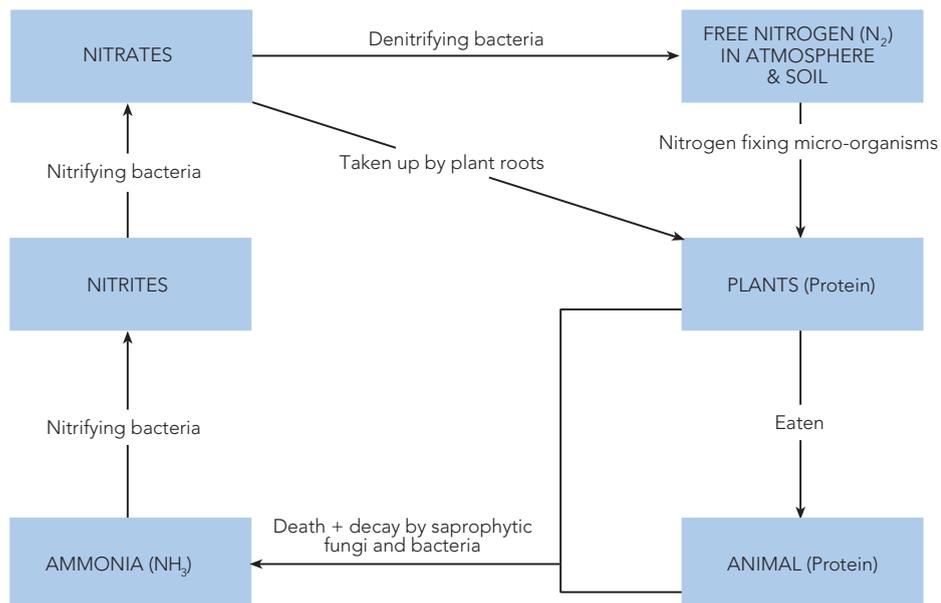
(iii) (a) How do plants obtain water?

(b) How do animals obtain water?

(iv) How does water enter the atmosphere?

(v) A high proportion of the body weight of any animal or plant is water. Why is this?

5. The diagram below shows a scheme which summarises the cycling of nitrogen compounds in nature. After studying it carefully, answer the questions below.



(i) Why is free nitrogen ( $N_2$ ) not available to plants?

(ii) Explain what nitrogen fixing micro-organisms do to free nitrogen?

(iii) How do animals obtain their nitrogen?

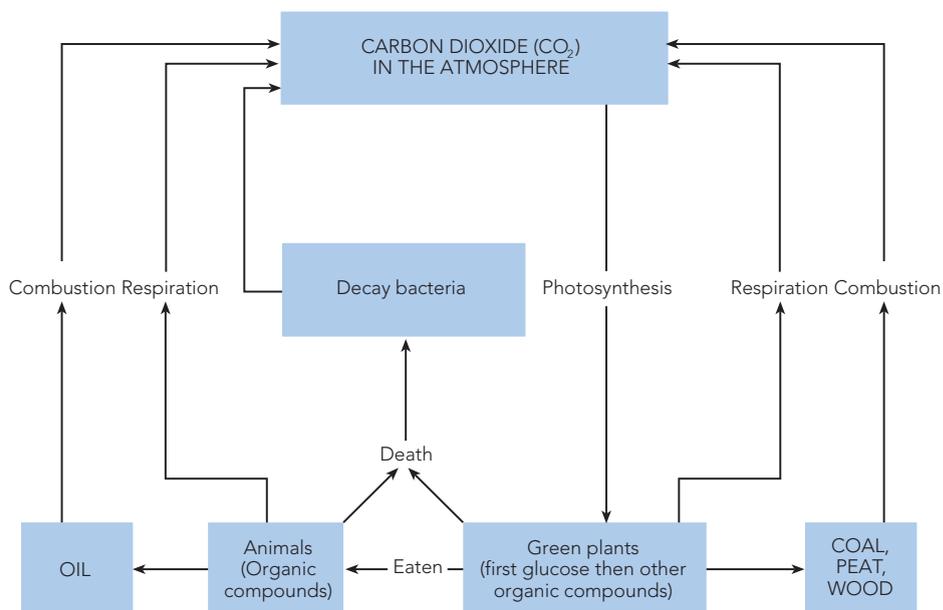
(iv) What do both plants and animals use nitrogen for?

(v) When plants and animals die, what becomes of the nitrogen in their bodies?

(vi) Nitrates which are formed by nitrifying bacteria may take at least two paths – what are they?

(vii) Lightning is not shown in this scheme. What role does it play in the cycle?

6. The carbon cycle illustrates the movement of carbon in an ecosystem. Study the diagram and answer the questions below.



(i) How is carbon dioxide removed from the atmosphere?

(ii) How does it return to the atmosphere?

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(iii) What other organic compounds does a plant produce using glucose as a starting compound?

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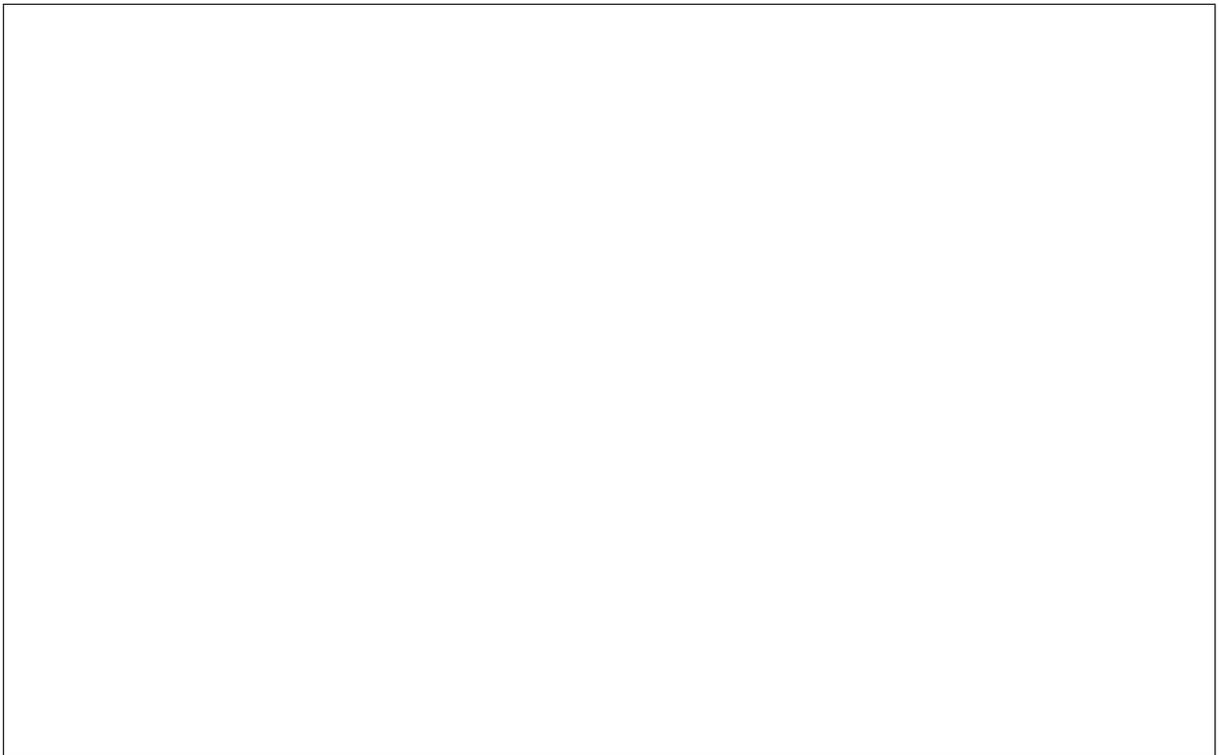
(iv) In what compounds might carbon be present in an animal?

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7. (i) Draw a food web to illustrate the following feeding relationships:

In a forest, eucalyptus leaves are eaten by saw-fly larvae. The roots of the trees are eaten by nematodes; nematodes are eaten by ants. The saw-fly larvae and ants are fed upon by small birds. Small birds are eaten by feral cats, foxes and eagles. Feral cats sometimes eat the fledglings of the eagles. Dragonflies eat adult saw-flies and they are in turn eaten by small birds. Wallabies feed on the grasses and are themselves eaten by foxes, cats (native and feral) and eagles. Numbats eat termites which feed on eucalyptus. The numbats are eaten by native cats, feral cats and foxes.



(ii) If the number of wallabies was reduced by an increase in the number of feral cats, how would this affect the eagle population?

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(iii) If the number of dragonflies was reduced due to pollution of local rivers, how might this affect the numbers of small birds? Explain.

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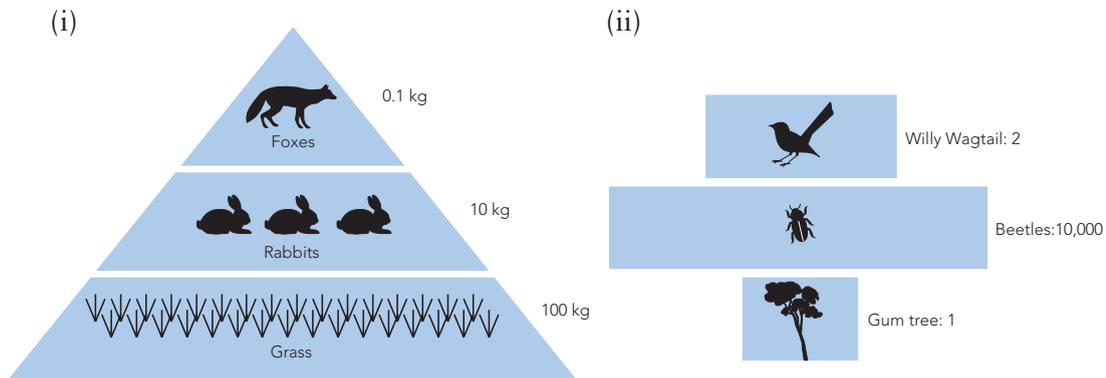
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(iv) Where do the decomposers (bacteria and fungi) fit into the food web?

---

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8. Explain what each of the “pyramids” below illustrate.



(i)

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---

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(ii)

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---

---

---

9. In question 8(i), why is the mass of the grass greater than the mass of the rabbits?

---

---

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---

10. (i) Draw a food chain involving just three organisms.

- (ii) Now draw a possible “pyramid” of numbers for your food chain.

## 2.2 POPULATIONS AND COMMUNITIES



### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

- (i) carrying capacity

---

- (ii) collaboration

---

- (iii) commensalism

---

- (iv) immigration

---

- (v) mutualism

---

- (vi) niche

---

- (vii) population density

---

## Review Questions

1. (i) Explain what is meant by the “competitive exclusion principle”?

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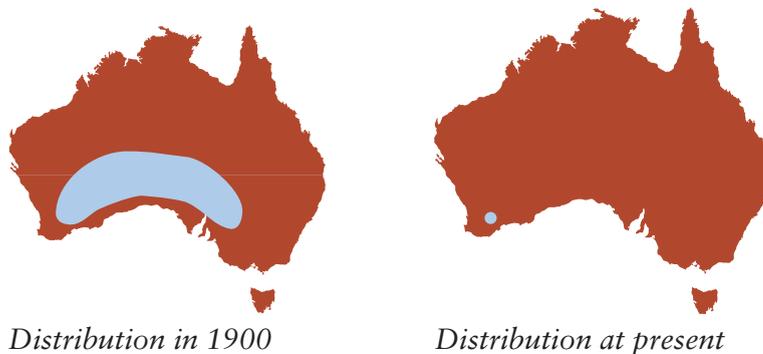
- (ii) Describe one example to illustrate this principle.

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2. **Numbat Distribution (blue areas)**



- (i) Describe what has happened to the distribution of numbats in WA since 1900.

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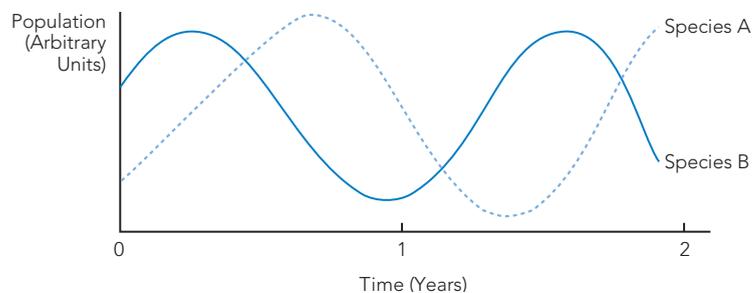
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- (ii) Do these maps indicate how the density of the species may have changed? Explain.

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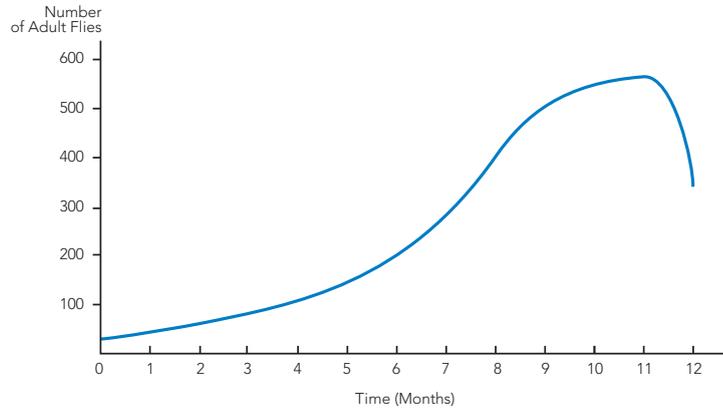
3. (i) The graph below indicates two populations in a predator-prey relationship.



Which species is the predator and which the prey? Explain.

---

- (ii) The graph below shows a population of fruit fly in a closed experimental environment.



- (a) During which months are the flies increasing at the greatest rate? Explain.

---

---

- (b) During which months are the flies declining in numbers? Explain.

---

---

- (c) What factors might cause this decline?

---

---

---

4. In the early days of Perth's settlement, huge flocks of Black cockatoos were frequently seen in the sky over the town. Today only small numbers are seen. These birds feed on Banksia seeds and other native fruit.

- (i) Why might this bird population have declined so dramatically in such a short period of time?

---

---

- (ii) How might the decline of these birds affect the populations of Banksia trees in the south-west of Western Australia?

---

---

5. (i) Populations may change due to either density-dependent or density-independent factors. What is the difference between these two factors?

---

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---

- (ii) A population of horses on an island decreases because food becomes difficult to find during a drought. Is the decline in numbers density-dependent or density-independent? Explain.

---

---

---

- (iii) The population of Numbats in an area of woodland increases because of fox baiting in the area. Is this density-dependent or density-independent? Explain.

---

---

---

- (iv) The number of rabbits in W.A. decreases as a result of an introduced disease, the calicivirus. Is this decline density-dependent or density-independent? Explain.

---

---

---

6. When would competition be an important factor in limiting the growth of a natural population?

---

---

7. (i) Make a list of the factors that may affect the **carrying capacity** of an area of forest for the Black cockatoo species.

---

---

---

- (ii) When would the population of Black cockatoos be expected to increase?

---

(iii) When would the population of Black cockatoos be expected to decrease?

---

(iv) Lack of available nesting sites may limit the population in the area. Why?

---

(v) What other limiting factors may lower the expected carrying capacity of the area?

---

---

(vi) Explain why the carrying capacity of the forest may vary from one year to another.

---

---

8. What is meant by:

(i) birth rate (b)

---

---

(ii) death rate (d)

---

---

(iii) immigration rate (i)

---

---

(iv) emigration rate (e)

---

---

9. What factors may affect the:

(i) birth rate

---

---

(ii) death rate

---

---

10. A population's growth rate may be calculated using the formula:

$$\text{Population growth rate, } r = (b + i) - (d + e)$$

Use this formula to illustrate when a population will be:

(i) increasing

---

(ii) decreasing

---

(iii) static

---

11. (i) Use the above formula to calculate the population growth rate ( $r$ ) of a town which had a population of 10,000 at the beginning of a year if in that year the number of births was 50, the number of deaths was 100, the number of people leaving the town was 10 and the number of new arrivals was 5. (Show all working).

---

---

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---

---

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---

(ii) What would the population have been at the end of the year in question (i)?

---

---

---

12. The population of dugites which inhabit Rottnest Island generally remains fairly stable. However, there may be some years in which the population rises dramatically and others in which it may decline significantly. Describe some likely causes for such changes.

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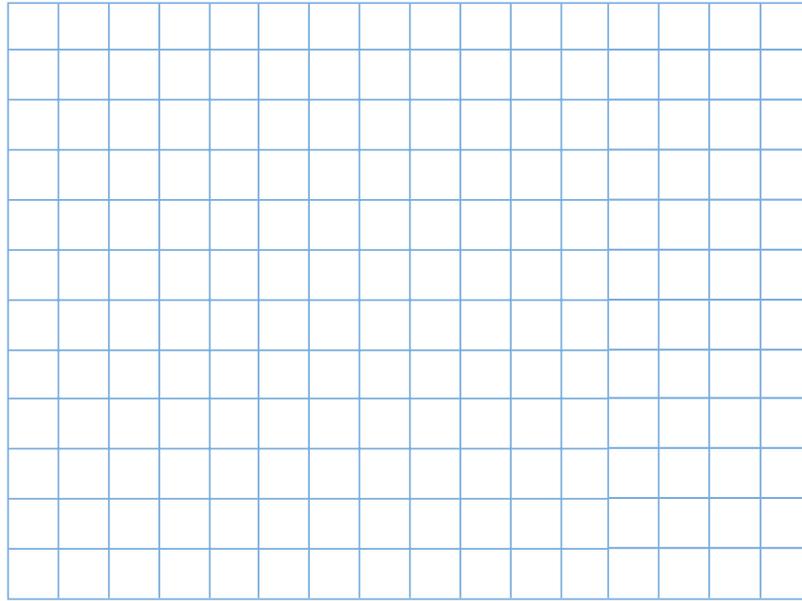
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---

13. (i) Use the grid below to show the change in the hypothetical population of Silver gulls in the Perth area during the period given in the table.

YEAR	1850	1880	1910	1920	1930	1940	1950	1960	1970	1980	1985	1990	1995	2000	2010
POPULATION	1100	1800	1700	2100	2700	2900	3500	4200	4700	5300	4100	3900	3800	3800	3900



- (ii) During which years does the population appear to be increasing most rapidly?

---

- (iii) After which year/s does the population appear to be declining?

---

- (iv) What could cause the population of Silver gulls to grow rapidly?

---



---

- (v) What could cause the population to decline?

---



---



---

14. The data below shows the estimated number of some resident birds (i.e. not migratory) on Rottneest during October.

BIRD SPECIES	ESTIMATED TOTAL NUMBER
Fairy tern	455
Rock parrot	31
Sacred kingfisher	50
Silver gull	650
Osprey	10

- (i) The Osprey population appears to be lower than that of other bird populations. Why might this be so?

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---



- (ii) What explanation can be given for the high number of Fairy terns and Silver gulls?

---

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## 2.3 ECOSYSTEM CHANGE

Study  
these  
terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

- (i) adaptation

---

- (ii) climax community

---

- (iii) ecological succession

---

- (iv) keystone species

---

- (v) pioneer organisms

---

- (vi) primary succession

---

- (vii) secondary succession

---

(viii) spatial succession

---

(ix) temporal succession

---

## Review Questions

1. The cassowary is a large flightless bird native to northern Queensland and Papua New Guinea. It eats native fruits and is responsible for the dispersal of many different seeds in the rainforests where it lives.

(i) Describe how this bird is likely to disperse seeds.

---

---

(ii) Explain why the cassowary is regarded as a keystone species.

---

---

2. (i) Explain how frequent bush fires can change the species diversity in an area which has not experienced fires in the past.

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---

(ii) How are some plants adapted to survive fire?

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---

(iii) Explain why some plants reproduce as a result of fire.

---

---

(iv) What factors determine the intensity of a bush fire?

---

---

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---

(v) How might the following organisms survive a bush fire?

a)	soil microorganisms	
b)	insects	
c)	reptiles	
d)	birds	
e)	mammals	
f)	tall trees	

(vi) In what way might the soil be changed by fire?

---

---

(vii) Are ecological changes caused by fire an example of succession? Explain.

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---

3. Describe briefly how an intense bushfire is likely to affect the biodiversity of:

(i) an Australian eucalyptus forest in the south east or south west of Australia.

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---

(ii) a rainforest in northern Australia.

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4. Is the succession that follows a fire primary or secondary? Explain.

---

---

5. The herbivorous Western Ringtail Possum lives along the south west coastland of Australia in peppermint and eucalypt forest. Since European settlement its population has declined and it is now classified as critically endangered. It is nocturnal and normally sleeps during the day in the hollow of a tree. It eats the leaves of peppermint trees and eucalypts and their buds, blossoms and fruit. Its natural predators include large pythons and monitors.

(i) How might this possum's ecosystem have changed in recent decades?

---

---

---

(ii) Discuss how these changes affect the carrying capacity of the environment for the possum.

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---



6. (i) How might the carrying capacity of an environment for a particular small mammal be measured in the field?

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---

- (ii) Populations of the Pink and grey galah have increased in many parts of Australia's pasture and wheat growing areas. How have the ecosystems changed to allow this increase in their carrying capacity for these cockatoos?

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- (iii) Numbats in the wild feed exclusively on termites. How might an intense fire affect their population? Explain.

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- (iv) A chemical that is found in some native plants is poisonous to introduced animals but not to native animals. How does this affect the carrying capacity of the areas where these plants grow for introduced species of herbivores?

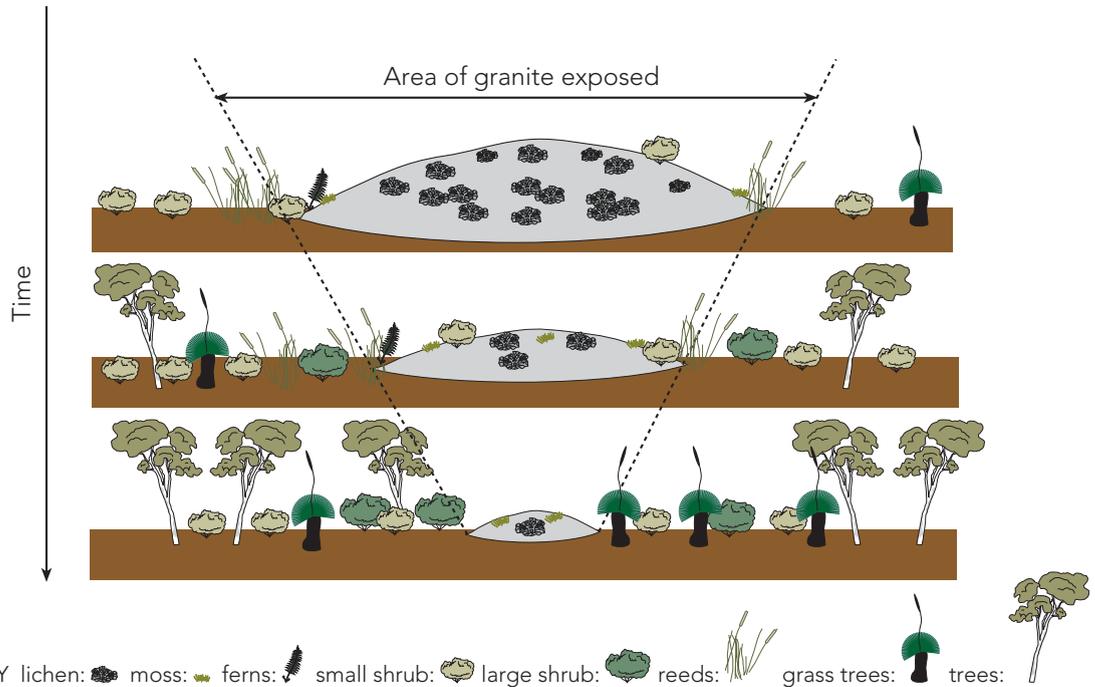
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7. Study the diagram below which illustrates the distribution of plants on a granite outcrop and the changes occurring over a very long period of time on the granite outcrop. Then answer the questions.



- (i) Is this an example of primary or secondary succession? Justify your answer.

---



---

- (ii) Name the pioneer organisms in this progression.

---

- (iii) How might the pioneer organisms change the granite?

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---

- (iv) (a) Name two abiotic factors that may change the granite over time.

---



---

- (b) Describe how each factor may change the granite.

---



---

- (v) When is the biodiversity on the granite outcrop at its greatest? Explain.

---



---

- (vi) The diagrams incorporate the concepts of both spatial and temporal succession. Discuss where and how they illustrate these ideas.

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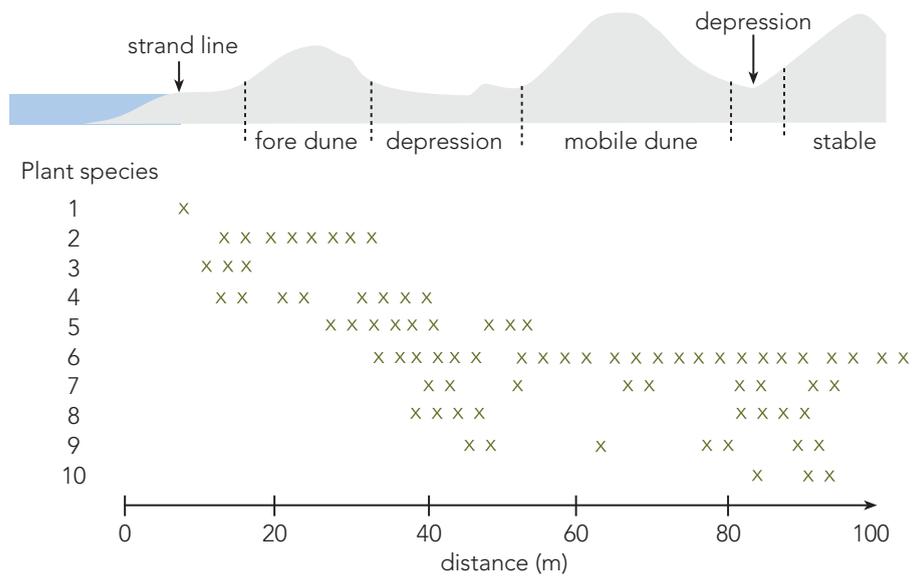
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8. Succession can also be observed at the beach. The sketch below shows how vegetation changes from the strandline (high tide leaves algae along this line) to the surrounding hinterland.

**A sketch of the profile of a section of the beach and the location of plant species numbered 1–10 growing there**



- (i) How could data showing the distribution of plants, as illustrated in the diagram, be obtained?

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- (ii) Does this diagram illustrate spatial or temporal succession? Explain your answer.

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- (iii) Why do the plant zones exist?

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---

(iv) Describe the abiotic factors that make this a hostile environment for most plants.

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---

(v) List the special adaptations possessed by the plants growing closest to the ocean?

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(vi) What special adaptations must plants growing in unstable sand dunes possess?

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---

(vii) Where is the greatest biodiversity of animal species likely to be found in this ecosystem? Explain.

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## 2.4 HUMAN ACTIVITIES AND CONSERVATION

Study  
these  
terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) bioaccumulation

---

(ii) biodegradable

---

(iii) biomagnification

---

(iv) deforestation

---

(v) desertification

---

(vi) eutrophication

---

(vii) ex situ conservation

---

(viii) extinct

---

(ix) habitat fragmentation

---

(x) invasive species

---

(xi) in situ conservation

---

(xii) reforestation

---

(xiii) salinity

---

(xiv) threatened species

---

(xv) urbanisation

---



## Review Questions

1. Complete the table below.

ENVIRONMENTAL PROBLEM	HUMAN ACTIVITIES THAT CAUSE PROBLEM	BIOLOGICAL CONSEQUENCES
(i) eutrophication		
(ii) dryland salinity		
(iii) habitat fragmentation		
(iv) exotic plant pests		
(v) feral animals		
(vi) desertification		
(vii) deforestation		
(viii) overharvesting natural resources		
(ix) biomagnification		
(x) ozone depletion		
(xi) climate change		

2. Describe human activities that lead to excessive use of fertilisers and the eutrophication of rivers and lakes in:

(i) urban areas

---



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(ii) agricultural areas

---

---

3. How does overgrazing cause desertification in 'marginal' agricultural areas?

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4. Sewage sometimes escapes into river systems. What problems does this type of pollution cause?

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5. Feral animals are a serious problem in Australia.

(i) Make a list of five feral **mammals** and indicate what damage each can do to the environment.

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(ii) Cane toads (*Bufo marinus*) were originally introduced into Australia as a biological control but have instead become pests themselves.

(a) Why has the cane toad's distribution and population continued to increase unchecked?

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(b) What damage does the cane toad cause to Australian ecosystems?

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6. (i) How does deforestation contribute to increased soil salinity in agricultural areas?

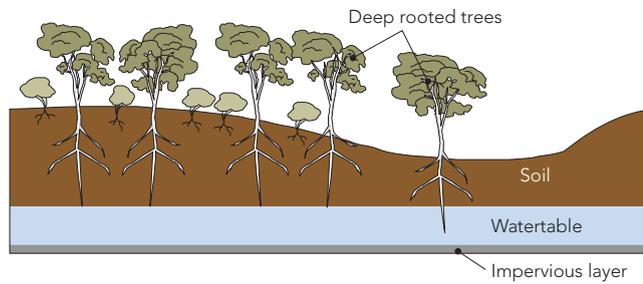
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(ii) The following diagrams show a sequence of events which may lead to an increase in the salinity of the soil in the south west of Western Australia. Beneath each, write an explanation of the diagram.

(a) SUMMER (before clearing)

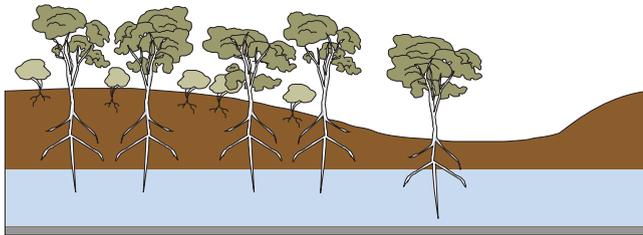


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(b) WINTER (before clearing)

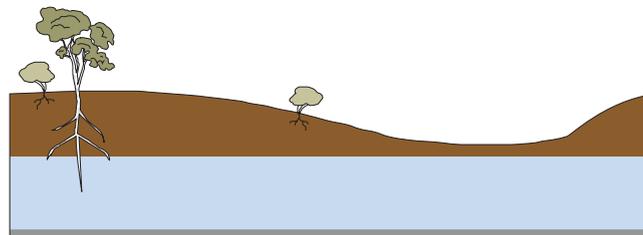


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(c) SUMMER (after clearing)

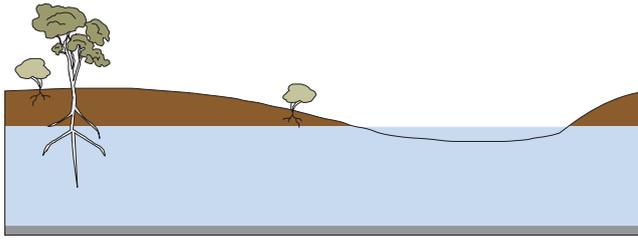


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(d) WINTER (after clearing)

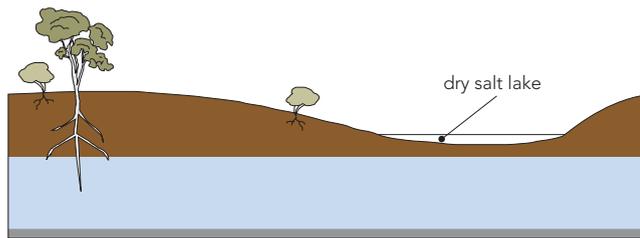


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(e) SUMMER (second, after clearing)



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7. Mercury compounds are toxic substances which accumulate in the nervous tissue of humans. How do such toxic substances enter the human body?

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8. As a measure of the amount of sewage in a body of water, such as a lake or river, the density of a mostly harmless bacteria (*Escherichia coli*) is often determined. How does this provide a measure of the degree of faecal contamination?

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9. Can harvesting a natural resource be ecologically sustainable? Explain your answer using an example.

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10. (i) Describe two examples of climate change that may occur naturally.

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(ii) Most scientists believe that Earth's atmosphere is warming. Explain what they think is the cause of this rise.

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(iii) How do scientists think the problem could be solved?

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11. What reasons are there for conserving natural ecosystems? List four.

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12. (i) What is the major threat to biodiversity on Earth?

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(ii) Is this threat presently having any effect on the Earth's biodiversity?

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---

13. Conservation can be approached in at least three major ways, through:

- i) genetic strategies
- ii) environmental strategies, or
- iii) managerial strategies.

Discuss generally how each of these strategies is used illustrating your answer with an example.

(i) \_\_\_\_\_

---

---

(ii) \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(iii) \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

14. Climate change has an impact on the rate of extinction. What measures might be necessary to counteract the effects of climate change on species diversity in the south-west of Western Australia?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

15. Explain how each of the following strategies is used and give an example of one place in which the strategy could be, or is being used, to conserve biodiversity (use local examples where possible).

STRATEGIES	EXPLANATION	EXAMPLE
Seed Banks		
Captive Breeding Programs		
DNA Profiling		
New Strain Development		
Biological Control		
Reafforestation		
Introduced Species		

STRATEGIES	EXPLANATION	EXAMPLE
Pest Control		
National Parks		
Protected Zones		
Licences		
Open Seasons		

16. Invasive species of plants are not necessarily introduced or exotic. How could a plant, like Geraldton wax, native to the northern parts of the south-west of W.A., become an invasive pest?

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17. The genetically modified canola being used in W.A. is described as 'Roundup® Ready'. Roundup® is a herbicide.

(i) What does 'Roundup® Ready' mean?

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---

(ii) Why might this 'readiness' be a problem?

---



---

18. (i) Why do government bodies issue licences which allow fishing for such species as marron, abalone and freshwater cobbler?

---

---

(ii) Why is there a charge for these licences?

---

---

19. (i) How could an animal's habitat be:

(a) naturally fragmented?

---

---

---

(b) artificially fragmented?

---

---

---

(ii) Explain the likely consequence of each type of fragmentation.

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## 2.5 PREDICTING ECOSYSTEM CHANGE

Study these terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) data

---

(ii) extrapolation

---

(iii) macroinvertebrate

---

(iv) model

---

(v) prediction

---

(vi) random

---

(vii) reliability

---

(viii) sample

---

1. (i) The 'health' of an ecosystem is largely determined by its species biodiversity. Explain this.

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---

---

(ii) What environmental influences may change the biodiversity of any ecosystem?

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- (iii) Another factor that is important in determining the 'health' of an ecosystem is the abundance of organisms within each of its species. Briefly discuss and explain.

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---

2. How are 'ecological sustainability' and 'biodiversity' related?

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3. Suppose you were part of an ecological study of a lake to determine what the impact on the lake would be if a housing estate was established nearby.

- (i) Your first task is to assess the plant species diversity and abundance within an area of 100 metres from the edge of the lake. How would you assess the plant species and abundance in the area?

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---

- (ii) What general effects could such developments have on a wetland community?

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- (iii) How might you use the capture-recapture method to estimate the population of a small native mammal living around the lake?

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- (iv) With reference to the formula used to estimate the population in the capture-recapture method, how could you improve the reliability of the population estimate?

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---

- (v) How might you determine the diversity of macroinvertebrates in the lake?

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- (vi) If migratory birds visit the lake on an annual basis, how would you assess the impact of the proposed development on their use of the lake?

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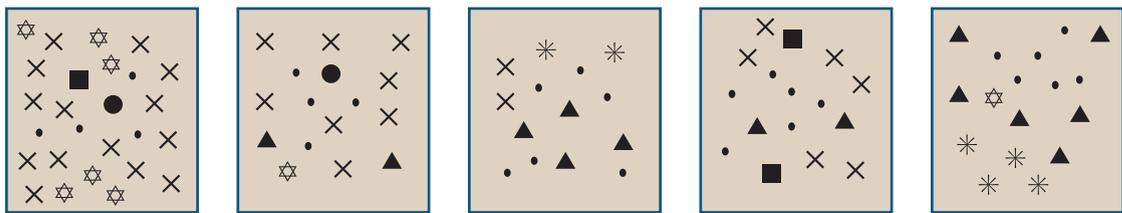
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4. The following rough data were collected by students working on a biology field trip to a forest.

**Quadrats (4 m<sup>2</sup>) - randomly selected.**



Quadrat 1

Quadrat 2

Quadrat 3

Quadrat 4

Quadrat 5

Key: • Wattle X Hibbertia ■ Marri ● Jarrah \* Grass Tree ▲ Isopogan ☆ Kangaroo Paw

- (i) How would the students have collected the data?

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---

- (ii) Why were the quadrats randomly selected?

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- (iii) What was the likely aim of the students' activity?

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- (iv) What hypothesis might the students have been testing?

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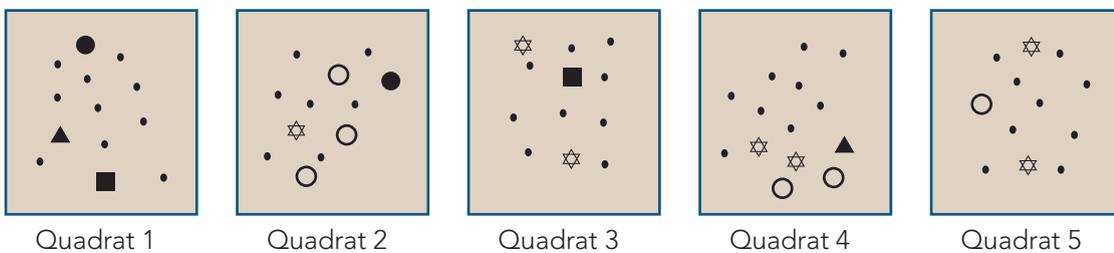
- (v) Arrange the data in a table which would enable them to compare the number of each plant in each quadrat.

--	--

- (vi) Calculate the density of each plant type in the community. Complete the table below.

PLANT TYPE	DENSITY (No.plants/m <sup>2</sup> )

Shortly after their field trip an intense bushfire passed over the area they had surveyed. Two years later another group of students returned to the area and conducted five similar quadrat surveys. Their data is shown diagrammatically below.



- (vii) Using the new data calculate the density of each plant type in the community two years after the fire. Complete the table below.

PLANT TYPE	DENSITY (No.plants/m <sup>2</sup> )

PLANT TYPE	DENSITY (No.plants/m <sup>2</sup> )

(viii) Use this data to compare the biodiversity of plants in the area before and after the fire.

---



---

(ix) How might these changes affect the animals in this community?

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---

(x) Describe generally how the food web in the community would change following the fire.

---



---

(xi) Make a prediction about the immediate effect this change could have on the stability of the community. Explain.

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---

(xii) How could reliable predictions be made regarding the ecological succession that may follow the fire in this area?

---



---

(xiii) How could the reliability of the data and the predictions be improved?

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## INQUIRY SKILLS AND HUMAN ENDEAVOUR 1



### SYLLABUS CHECKLIST

**This is the knowledge that you should understand upon completing this section:**

#### 3.1 SCIENCE INQUIRY SKILLS 1

- Identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes.
- Design investigations, including the procedure(s) to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics, including the ethics of research involving living organisms.
- Conduct investigations, including using ecosystem surveying techniques (quadrats, line transects and capture/recapture) safely, competently and methodically for the collection of valid and reliable data.
- Represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships; qualitatively describe sources of measurement error, and limitations in data; and select, synthesise and use evidence to make and justify conclusions.
- Interpret a range of scientific and media texts and evaluate processes, claims and conclusions by considering the quality of available evidence; and use reasoning to construct scientific arguments.
- Select, construct and use appropriate representations, including classification keys, food webs and biomass pyramids, to communicate conceptual understanding, solve problems and make predictions.
- Communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes, including scientific reports.

#### 3.2 SCIENCE AS A HUMAN ENDEAVOUR 1

- Classification systems are based on international conventions and are subject to change through debate and resolution; changes are based on all currently available evidence.

- Identification and classification of an ecological area as a conservation reserve also requires consideration of the commercial and recreational uses of the area, as well as indigenous peoples' usage rights.
- Keystone species theory has informed many conservation strategies. However, there are differing views about the effectiveness of single-species conservation in maintaining complex ecosystem dynamics.
- international agreements about biodiversity encourage international cooperation in the protection of unique locations, including:
  - World Heritage sites, for example, Shark Bay, Great Barrier Reef
  - biodiversity hotspots, for example, south west WA
  - international migration routes and areas used for breeding, for example, by birds, whales, turtles, whale sharks.
- Contemporary technologies, including satellite sensing and remote monitoring enable improved monitoring of habitat and species population change over time.

### 3.1 SCIENCE INQUIRY SKILLS 1

Study these terms

#### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) classification

---

(ii) dependent variable

---

(iii) hypothesis

---

(iv) independent variable

---

(v) procedure

---

(vi) quadrat

---

(vii) radio tracking

---

(viii) taxonomic key

---

(ix) transect

---

(x) variable

---

## Review Questions

1. The following is a description of a simple experiment carried out to test a particular hypothesis.

“Two batches of 1 000 bean seeds were planted in the same soil type in nearby localities. One batch (X) was played classical music for one hour each day. The other batch (Y) was not subjected to any music at all. The dry weight of a randomly selected sample of each batch was measured each week for several months from germination to maturity.”

(i) What hypothesis was this experiment designed to test?

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(ii) How was the experiment controlled?

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(iii) Why were so many bean seeds (1 000) used in each batch?

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(iv) (a) What was the ‘independent variable’ in this experiment?

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(b) What was the ‘dependent variable’?

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---

(c) List four other variables which should have been controlled in this experiment.

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(v) (a) What is meant by the ‘dry weight’ of a sample?

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(b) Why use ‘dry weight’ instead of ‘total weight’ of the sample?

---

---



(iv) How might you improve the design of the experiment? List three ways.

---

---

(v) Would you be confident, from this experiment, of the effect that music has on other plants? Explain your answer.

---

---

3. Why is each of the following important in an experiment?

(i) Sample size

---

---

(ii) Randomly selected samples

---

---

(iii) Replicates

---

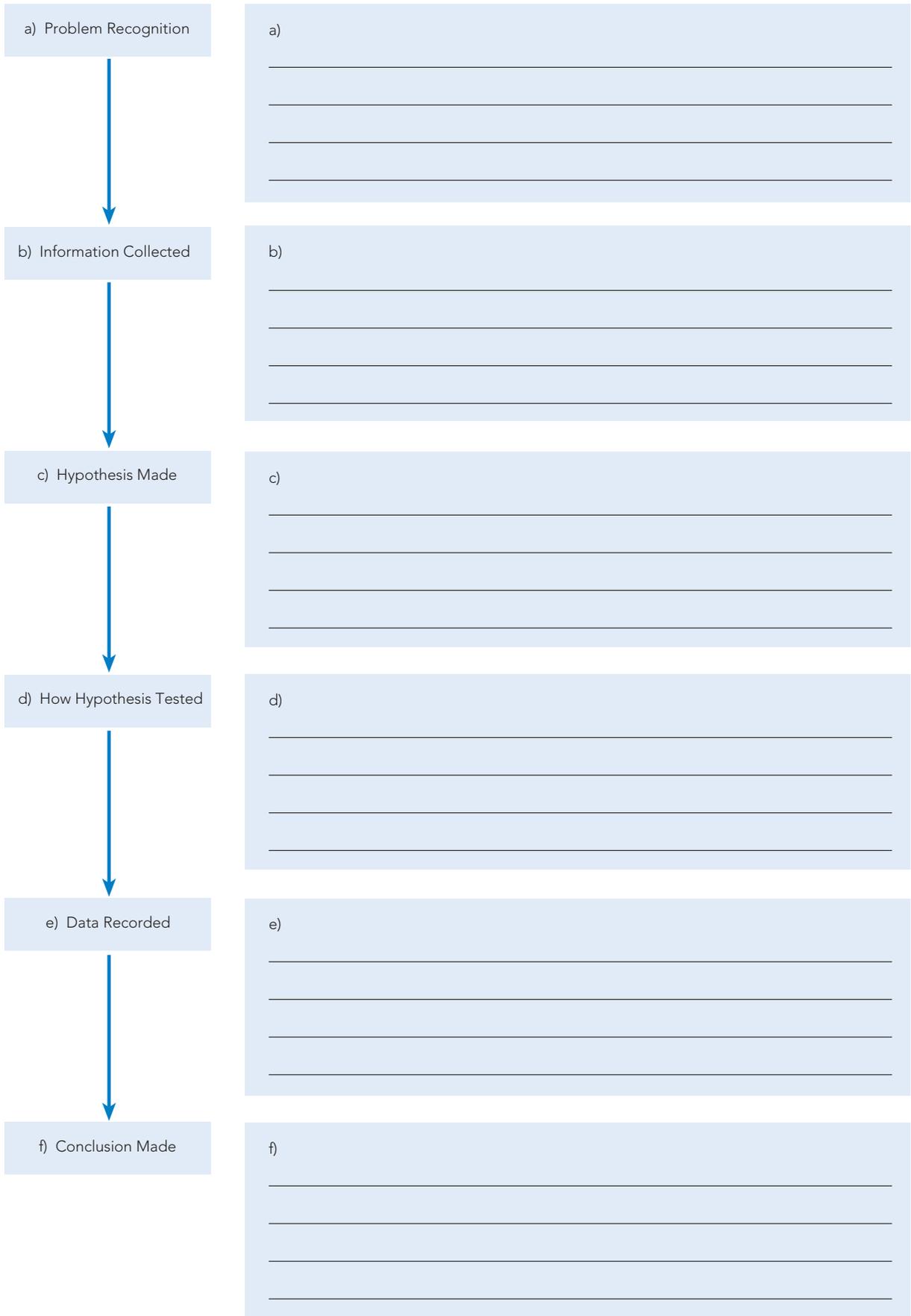
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(iv) Repeat procedures

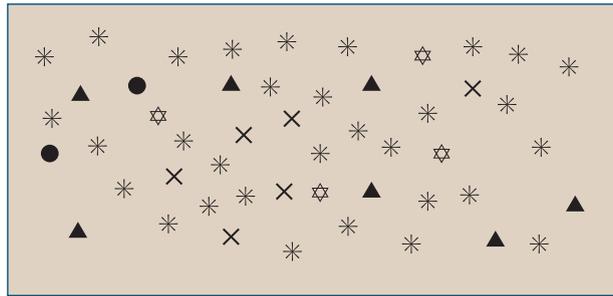
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4. 'Scientific Methodology' refers to the process that scientists use to help solve a problem. Using any case study, give an example, in the boxes provided, of what is meant by the corresponding terms. (Hint: You may use the famous case study of Louis Pasteur's investigation into the problem of wine souring.)



5. The diagram below represents an area of land in a Jarrah forest. Only some of the species of trees are shown, and only trees over 2 metres tall.



Key: \* Jarrah ☆ Wattle ▲ Marri ● Grass Trees X Banksia

If the area shown is 1.0 kilometre long and 0.5 kilometre wide, outline how you would use quadrats to estimate:

- (i) The density of Jarrah trees in the forest.

---



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---

- (ii) The total population of Jarrah trees.

---



---



---

6. (i) If in the same forest described in question 5, a number of wallabies were seen, describe how an estimate of their total population in the forest could be made using the capture – recapture method? (Do not give the formula).

---



---



---



---

- (ii) Suppose that in using the method above, the following data was obtained:

- Number tagged in first sample ( $n_1$ ) = 55
- Number captured in second sample ( $n_2$ ) = 31
- Number found tagged in second sample ( $m$ ) = 6

Use the formula below to estimate the population ( $N$ )

$$N = \frac{n_1 \times n_2}{m}$$

---



---

7. (i) What kind of animals might small 'pit traps' be used to collect?

---

---

(ii) Why do 'pit traps' need to be checked frequently?

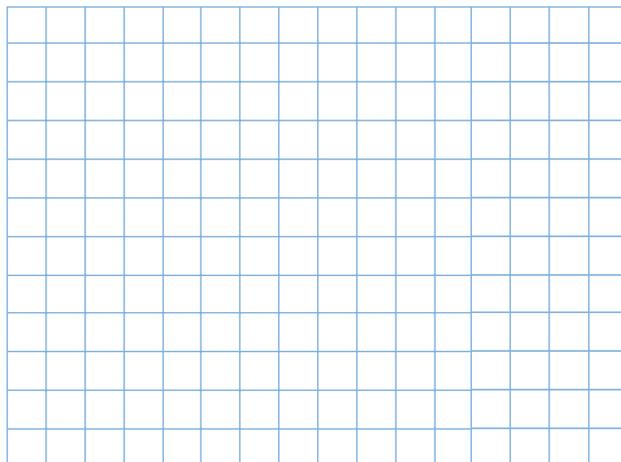
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8. Using a net, over 4 trials in one day, a biologist collected the following samples of small fish from a river. He weighed them and returned them to the river. The data below is how he recorded his results in the field.

trial one	species A	3g, 2g	species B	4g, 14g
	species C	3g, 8g	species D	3g, 7g, 8g
trial two	species A	7g, 2g	species B	19g, 12g, 13g
	species D	9g, 7g		
trial three	species A	3g, 5g	species B	7g, 13g
	species D	6g, 8g		
trial four	species A	2g	species B	11g, 17g
	species D	9g, 8g, 9g, 7g, 14g		

(i) Draw a results table in the space below to show a tally of the weight distribution for each fish species using 5 gram intervals.

(ii) Construct a graph to show the weight distribution and frequency of the four fish species caught in these trials.



9. In writing a critique of a biological experiment:

(i) What features of the experiment's hypothesis would you assess?

---

---

(ii) In the 'methods used' section of a study, what might constitute reliable and valid procedures?

---

---

---

(iii) What features might characterise poor method?

---

---

---

(iv) In evaluating the data, the scientific error involved in making readings is very important. Explain, using an example, how this error may occur and how it might impact on the reliability of a study.

---

---

---

---

(v) In the 'conclusion' section, which usually focuses on whether the hypothesis has been supported or refuted, what should your critique be most mindful of?

---

---

---

(vi) Scientific reports on the internet may vary in size and detail enormously. Why are e-publications so variable?

---

---

---

(vii) What is the importance of 'peer review'?

---

---

---

10. (i) What is a 'control' in a scientific experiment?

---



---



---



---

(ii) Why is a control necessary?

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---



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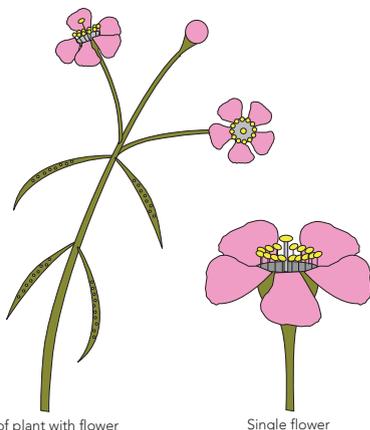


---

11. Use the key below to identify to which family each of the following two flower specimens belong. Write your answer and the steps chosen in the spaces next to each drawing. You may need the glossary to check some of the terms used in the key.

KEY TO SOME PLANT FAMILIES	
1a. Petals joined	2
1b. Petals separate from one another	5
2a. Sepals overlapping but not joined	Epacridaceae
2b. Sepals joined	3
3a. Stamens five	4
3b. Stamens four	Myoporaceae
4a. Only one style	Solanaceae
4b. More than one style	Malvaceae
5a. Stamens fewer than ten	6
5b. Stamens ten or more	8
6a. Petals four	Cruciferae
6b. Petals five	7
7a. Flowers not in umbels, oil glands present on leaves as clear dots	Myrtaceae
7b. Flowers in umbels, no oil glands on leaves	Umbelliferae
8a. Ovary inferior, oil glands present on leaves as clear dots	Myrtaceae
8b. Ovary superior, no oil glands in leaves, one style, 5 similar petals	Caesalpiaceae

**Specimen 1**



Part of plant with flower

Single flower

Family:

---



---

Choices:

---



---

**Specimen 2**

Family:

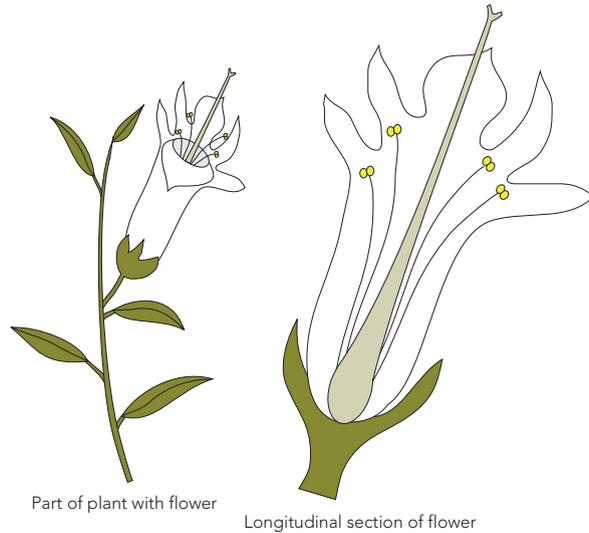
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---

Choices:

---

---



12. In an experiment designed to test the hypothesis that caffeine, which is found in several popular beverages, increases heart rate, a biologist carried out the following experiment.

- She randomly selected 100 adults from the population.
- She divided the group into two equal subgroups, again selecting individuals at random.
- Each group was allowed 15 minutes rest and then she measured each person's heart rate, recording an average for the group.
- Then each individual in one group was given a caffeine tablet and 5 minutes later had his/her heart rate measured again. A new average heart rate was calculated for this group.
- Each individual in the second group was given a tablet which contained no caffeine, a placebo. These individuals then had their heart rates measured and averaged as in the first group.

Before completing the experiment, the biologist was required to begin a written report using the format:

i) Title ii) Aim iii) Materials iv) Procedure v) Results vi) Conclusion vii) References.

Using the information above, write brief notes to summarise what she might have written. Make up a table of imaginary results which support the hypothesis and record in correct format imaginary references she may have used.

(i) Title

---

(ii) Aim

---

---

(iii) Materials and Resources

---

---

(iv) Procedure

---

---

---

---

---

---

---

(v) Results



(vi) Conclusion

---

---

(vii) References

---

---

13. In the experiment on caffeine in question 12:

(i) What was the sample size? \_\_\_\_\_

(ii) In the description what is meant by “randomly selected”?

---

---

(iii) Describe an imaginary example of a sample which is not collected at random.

---

---

(iv) Why was the second group given a tablet containing no caffeine (ie. a placebo)?

---

---

(v) In this experiment which variables were controlled?

---

---

(vi) Name the independent variable.

---

(vii) Name the dependent variable.

---

14. In the experiment described in Q 12, were each of the following adequately considered by the biologist? Justify your answer.

(i) Sample size

---

---

(ii) Randomly selected samples

---

---

(iii) Replicates

---

---

(iv) Repeat procedures

---

---

15. How could the experiment in Q 12 be improved?

---

---

## 3.2 SCIENCE AS A HUMAN ENDEAVOUR 1

Study  
these  
terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) biodiversity hotspot

---

(ii) ecosystem resilience

---

(iii) fire regimes

---

(iv) genetic diversity

---

(v) migration route satellite sensing

---

(vi) single species conservation

---

## Review Questions

1. (i) How are organisms classified?

---

---

(ii) On what evidence might a population of organisms be reclassified by the scientific community?

---

---

(iii) Sometimes a particular species is reclassified and moved to another genus. Why do scientists think such reclassification is important?

---

2. What is a conservation reserve and why are reserves important?

---

---

---

3. (i) Explain why the conservation of a keystone species is regarded as crucial by many scientists.

---

---

---

(ii) Why might the conservation of a keystone species be of little use in maintaining an ecosystem?

---

---

(iii) The targeting of one species for conservation is also controversial. Explain why this is so and give an example to illustrate your answer.

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4. (i) What is meant by “biodiversity”?

---

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(ii) Why is Australia’s biodiversity under threat?

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(iii) In ecological conservation, what is meant by the “precautionary principle”?

---

---

5. (i) Why is international cooperation in the protection of many ecosystems essential for their survival?

---

---

(ii) Describe an example to illustrate your argument.

---

---

---

(iii) (a) What is meant by describing an area as a “World Heritage Site”?

---

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---

(b) Why is the south west of WA described as a “biodiversity hotspot”?

---

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---

(iv) Where are the migration routes of Humpback whales around Australia?

---

(v) On the map of Australia below using arrows show these migration routes.



(vi) Why do these whales migrate?

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---

(vii) What might happen to their populations if these routes were interrupted?

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---

(viii) Wetland areas such as swamps are often temporary homes to migratory birds. What is the consequence of building roads and housing estates over swamps to the life cycle of such animals?

---

---

6. (i) Explain how satellite sensing enables the monitoring of habitat and species change.

---

---

- (ii) What alternative is there to obtain similar data?

---

---

- (iii) What are the advantages and disadvantages of satellite sensing over conventional methods of monitoring?

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7. Studies of wildlife in their natural environments often involve the use of radio tracking. A radio transmitter is attached to the animal which emits a signal that can be picked up by a receiver. The signal may be a beep which is emitted at a particular rate per minute.

- (i) A biologist using this technology to track particular animals must first have approval from an ethics committee. Why?

---

---

- (ii) What would the biologist need to consider first in deciding how to attach the transmitter to the animal.

---

---

- (iii) Sometimes transmitters are glued on to the animal, some are attached to a collar and some are implanted in the animal. Name one animal for which each of these three methods would be appropriate.

---

---

- (iv) The battery life of the transmitter may determine its weight. What two factors would need to be considered in choosing the weight of the transmitter to be used?

---

---

- (v) A transmitter may have a function whereby it begins to emit a different pulse if it is not moved after twenty four hours. What information might this different pulse provide?

---

---

- (vi) A receiver picks up the signal using an antenna. The range of the receiver, i.e. how far away it is from the transmitter before it fails to detect the transmitter's beep, is important. Explain how the species of animal that is being tracked may influence the receiver's range that is chosen by the scientist.

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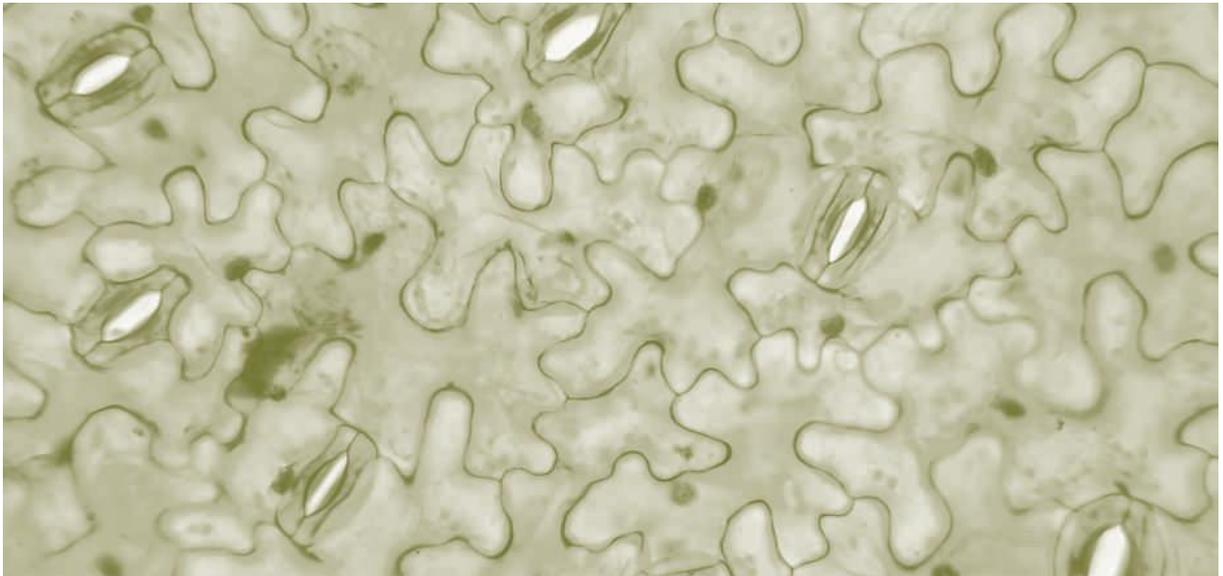
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BIOLOGY

UNIT 2





## SYLLABUS CHECKLIST

This is the knowledge that you should understand upon completing this section:

### 4.1 PROKARYOTIC & EUKARYOTIC CELLS

- Cells require inputs of suitable forms of energy, including light energy or chemical energy in complex molecules and matter, including gases, simple nutrients, ions and removal of wastes, to survive.
- Prokaryotic and eukaryotic cells have many features in common, which is a reflection of their common evolutionary past, but prokaryotes lack internal membrane bound organelles, do not have a nucleus, are significantly smaller than eukaryotes, usually have a single circular chromosome and exist as single cells.
- Metabolism describes the sum total of the physical and chemical processes by which cell components transform matter and energy needed to sustain life.
- Eucaryotic cells carry out specific cellular functions in specialised structures and organelles including: cell membrane, cell wall, chloroplasts, endoplasmic reticulum (rough and smooth), Golgi apparatus, lysosomes, mitochondria, nucleus, ribosomes, vacuoles.

### 4.2 CELL MEMBRANES

- The currently accepted model of the cell membrane is the fluid mosaic model.
- The cell membrane separates the cell from its surroundings and controls the exchange of materials, including gases, nutrients and wastes, between the cell and its environment.
- Movement of materials across membranes occurs via passive processes including diffusion, facilitated diffusion, osmosis, active processes including active transport, endocytosis and exocytosis
- Factors that affect exchange of materials across membranes include:
  - the surface-area-to-volume ratio of the cell,
  - concentration gradients, and
  - the physical and chemical nature of the materials being exchanged.

### 4.3 BIOCHEMICAL PROCESSES & ENZYMES

- Biological molecules are synthesized from monomers to produce complex structures including carbohydrates, proteins and lipids.
- Biochemical processes in the cell are controlled by factors including the nature and arrangement of internal membranes and the presence of specific enzymes.
- Enzymes have specific functions, which can be affected by factors including:
  - temperature
  - pH
  - the presence of inhibitors
  - the concentrations of reactants and products.
- Two models that are used to explain enzyme action are the lock and key model and the induced fit model.

### 4.4 PHOTOSYNTHESIS & CELLULAR RESPIRATION

- Photosynthesis is a biochemical process that uses light energy to synthesise organic compounds; light dependent and light independent reactions occur at different sites in the chloroplast and make up separate parts of the overall process that can be represented as a balanced chemical equation.
- The rate of photosynthesis can be affected by the availability of light and carbon dioxide and temperature.
- Cellular respiration is a biochemical process that occurs in different locations in the cytosol and mitochondria and metabolises organic compounds, aerobically or anaerobically, to release useable energy in the form of ATP; products of anaerobic respiration vary between organisms (plants, bacteria, animals) the overall process of aerobic respiration can be represented as a balanced chemical equation.
- The rate of respiration can be affected by the availability of oxygen and glucose and temperature.

## 4.1 PROKARYOTIC AND EUKARYOTIC CELLS

Study these terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) electron micrograph

---

(ii) exocytosis

---

(iii) metabolic waste

---

(iv) nutrient

---

(v) organelle

---

(vi) respiration (cellular)

---

## Review Questions

1. (i) What do plants take from their surroundings?

---

---

(ii) Why are these materials taken in by the plant?

---

---

---

---

(iii) How is the energy which is absorbed, used by the plant?

---

---

2. (i) What do animals take from their surroundings?

---

---

(ii) Explain why they need to absorb each of these things.

---

---

---

---

---

3. (i) Complete the simple word equation for photosynthesis.

water + \_\_\_\_\_ → \_\_\_\_\_ + \_\_\_\_\_

(ii) In order for this reaction to proceed, what other requirements must be met?

---

(iii) Where does this process occur in the eukaryotic cell?

---

(iv) Explain the need for each requirement.

light

---

---

water

---

---

enzymes

---

---

carbon dioxide

---

---

chlorophyll

---

---

4. (i) What are the wastes that cells produce?

---

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(ii) How do cells dispose of waste?

---

---

(iii) Why do cells require the removal of wastes?

---

---

5. The micrographs in this question were obtained using transmission electron microscopes.

(i) The micrograph below shows a palisade mesophyll cell from a green leaf (magnification 100,000x). Name the parts labelled a – e.

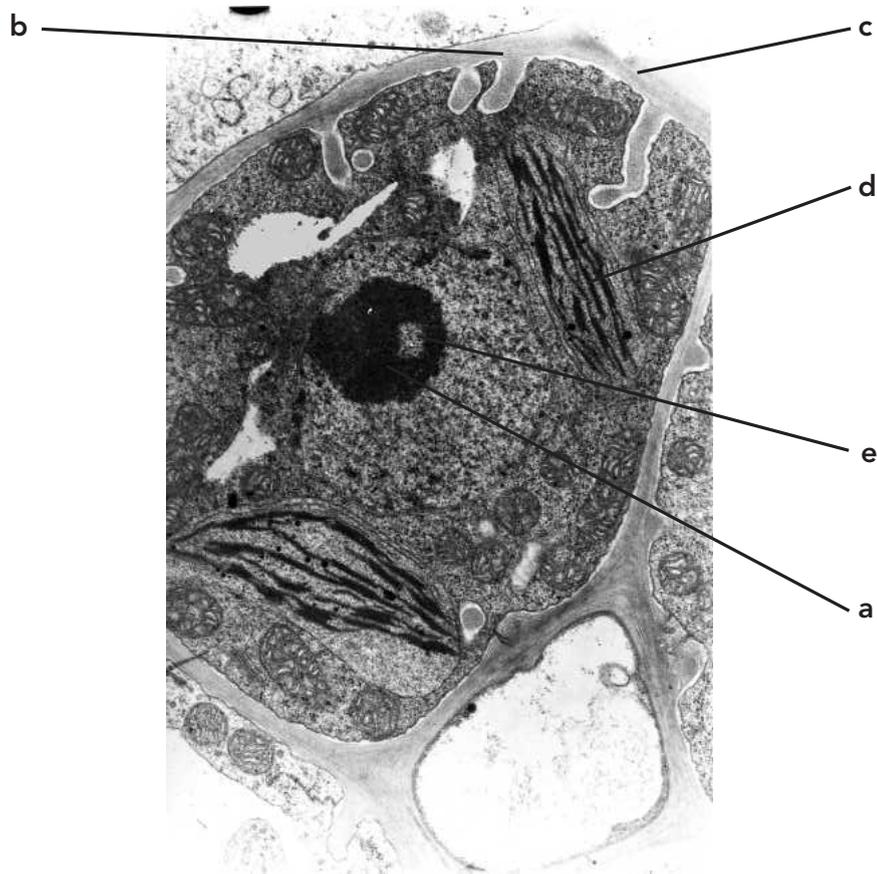
a) \_\_\_\_\_

b) \_\_\_\_\_

c) \_\_\_\_\_

d) \_\_\_\_\_

e) \_\_\_\_\_



(ii) This micrograph is of Jarrah root cells (21,000x).

a) Name the organelles that are present in the palisade mesophyll cell in 6 (i) that are not found in the root cell.

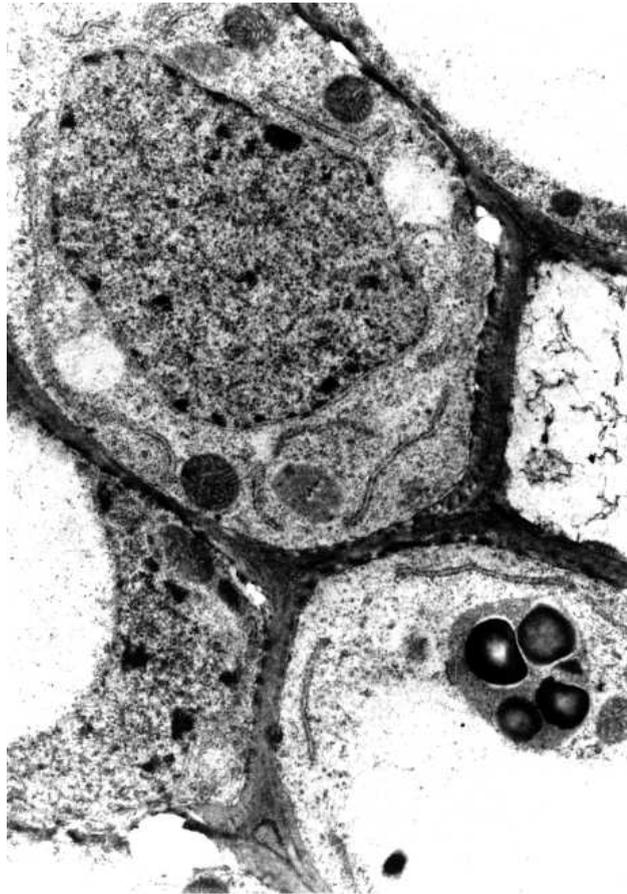
\_\_\_\_\_

b) Explain why these cells lack this organelle.

---

---

---



(iii) The micrograph below shows liver cells from a sheep.

Name the parts a – d.

a) \_\_\_\_\_

b) \_\_\_\_\_

c) \_\_\_\_\_

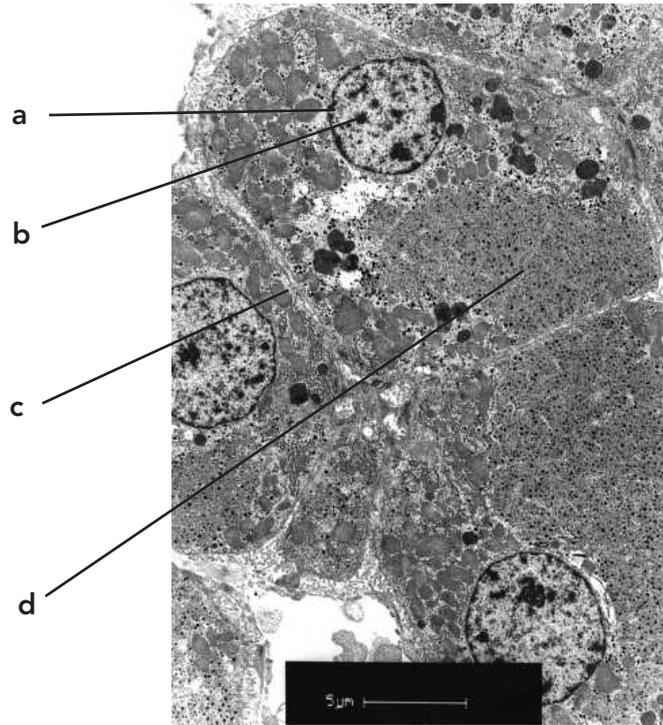
d) \_\_\_\_\_

- (iv) Use the scale shown to estimate the dimensions of the cell which has been labelled. (Calculate the actual length and width at the widest points).

---

---

---



- (v) The micrograph below shows several white (X) and red (Y) blood cells from a dog.
- a) Which organelles do the dog's white blood cells appear to have that are not present in the red blood cells?

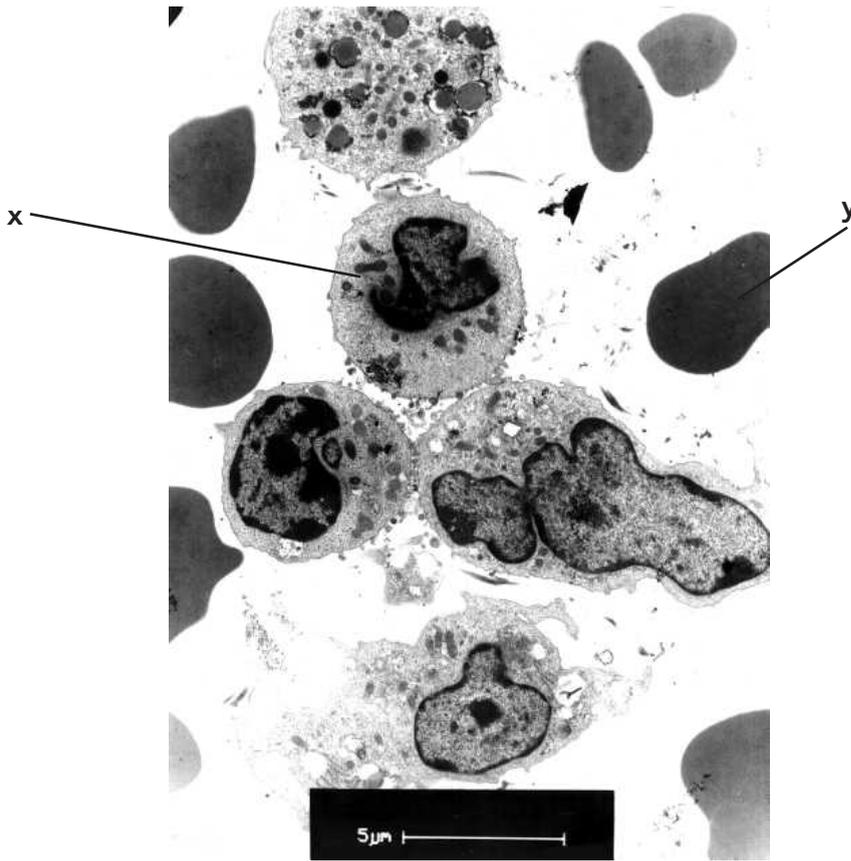
---

- b) Estimate the size of the largest white blood cell using the scale shown.  
(Show your working.)

---

---

---



6. (i) What are the main differences between prokaryotic cells and eukaryotic cells?

---

---

- (ii) Give examples of each.

---

---

7. List the three main structural differences between a typical plant cell and a typical animal cell.

- (i) \_\_\_\_\_

---

- (ii) \_\_\_\_\_

---

(iii) \_\_\_\_\_  
\_\_\_\_\_

8. For each of the above features, explain why plant cells are different from animal cells.

(i) \_\_\_\_\_  
\_\_\_\_\_

(ii) \_\_\_\_\_  
\_\_\_\_\_

(iii) \_\_\_\_\_  
\_\_\_\_\_

9. What are three features that prokaryotic and eukaryotic cells have in common?

\_\_\_\_\_  
\_\_\_\_\_

10. (i) Define metabolism.

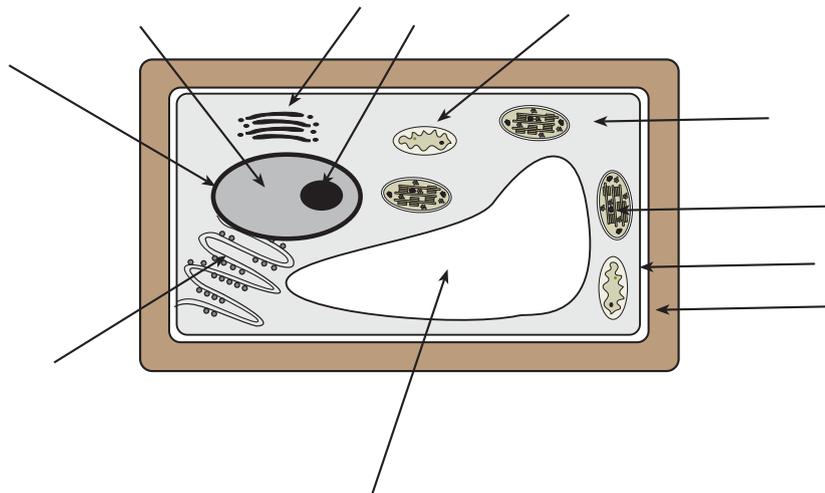
\_\_\_\_\_  
\_\_\_\_\_

(ii) Give an example of two metabolic processes that occur inside cells and in each case indicate whether the process releases or absorbs energy.

\_\_\_\_\_  
\_\_\_\_\_

11. Label the diagram of the cell shown using the following labels:

*cytoplasm, plasma membrane, cell wall, nucleus, nucleolus, nuclear membrane, vacuole, chloroplast, ribosome, endoplasmic reticulum, mitochondrion and Golgi body.*



12. What is the function of each of the following organelles?

(a)	plasma membrane	
(b)	cell wall	
(c)	nucleus	
(d)	vacuole	
(e)	chloroplast	
(f)	ribosome	
(g)	endoplasmic reticulum	
(h)	mitochondrion	
(i)	Golgi body	
(j)	centriole	
(k)	cilia	
(l)	flagellum	

13. Write the correct spelling of the **plural** of the following organelles:

- (a) nucleus \_\_\_\_\_
- (b) endoplasmic reticulum \_\_\_\_\_
- (c) mitochondrion \_\_\_\_\_
- (d) cilium \_\_\_\_\_
- (e) flagellum \_\_\_\_\_

14. Describe the structure and function of a lysosome.

---

---

15. (i) What is it that makes some endoplasmic reticula rough and some smooth?

---

---

(ii) Illustrate your answer with a simple sketch of each in the space below.



## 4.2 CELL MEMBRANES

Study these terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) concentration

---

(ii) concentration gradient

---

(iii) emulsify

---

(iv) extracellular

---

(v) hydrophilic

---

(vi) hydrophobic

---

(vii) osmosis

---

### Review Questions

1. What are the two main chemical constituents of cell membranes?

(i) \_\_\_\_\_

(ii) \_\_\_\_\_

Describe how and explain why alcohol and detergent affect cell membranes.

(iii) alcohol

---

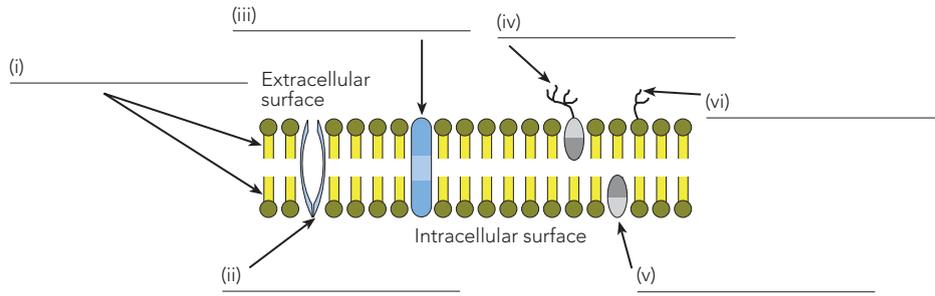
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(iv) detergent

---

---

2. Using the diagram below, discuss the “fluid mosaic” model of the cell membrane. You will need to label the diagram first.




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---



---

3. (i) Which of the following processes are active means by which substances move across cell membranes: *diffusion, osmosis, active transport, pinocytosis, phagocytosis, exocytosis*?

---

- (ii) Explain why these are described as active.

---

- (iii) Which processes are passive?

---

- (iv) Explain why these are described as passive.

---

- (v) Which two processes are examples of endocytosis?

---

4. (i) What do osmosis and diffusion have in common?

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---



---

(ii) How are osmosis and diffusion different?

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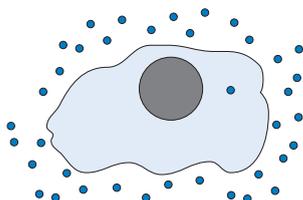
5. The diagrams below show how a molecule like glucose, which is large and not soluble in lipids, is thought to move into a cell.

Complete the sentences in the third column of the table.

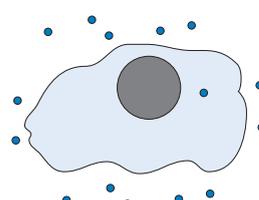
(a)	<p>Extracellular fluid</p> <p>Intracellular fluid</p>	<p>This shows the glucose concentration is _____ on the outside than on the inside.</p> <p>Glucose molecules are too _____ to pass into the cell by normal _____.</p>
(b)	<p>Extracellular fluid</p> <p>Intracellular fluid</p>	<p>A glucose molecule fits on to a transport _____ like an enzyme fits its _____.</p>
(c)	<p>Extracellular fluid</p> <p>Intracellular fluid</p>	<p>The transport protein changes _____ so that the _____ molecule can move _____ the cell membrane.</p>
(d)	<p>Extracellular fluid</p> <p>Intracellular fluid</p>	<p>This process is called _____ diffusion.</p> <p>Another glucose molecule can now fit onto the _____ protein.</p>

6. Study the two diagrams below. The blue dots represent small fat soluble molecules.

(a) Cell A



(b) Cell B



(i) Which cell would absorb the molecules most rapidly? \_\_\_\_\_

Explain your answer.

---



---

(ii) If this fat molecule is used (e.g. respired ) by the cells A and B, describe what will happen in both cases.

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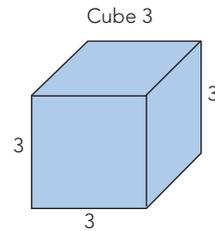
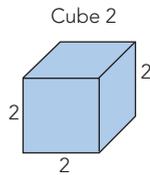
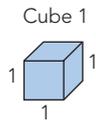


---

7. As a cell grows its surface area compared to its volume decreases, that is SA:V becomes smaller. To appreciate this idea, complete the following activity.

(a) Calculate the surface area and the volume of each cube shown (their dimensions are in centimetres). Enter your answers in the table.

(b) Now calculate the surface area per cubic centimetre for each cube. Enter your answers in the last column.



CUBE	SURFACE AREA (cm <sup>2</sup> )	VOLUME (cm <sup>3</sup> )	SA : V (cm <sup>2</sup> / cm <sup>3</sup> )
1			
2			
3			

Use the results in the table to answer the following questions:

(i) Which cube has the greatest surface area per cubic centimetre? \_\_\_\_\_

Which has the smallest surface area per cubic centimetre? \_\_\_\_\_

(ii) What generalisation could be made from these observations?

---



---

(iii) How would an increase in size affect a cell's efficiency in absorbing nutrients or eliminating wastes by diffusion?

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8. How does the structure of the cell membrane affect the types of molecules which can move freely through the membrane by diffusion?

---

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## 4.3 BIOCHEMICAL PROCESSES AND ENZYMES

Study these terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

- (i) biochemical process

---

- (ii) convolution

---

- (iii) inhibit

---

- (iv) monomer

---

- (v) pH

---

- (vi) polymer

---

- (vii) reactant

---

### Review Questions

1. What are the chemical “building blocks” of the following organic compounds?

(i) carbohydrates \_\_\_\_\_

(ii) lipids \_\_\_\_\_

(iii) proteins \_\_\_\_\_

2. Draw simple diagrams to show how the “building blocks” are arranged in these substances.

(i) carbohydrates

(ii) lipids

(iii) proteins

3. Complete the table below for mammals.

NUTRIENT	SOURCE	FUNCTION
amino acids		
simple sugars		
fatty acids		

4. (i) Describe the structure and function of endoplasmic reticulum.

---

---

(ii) Why do eukaryotic cells need an extensive network of endoplasmic reticula, whereas prokaryotic cells do not?

---

---

(iii) Where ribosomes are located on the outer membrane surface of the endoplasmic reticulum, the movement of newly synthesized proteins within the cell is made more efficient. Explain.

---

---

(iv) Many biochemical processes take place on membranes. Explain.

---

---

(v) Draw a sketch of a mitochondrion in the space below.



(vi) Why is the mitochondrion's inner membrane highly convoluted?

---

---

(vii) What is the advantage of the compartments formed by organelle membranes in eukaryotic cells? Use an example to illustrate your answer.

---

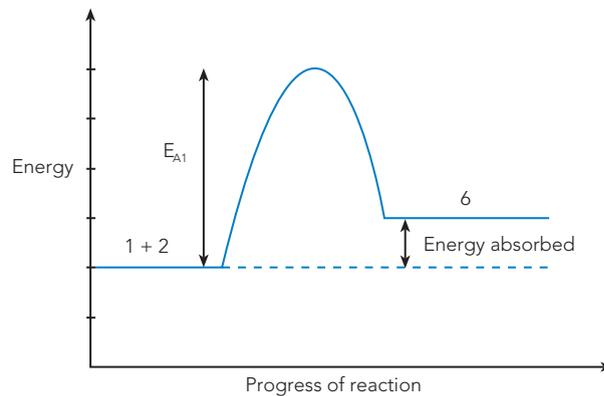
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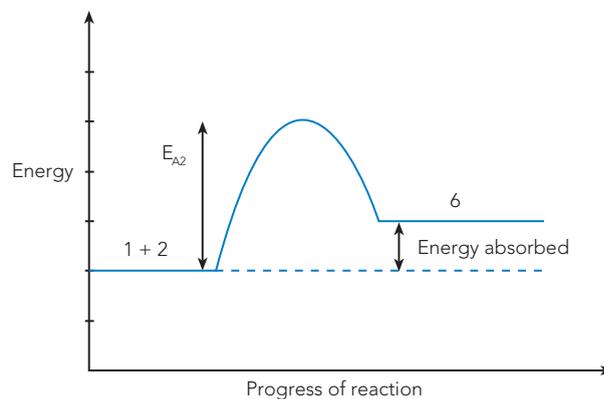
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5. The graph below shows the energy changes that occur when substances 1 and 2 react with no enzyme present (forming substance 6) i.e.  $1 + 2 \rightarrow 6$ .



*Graph 1*

When an enzyme is present, the following energy changes occur.



*Graph 2*

(i) What is the significant difference between the two graphs?

---

---

(ii) The activation energy is shown by  $E_A$  in the graphs. How is this energy different in these two reactions?

---

(iii) In both reactions the product (6) appears to contain more energy than the reactants (1 and 2).

a) In this example which molecule is likely to be the most complex?

---

b) What kind of reaction is occurring?

---

(iv) How does the presence of an appropriate enzyme affect energy changes in a reaction?

---

---

(v) If this is an essential reaction in the organism, what benefits does the enzyme provide?

---

---

(vi) Using a similar scale, draw and label a graph in which the products have a lower energy level than the reactants – i.e. a catabolic reaction.

Use the space below and these labels: **Reactant/s**, **Activation Energy**, **Product/s**, **Energy Lost**.

6. (i) What is meant by 'activation energy'?

---

---

(ii) Without enzymes, how might this activation energy be provided?

---

(iii) Why might this be a problem in living cells?

---

---

(iv) How does an enzyme affect the 'activation energy'?

---

---

7. (i) Explain why enzymes are required only in small quantities?

---

---

(ii) What is the 'active site' on the enzyme?

---

---

(iii) Describe the effect that temperature generally has on enzyme action.

---

---

---

(iv) What other environmental changes, besides temperature, may change enzyme activity?

---

---

---

8. (i) What is meant by the 'specificity of enzymes'?

---

---

---

(ii) There are thousands of different enzymes in living cells. Why?

---

---

(iii) What would be the consequences to a cell if an enzyme was missing or different from the normal enzyme.

---

---

9. Explain how enzyme inhibitors are thought to slow an enzyme controlled reaction.

---

---

---

10. Discuss how the concentrations of the:

(i) reactants affect the rate of a reaction?

---

---

---

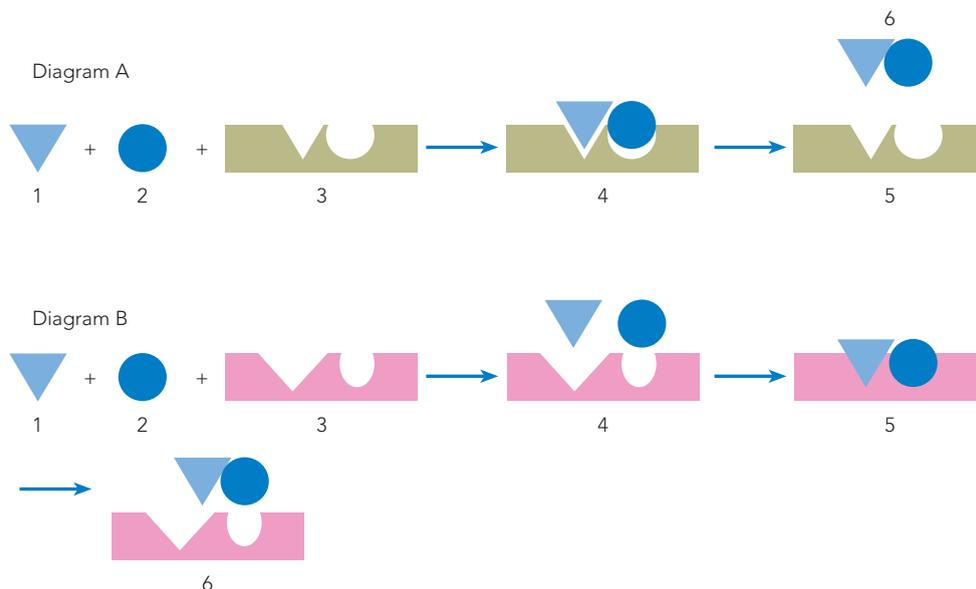
(ii) products affect the rate of a reaction?

---

---

---

11. Carefully study the two series of diagrams below. Note particularly any changes in the shape of the enzymes involved. Then answer the questions that follow.



Both diagrams represent different theories about how enzymes function.

(i) What do these theories have in common?

---

---

---

---

(ii) How are the theories different?

---

---

---

(iii) Name the theory that each diagram represents:

a) diagram A \_\_\_\_\_

b) diagram B \_\_\_\_\_

## 4.4 PHOTOSYNTHESIS AND CELLULAR RESPIRATION

Study  
these  
terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) adenosine triphosphate (ATP)

---

(ii) by-product

---

(iii) anaerobic

---

(iv) cytosol

---

(v) glycolysis

---

(vi) granum

---

(vii) lamella

---

(viii) limiting factor

---

(ix) stroma

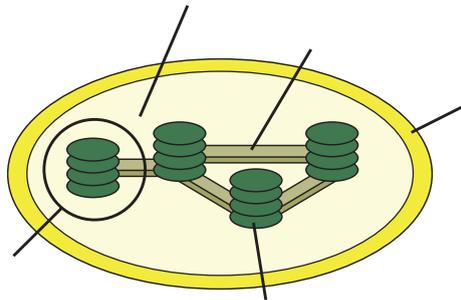
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(x) thylakoid

---

## Review Questions

1. Label the diagram of the chloroplast below using the following labels: **stroma**, **double membrane**, **granum**, **thylakoid**, **lamella**



2. (i) Write the word equation for photosynthesis in the spaces below:



- (ii) Apart from the necessary reactants (on the left of the equation), what other conditions are necessary for photosynthesis to occur?

---

---

---

- (iii) Where does this process occur in a eukaryotic cell? \_\_\_\_\_

- (iv) Explain the need for each requirement.

light	
water	
enzymes	
carbon dioxide	

chlorophyll	
ADP and P	

3. The general chemical equation for photosynthesis is shown below:



According to this equation,

- (i) What is the chemical formula for glucose? \_\_\_\_\_
- (ii) How many molecules of  $\text{CO}_2$  are needed to produce **one** molecule of glucose?  
\_\_\_\_\_
- (iii) How many molecules of  $\text{H}_2\text{O}$  are needed to produce **one** molecule of glucose?  
\_\_\_\_\_
- (iv) How many molecules of  $\text{O}_2$  are produced with **one** molecule of glucose?  
\_\_\_\_\_
- (v) Which is the most complex compound in the equation?  
\_\_\_\_\_
- (vi) Chemical reactions that release energy are called catabolic. Those that require energy input are called anabolic. Which type of reaction is photosynthesis?  
\_\_\_\_\_

4. Photosynthesis takes place in two stages.

- (i) What are these stages called?  
\_\_\_\_\_
- (ii) What is the role of the first stage?  
\_\_\_\_\_
- (iii) What is a by-product of the first stage?  
\_\_\_\_\_
- (iv) The second stage is sometimes called the Calvin cycle. What is used and what is produced during this cycle?  
\_\_\_\_\_  
\_\_\_\_\_

(v) How is the energy for the second stage provided?

\_\_\_\_\_

5. Complete the table below.

REACTIONS OF PHOTOSYNTHESIS	LIGHT DEPENDENT	LIGHT INDEPENDENT
Site at which it occurs		
Requirements		
Products		

6. A green plant may grow very rapidly because its rate of photosynthesis is high or grow very slowly because its average rate of photosynthesis is slow.

(i) What environmental factors may alter the rate of photosynthesis?

\_\_\_\_\_  
\_\_\_\_\_

(ii) List a plant's features which affect its rate of photosynthesis.

\_\_\_\_\_  
\_\_\_\_\_

7. (i) What is aerobic respiration?

\_\_\_\_\_

(ii) Show the net reaction using a simple word equation.

\_\_\_\_\_

(iii) What is anaerobic respiration?

\_\_\_\_\_

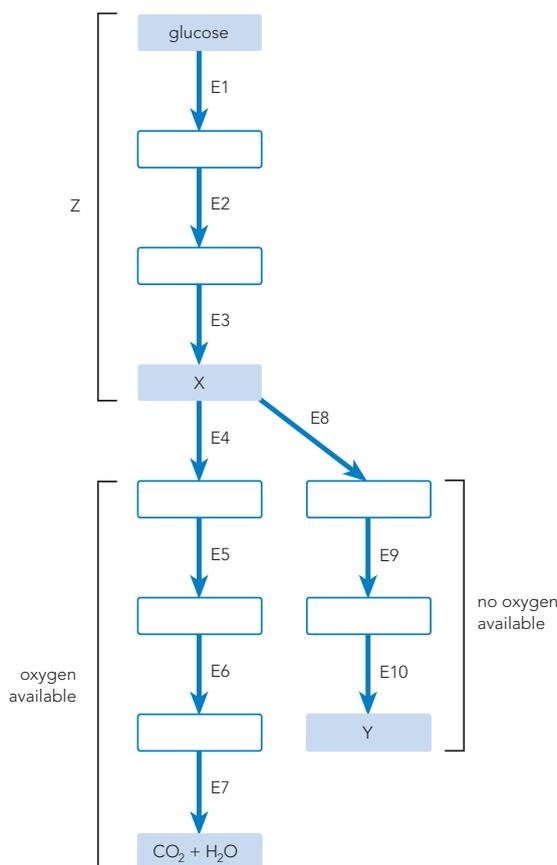
(iv) Show a simple word equation for anaerobic respiration:

a) in animals \_\_\_\_\_

b) in plants \_\_\_\_\_

8. Write the balanced equation for the overall process of aerobic respiration.

9. Respiration takes place in a number of stages. Each stage is controlled by a specific enzyme and many intermediate compounds are formed. This can be simply represented as shown below.



- (i) Name the substance in box 'X' \_\_\_\_\_
- (ii) Name the substances in box 'Y'
- a) in animals \_\_\_\_\_
- b) in plants \_\_\_\_\_
- (iii) How many molecules of ATP are produced if one (1) molecule of glucose follows the pathway leading to box 'Y'?
- \_\_\_\_\_
- (iv) Where in a eukaryotic cell does the anaerobic pathway occur?
- \_\_\_\_\_
- (v) How many molecules of ATP are produced if one (1) molecule of glucose follows the aerobic pathway?
- \_\_\_\_\_
- (vi) Describe the location in a eukaryotic cell of the aerobic pathway.
- \_\_\_\_\_
- (vii) Name the overall process (Z) in which glucose breaks down to pyruvate.
- \_\_\_\_\_

10. Complete the table below to contrast and summarise aerobic and anaerobic respiration.

	AEROBIC RESPIRATION	ANAEROBIC RESPIRATION
Site of occurrence		
Requirements for oxygen		
Products in plants		
Products in animals		
Products in bacteria		
Amount of ATP produced from 1 molecule of glucose		

11. Glucose is the starting substance in both plants and animals, explain why the products of anaerobic respiration are different in plants and animals.

---

---

12. Briefly describe three ways in which the rate of respiration can be determined.

---

---

---

13. (i) What environmental factors may limit the respiration rate in cells?

---

---

(ii) What traits of a cell itself may limit its respiration rate?

---

---



## SYLLABUS CHECKLIST

**This is the knowledge that you should understand upon completing this section:**

### 5.1 CELLS, TISSUES, ORGANS AND SYSTEMS

- Multicellular organisms have a hierarchical structural organisation of cells, tissues, organs and systems.

### 5.2 RESPIRATORY SYSTEMS

- In animals, the exchange of gases between the internal and external environments of the organism is facilitated by the structure of the exchange surface/s including spiracles, gills, alveoli and skin.

### 5.3 DIGESTIVE SYSTEMS

- In animals, the acquisition and processing of nutrients is facilitated by the structures of the digestive system; animals may have a gastrovascular cavity or a specialised alimentary canal; specialisation of alimentary canals is related to diet, for example, herbivores and carnivores.

### 5.4 CIRCULATORY SYSTEMS

- In animals, the transport of materials within the internal environment for exchange with cells is facilitated by the structure of open and closed circulatory systems according to the different metabolic requirements of organisms and differing environments.

### 5.5 EXCRETION

- In animals, waste such as carbon dioxide, water, nitrogenous compounds and salts are excreted; most aquatic animals excrete nitrogenous wastes directly into their surroundings; terrestrial animals require specialised mechanisms.

### 5.6 TRANSPORT IN VASCULAR PLANTS

- In vascular plants, gases are exchanged via stomata and the plant surface and does not involve the plant transport system.
- In vascular plants, transport of water and mineral nutrients from the roots occurs via xylem involving root pressure, capillary action transpiration (adhesion and cohesion of water molecules); transport of the products of photosynthesis and some mineral nutrients occurs by translocation in the phloem.

## 5.1 CELLS, TISSUES, ORGANS AND SYSTEMS

Study these terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) cell

---

(ii) organ

---

(iii) system

---

(iv) tissue

---

(v) vascular tissue

---

### Review Questions

1. Place the following terms in order of their size and complexity: **organ, system, cell, tissue.**

---

2. What is meant by:

(i) cell differentiation?

---

---

(ii) cell specialisation?

---

---

3. (i) In animals why is tissue which lines the windpipe or trachea different to tissue that lines the small intestine?

---

(ii) What are the functions of these different tissues?

---

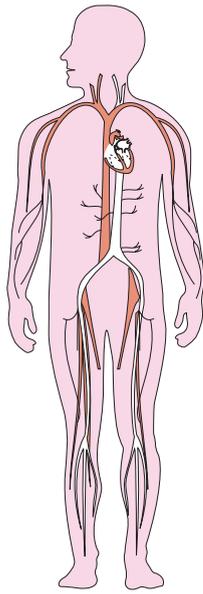
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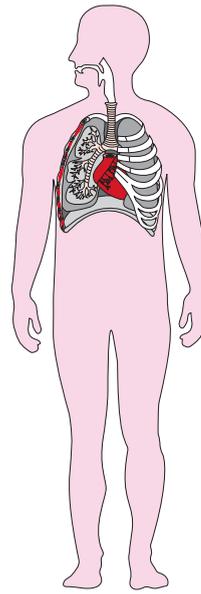
4. The table below refers to higher animals. Complete the blank spaces.

ORGAN SYSTEM	MAIN ORGANS	FUNCTION/S
(i) circulatory	heart, arteries, veins, arterioles, venules, capillaries	
(ii)	lungs, nose, nasal cavity, pharynx, trachea, bronchi, bronchioles	
(iii) digestive		
(iv)	cardiac, smooth and striated muscle	
(v)		protects soft tissue, anchors muscle, site for blood cell synthesis, stores fat, supports body
(vi) excretory		
(vii)	lymph vessels, lymph nodes	

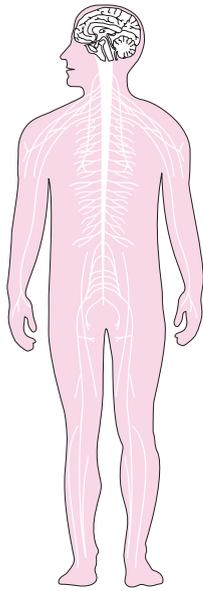
5. Name the system that is represented in each of the following diagrams:



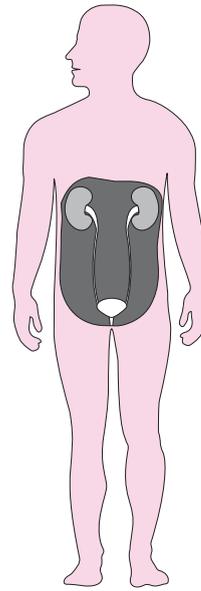
(i) \_\_\_\_\_



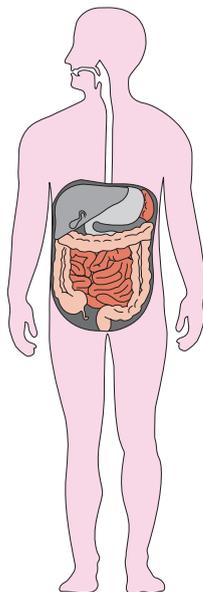
(ii) \_\_\_\_\_



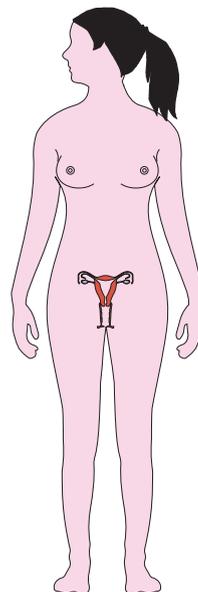
(iii) \_\_\_\_\_



(iv) \_\_\_\_\_

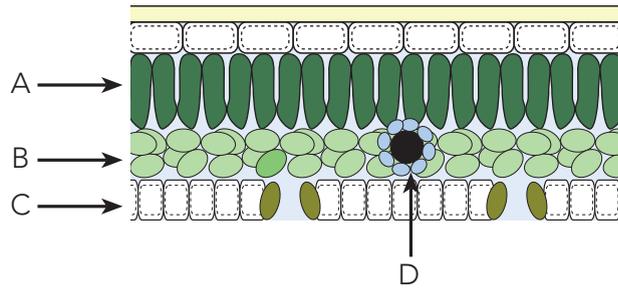


(v) \_\_\_\_\_



(vi) \_\_\_\_\_

6. From the diagram below, name the tissues marked A-D and describe in the table how their cells are specialised to carry out particular functions.



TISSUE	NAME	CELL SPECIALISATION
A		
B		
C		
D		

## 5.2 RESPIRATORY SYSTEMS

Study these terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

- (i) alveolus

---

- (ii) gas exchange

---

- (iii) oxygenated (blood)

---

- (iv) respiratory system

---

- (v) spiracle

---

- (vi) tracheal system

---

## Review Questions

1. Two main gases are exchanged by animals' lungs and gills. Name these two gases.

(i) \_\_\_\_\_

(ii) \_\_\_\_\_

2. Name organisms that exchange these gases using the following structures:

(i)	moist skin	
(ii)	tracheal system	
(iii)	lungs	
(iv)	gills	

3. (i) Why do the gills of a fish have a greater surface area than the lungs of a similarly sized mammal?

\_\_\_\_\_

(ii) Why does oxygen diffuse from the water into the plasma in the gills of a fish?

\_\_\_\_\_

(iii) Compare the gas exchange surfaces of insects and birds.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(iv) Why do respiratory surfaces need to remain moist?

\_\_\_\_\_

\_\_\_\_\_

(v) How do fish keep oxygenated water moving over their gills?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

4. How is the respiratory system of each animal listed below adapted to maximise its surface area and oxygen uptake from its environment?

(i) mammals

---

---

(ii) amphibians

---

---

(iii) fish

---

---

5. (i) A microscopic protozoan has a large surface area to volume ratio. How does this assist the organism in obtaining oxygen and excreting carbon dioxide?

---

---

(ii) What problem with gaseous exchange would a protozoan have if it were to continue to grow to the size of a human?

---

---

---

---

### 5.3 DIGESTIVE SYSTEMS

Study these terms

#### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) alimentary canal

---

(ii) carnivore

---

(iii) cnidaria

---

(iv) detrivore

---

(v) herbivore

---

(vi) insectivore

---

(vii) omnivore

---

(viii) parasite

---

(ix) rectum

---

(x) ruminant

---

## Review Questions

1. (i) What is digestion?

---

---

(ii) Why is digestion necessary?

---

2. (i) Name the two animal phyla that have a gastrovascular cavity.

---

(ii) Draw a simple sketch of either phyla's gastrovascular cavity in the space below.

(iii) How does this differ from the alimentary canal of higher animals?

---

---

---

3. (i) Animals can be classified according to what they eat. Which animal group would consume the most protein? Explain.

---

(ii) Which animal group would consume the most carbohydrates? Explain.

---

4. All animals need the six types of nutrients: **water, carbohydrates, fats, protein, minerals and vitamins**. The proportion of each type of nutrient in the diet varies according to the species to which the animal belongs. Complete the following with the appropriate food types.

(i) Animals that eat only plant matter obtain most of their energy from:

---

(ii) Animals that eat only meat obtain most of their energy from:

---

5. Because different animals consume different foods, their digestive tracts need to be specialised.

(i) Why is the carnivore's digestive tract comparatively shorter and less complex than a herbivore's?

---

---

(ii) What special role does the microflora in a herbivore's gut play in their digestive process?

---

---

(iii) Name two examples of ruminant herbivores and two examples of non ruminant herbivores.

---

---

(iv) Describe the difference in digestive processes between ruminant and non-ruminant herbivores.

---

---

(v) Which is the most efficient? Explain.

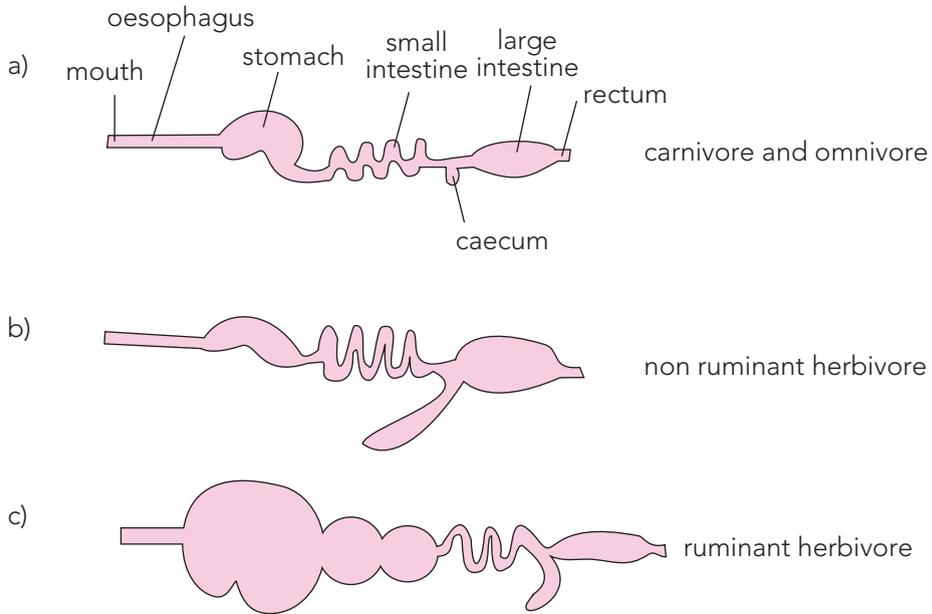
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(vi) What is similar in their digestive process?

---

6. Study the generalized diagrams below then answer the questions that follow:



(i) What is the main structural difference between the ruminant and the non ruminant alimentary canals? Explain.

---

---

(ii) The carnivore and omnivore alimentary canals are similar. How do they differ structurally from the herbivores? Explain.

---

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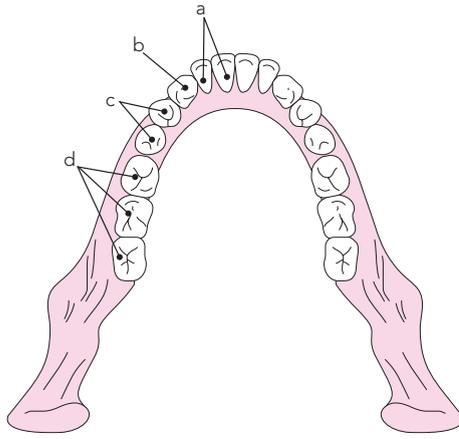
7. What are the chemical 'building blocks' of the following organic compounds?

(i) carbohydrates \_\_\_\_\_

(ii) lipids \_\_\_\_\_

(iii) proteins \_\_\_\_\_

8. (i) Label the four tooth types shown.



- a \_\_\_\_\_
- b \_\_\_\_\_
- c \_\_\_\_\_
- d \_\_\_\_\_

(ii) What type of digestion do the teeth carry out? \_\_\_\_\_

(iii) How is physical digestion different to chemical digestion?

---

---

---

---

(iv) What is the function of physical (or mechanical) digestion?

---

---

---

---

(v) Explain why the adult human dental formula is written as  $\frac{2\ 1\ 2\ 3}{2\ 1\ 2\ 3}$ .

---

---

---

---

(vi) The dental formula of a sheep is  $\frac{0\ 0\ 3\ 3}{3\ 1\ 3\ 3}$ . Describe the teeth in the sheep's upper and lower jaw.

---

---

---

(vii) The sheep has a tough pad where its upper incisors would be expected. Explain how this may help it eat grass.

---



---

(viii) How are the sheep's molars and premolars adapted for its diet?

---



---

(ix) The dental formula of a domestic cat is  $\frac{3 \ 1 \ 3 \ 1}{3 \ 1 \ 2 \ 3}$ . Describe the teeth in the cat's upper and lower jaw.

---



---



---

(x) What are carnassial teeth and what is their function?

---



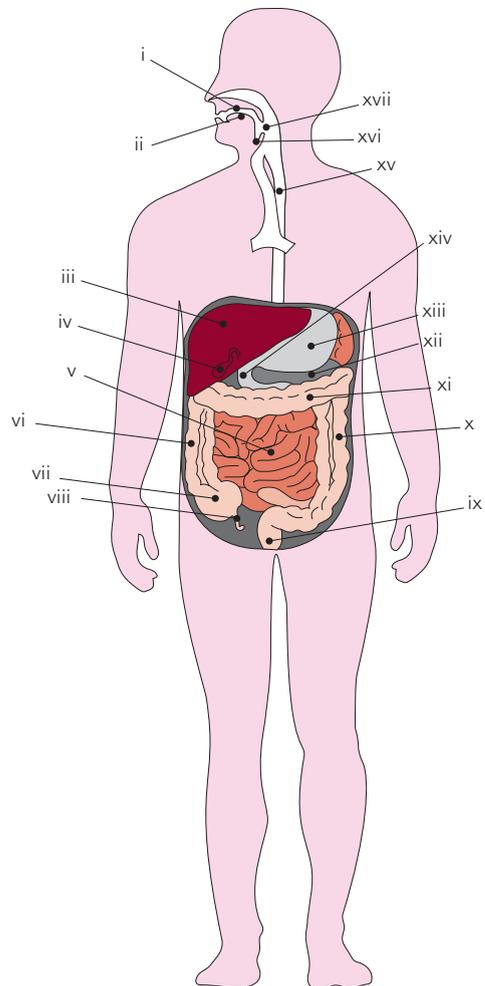
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9. Label the diagram of the alimentary canal and its associated organs.

- i \_\_\_\_\_
- ii \_\_\_\_\_
- iii \_\_\_\_\_
- iv \_\_\_\_\_
- v \_\_\_\_\_
- vi \_\_\_\_\_
- vii \_\_\_\_\_
- viii \_\_\_\_\_
- ix \_\_\_\_\_
- x \_\_\_\_\_
- xi \_\_\_\_\_
- xii \_\_\_\_\_
- xiii \_\_\_\_\_
- xiv \_\_\_\_\_
- xv \_\_\_\_\_
- xvi \_\_\_\_\_
- xvii \_\_\_\_\_



10. Name the part/s of the alimentary canal that is/are involved in:

- (i) Secretion of enzymes \_\_\_\_\_
- (ii) Absorption of nutrients \_\_\_\_\_
- (iii) Peristalsis \_\_\_\_\_
- (iv) Defaecation \_\_\_\_\_

11. (i) Explain the role of the circulatory system in absorbing and transporting nutrients.

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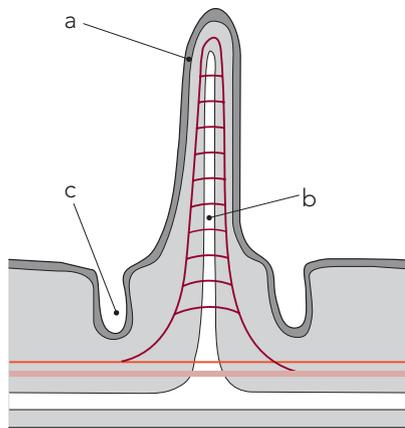
(ii) Explain the role of lymphatic system in absorbing and transporting nutrients

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---

12. (i) The diagram below shows a single villus. Label the parts shown.



- a \_\_\_\_\_
- b \_\_\_\_\_
- c \_\_\_\_\_

(ii) Where are villi found in the digestive system?

---

---

(iii) Why are the villi so small and so numerous?

---

## 5.4 CIRCULATORY SYSTEMS

Study these terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) arteriole

---

(ii) artery

---

(iii) capillary

---

(iv) circulatory system

---

(v) deoxygenated (blood)

---

(vi) dorsal

---

(vii) lymphatic system

---

(viii) multicellular

---

(ix) vein

---

(x) venule

---

### Review Questions

1. What does the transport system in a multicellular animal, like a vertebrate, do?

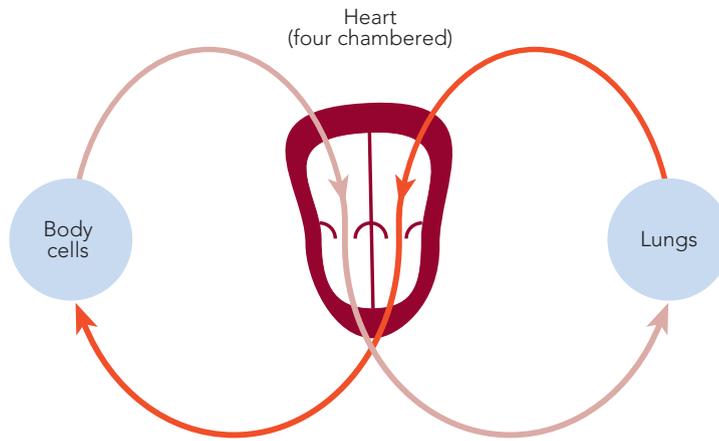
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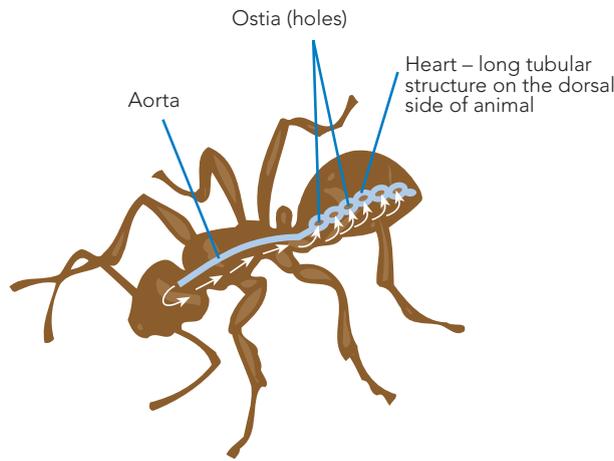
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2. The following diagrams illustrate the closed and open circulatory systems of a mammal and an insect respectively. Describe how they are different and explain why.

**Mammal – Circulatory System**



**Insect – Circulatory System**




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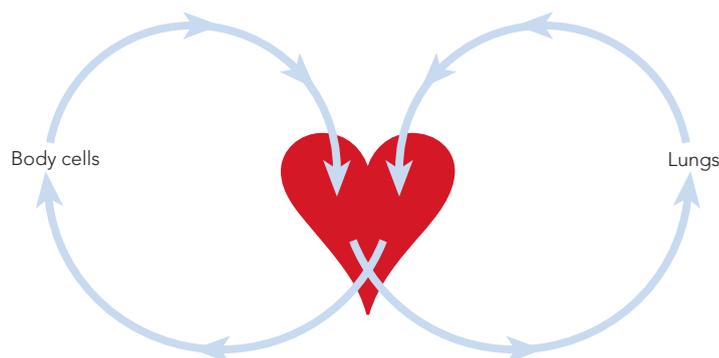


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3. The mammalian circulatory system, with the direction of blood flowing through it, is shown diagrammatically below.



(i) Using a red pen/pencil, colour the path taken by the oxygenated blood and using a blue pen/pencil, colour the path taken by deoxygenated blood.

(ii) What is the function of each of the following structures?

(a) Heart \_\_\_\_\_

\_\_\_\_\_

(b) Arteries \_\_\_\_\_

\_\_\_\_\_

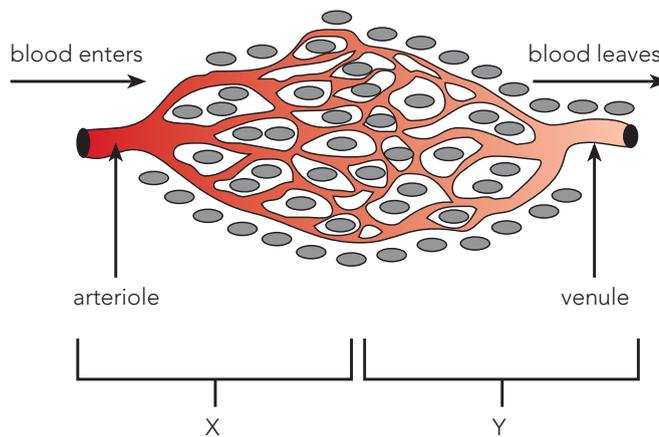
(c) Veins \_\_\_\_\_

\_\_\_\_\_

(d) Capillaries \_\_\_\_\_

\_\_\_\_\_

4. Below is an illustration of a capillary network showing the route taken by the blood through tissue in the body:



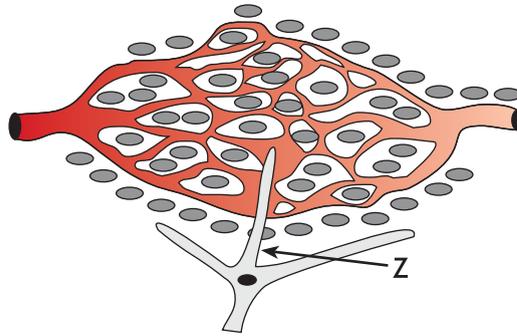
(i) What leaves the blood in the section labelled "X".

\_\_\_\_\_

(ii) What enters the blood in the section labelled "Y".

\_\_\_\_\_

5. In vertebrates more fluid leaves the blood in section “X” than returns to the blood in section “Y” (refer to question 4), there is a need for a system of vessels or tubes to drain the excess fluid away. This vessel, called a lymph vessel shown below, joins with other such vessels to form a network of tubes called the lymphatic system, which carries the fluid away but empties it back into veins above the heart.



- (i) What is the fluid which enters “Z” called?
- 
- (ii) Describe what might happen to the tissue bed if vessel “Z” were to become blocked by an infection or a parasite.

---

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---

6. An open transport system appears less complex than a closed transport system.

- (i) What does the closed system of a mammal have which is absent in the open system of an insect?

---

- (ii) Why does the mammal’s circulatory system need to be more complex?

---

---

- (iii) What type of adaptation is this?

---

## 5.5 EXCRETION

Study these terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) ammonia

---

(ii) aquatic (environment)

---

(iii) deamination

---

(iv) excretion

---

(v) isotonic

---

(vi) osmoregulation

---

(vii) terrestrial

---

(viii) toxicity

---

(ix) urea

---

(x) uric acid

---

### Review Questions

1. The mammalian liver plays a part in the metabolism of nitrogenous compounds like amino acids.

(i) How does the liver deal with surplus amino acids that are absorbed from the digestive tract and enter the mammal's blood?

---

---

(ii) What happens to the products produced from amino acids by the liver?

---

---

2. (i) What type of animal has a high protein diet?

---

(ii) How does this diet affect the animal's excretory products?

---

---

(iii) Explain how an animal with a high intake of protein and a low intake of fat and carbohydrate obtains sufficient energy from its diet.

---

---

3. (i) In what form do most aquatic organisms (e.g. fish, amphibians, invertebrates) excrete waste nitrogen?

---

---

(ii) Why do most terrestrial animals (e.g. mammals, birds, reptiles, insects) not use this substance to remove nitrogen wastes?

---

---

---

4. Birds and many reptiles (also terrestrial snails and insects) excrete their excess nitrogen as a semi-solid whitish paste.

(i) What is this nitrogen compound called?

---

---

(ii) What are the special properties that make it particularly suited for excretion by these animals?

---

---

---

5. (i) Below is a list of three nitrogen waste types which are excreted by various vertebrates. Give at least one example of an animal group which excretes the particular waste.

(a) Ammonia \_\_\_\_\_

(b) Urea \_\_\_\_\_

(c) Uric acid \_\_\_\_\_

(ii) Which of these waste compounds requires the least energy to produce and which requires the most energy to produce? Explain your answer.

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---

## 5.6 TRANSPORT IN VASCULAR PLANTS

Study these terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) adhesion

---

(ii) cohesion

---

(iii) flaccid

---

(iv) stoma

---

(v) translocation

---

(vi) root pressure

---

(vii) turgid

---

## Review Questions

1. (i) What are the two gases exchanged via the stomata on a vascular plant leaf?

---

- (ii) How does this gas exchange normally change during the day?

---



---

- (iii) How does this gas exchange normally change during the year?

---

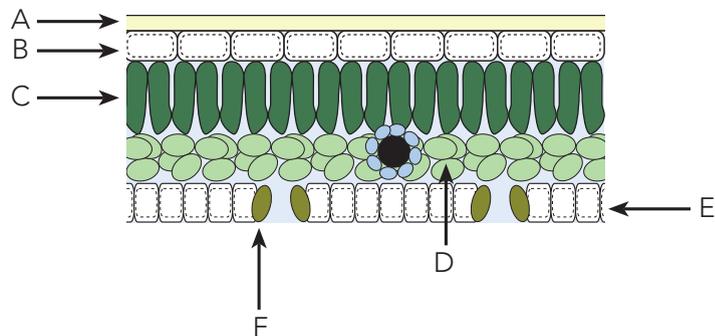


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2. The diagram below shows a magnified transverse section through a leaf blade.



Name each part and describe how it contributes to the plant's survival.

	NAME	HOW CONTRIBUTES
A		
B		
C		
D		
E		
F		

3. When an angiosperm begins to lose water at a rate greater than the rate at which water is being taken up by its roots:

(i) describe the visible evidence that shows water loss has exceeded water gain?

---

(ii) how does the plant respond and how does this affect the rate of water loss?

---

(iii) what effect does this change have on its rate of photosynthesis?

---

(iv) how does this affect the plant's general growth rate?

---

4. (i) What are root hair cells? Where are they located?

---

---

(ii) How do root hair cells contribute to a plant's survival?

---

---

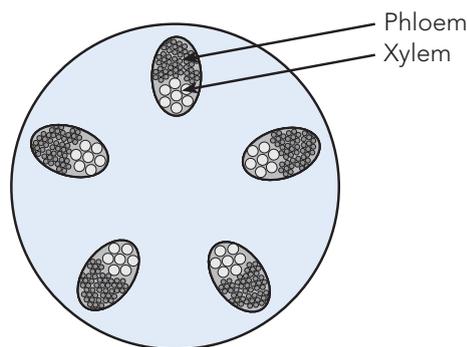
5. What does the transport system in ferns, conifers and angiosperms do?

---

---

---

6. The diagram below shows the position of xylem and phloem in a dicotyledonous plant stem.



(i) What is the name given to a group of phloem and xylem vessels?

---

(ii) What does phloem carry?

---

(iii) What does xylem carry?

---

7. (i) Where do the following substances enter terrestrial plants?

(a) water \_\_\_\_\_

(b) minerals \_\_\_\_\_

(c) carbon dioxide \_\_\_\_\_

(ii) Where are these substances used in the plant?

---

---

---

8. (i) Glucose is synthesised in the leaves. Some glucose may be stored in the stem or the roots. Where and how is glucose transported to these organs in the plant?

---

---

---

(ii) Water and minerals enter the plant from the soil. Where and how are they transported to the leaves?

---

---

9. Terrestrial plants need to maintain a fairly constant amount of water within their cells i.e.

**WATER GAIN = WATER LOSS**

(i) If **water loss** > **water gain** for an extended length of time, what happens to the plant?

---

---

(ii) If **water gain** > **water loss**, what happens to the plant?

---

---



### SYLLABUS CHECKLIST

**This is the knowledge that you should understand upon completing this section:**

#### 6.1 SCIENCE INQUIRY SKILLS 2

- Identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes.
- Design investigations, including the procedure(s) to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics, including the ethics of research involving living organisms.
- Conduct investigations, safely, competently, ethically and methodically for the collection of valid and reliable data.
- Represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships; qualitatively describe sources of measurement error, and limitations in data; and select, synthesise and use evidence to make and justify conclusions.
- Interpret a range of scientific and media texts, and evaluate processes, claims and conclusions by considering the quality of available evidence; and use reasoning to construct scientific arguments.
- Select, construct and use appropriate representations, including diagrams of structures and processes and images from different imaging techniques, to communicate conceptual understanding, solve problems and make predictions.
- Communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes, including scientific reports.

#### 6.2 SCIENCE AS A HUMAN ENDEAVOUR 2

- The cell membrane model has been continually reconceptualised and revised since the mid-nineteenth century and the currently accepted model, based on the evidence from improved technologies, is the fluid mosaic model.

- Developments in microscopy and associated preparation techniques have contributed to more sophisticated models of cell structure and function.
- The use of probes technologies and computer analysis has further advanced the understandings of vital chemical processes in cells.
- Current research for the production of food, beverages and biofuels and the breakdown of rubbish, involves the control of cellular respiration and photosynthesis.
- Ethical treatment of animals, including the three strategies of replacement, reduction and refinement, forms the basis of many international guidelines in animal research.

## 6.1 SCIENCE INQUIRY SKILLS 2

Study these terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) control

---

(ii) field of view

---

(iii) magnification

---

(iv) random

---

(v) sample

---

(vi) reliable data

---

(vii) resolution

---

(viii) risk assessment

---

(ix) virtual dissection

---

## Review Questions

1. Give (i) an example of a hypothesis and (ii) a prediction based on that hypothesis.

(i)

---

---

---

(ii)

---

---

---

2. Write a prediction which could be made from each of the following hypotheses by completing the statements below it.

- (i) Kangaroos and emus do far less damage than sheep and cattle to the Australian environment.

If \_\_\_\_\_

then \_\_\_\_\_

- (ii) The rise in the temperature of the sea is causing coral on Australian reefs to die.

If \_\_\_\_\_

then \_\_\_\_\_

- (iii) Native Australian sea lion pups are dying in great numbers at present because of an epidemic of hook worms in the sea lion population.

If \_\_\_\_\_

then \_\_\_\_\_

3. Mark each of the following with an 'H' if it is a hypothesis or 'P' if it is a prediction.

- (i) If the fern is watered well throughout each summer, it will survive for several years.

\_\_\_\_\_

- (ii) Plants which naturally grow in the desert do not require watering in the summer.

\_\_\_\_\_

- (iii) The fish died because it was overfed. \_\_\_\_\_

- (iv) Dogs that attend obedience classes on a regular basis as puppies will be easier to manage when fully grown.

\_\_\_\_\_

- (v) The bird began to lose its feathers as it was pining for its mate. \_\_\_\_\_

4. Mealworms are insects which undergo complete metamorphosis in their life cycle. The adults are beetles which lay their eggs in bran. These hatch into a worm-like larva stage which feeds on the bran. After some weeks the larvae form pupae, a dormant stage which later emerge as beetles.

A biologist proposed the hypothesis that a mealworm colony only increases at its maximum potential if the moisture content of the bran is kept at an optimum level of 10%.

- (i) Write a prediction based on this hypothesis.

---

- (ii) In testing the hypothesis what is the independent variable?

---

What is the dependent variable?

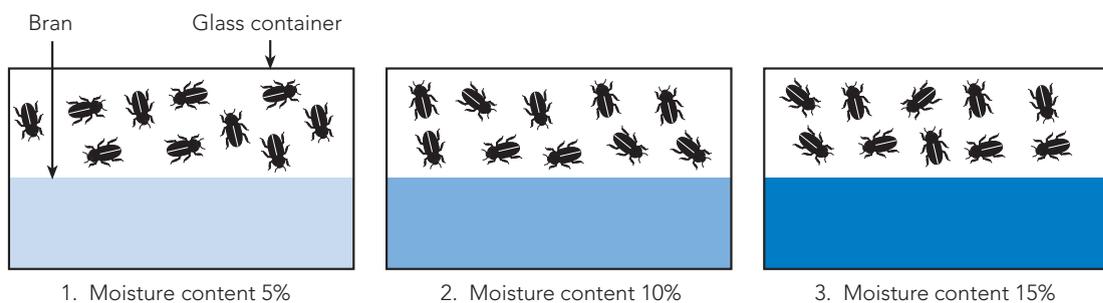
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- (iii) Give one alternative name used to describe these terms.

(a) Independent variable \_\_\_\_\_

(b) Dependent variable \_\_\_\_\_

In order to test the hypothesis, the biologist set up three mealworm colonies. The diagrams below show how these were set up.



To each container he added 10 adult beetles (5 males, 5 females).

- (iv) What results would support the biologist's hypothesis?

---



---

- (v) What results would refute the biologist's hypothesis?

---



---

- (vi) How could the design of the experiment be improved? (Describe two ways).

(a)

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---

(b)

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---

(vii) Having collected data over a period of several months, how could the growth of the colonies be compared?

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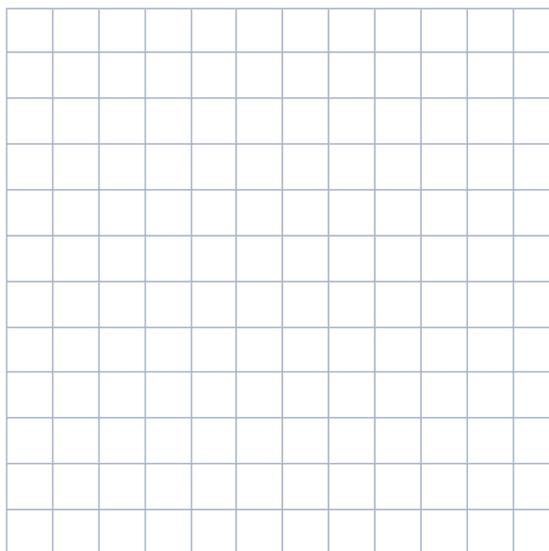
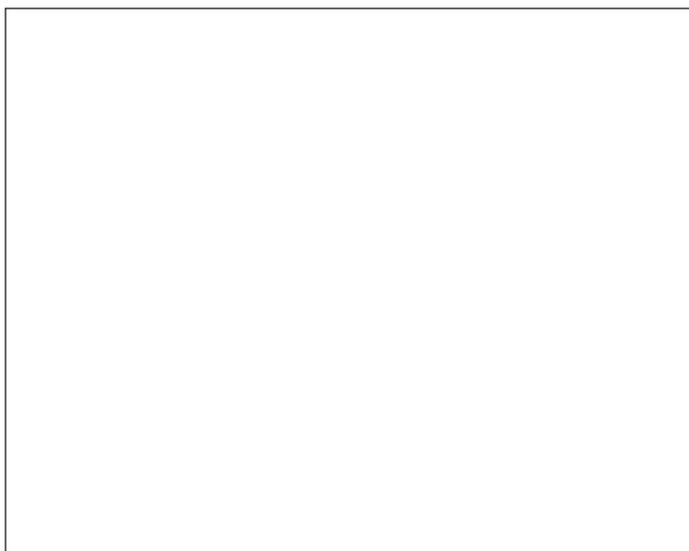
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(viii) The number of beetles in each container was counted at the end of each week for 9 weeks and the data written down roughly as below:

<b>Container 1</b>	12	15	19	21	23	27	26	13	5
<b>Container 2</b>	13	17	25	29	37	43	48	51	47
<b>Container 3</b>	12	13	17	18	21	23	21	10	3

In the box below present this data in a table which shows more clearly what information has been obtained.

(ix) Draw a graph which enables you to show this data more clearly.



(x) Does the data support or refute the hypothesis? Explain your answer.

---

---

(xi) Propose a hypothesis to account for the decline in the number of beetles towards the end of the 9 weeks in container 2.

---

---

(xii) How could you test your hypothesis?

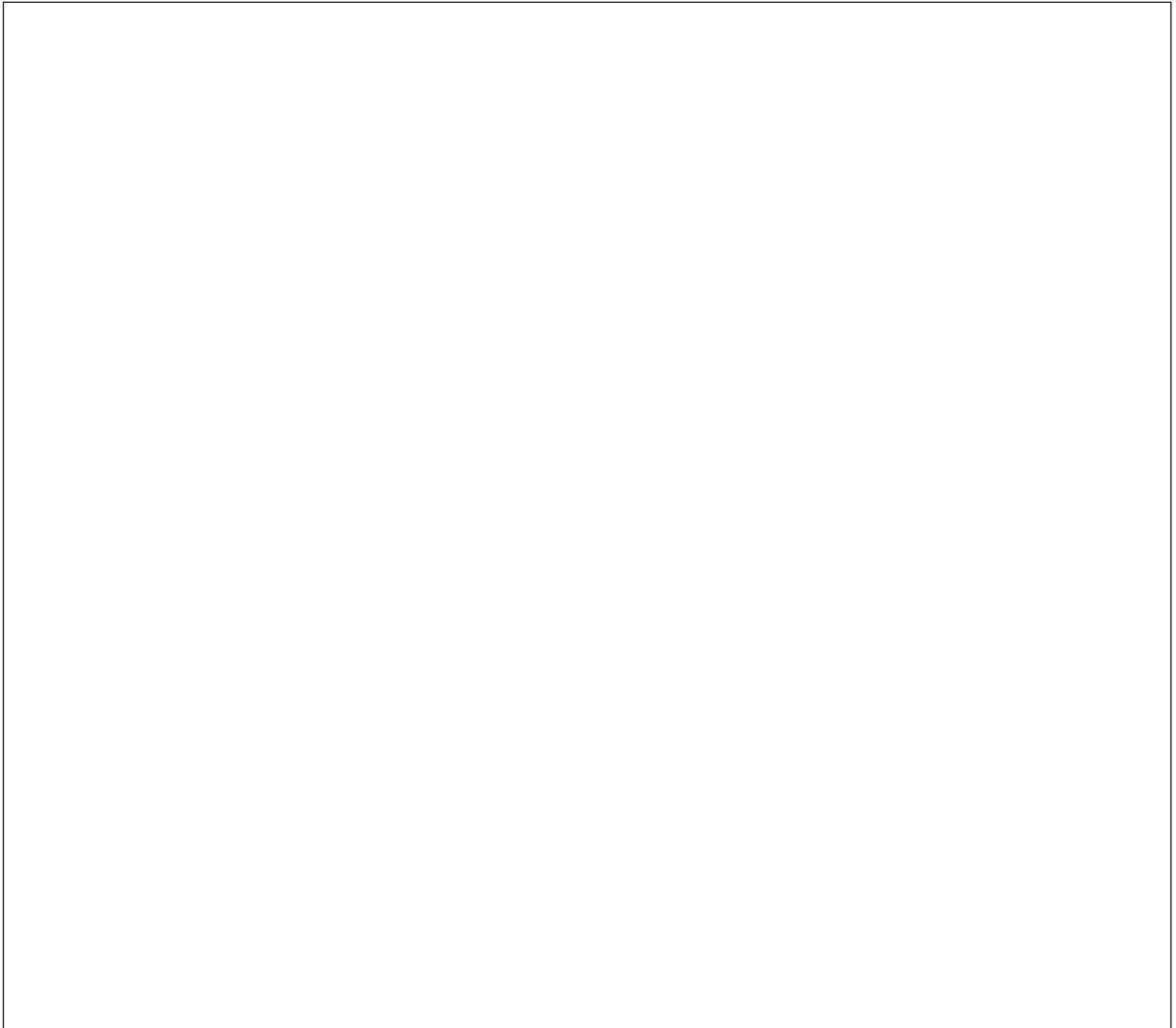
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(xiii) Draw a flow chart which could be used to show the experimental procedure used to test the biologist's hypothesis.



5. There are a number of debates which continue to engage people in this our new biotechnological era. One issue of great interest is the use of human embryos for scientific research. Another is the possible cloning of a human (this has already been achieved in other mammals – sheep, cattle and mice).

Choose a similar issue that particularly interests you, which has or may in the future generate different opinions about its ethics. (You may wish to begin with one of the two examples above.)

(i) Write your example here:

---

---

- (ii) What arguments do you think the supporters of the idea might put forward. List them below.

---

---

---

---

- (iii) What arguments do you think the objectors to the idea might put forward. List them below.

---

---

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---

6. (i) Before you begin a new science experiment it likely that you will need to make a risk assessment of the experiment. What does this mean?

---

---

- (ii) Why is it necessary to do a risk assessment?

---

7. What is the difference between primary and secondary data?

---

---

8. Imagine that you are a scientist working about eighty years ago. After some years of casual observation you make the hypothesis that smoking causes lung cancer. At the time no one believes you, as it is a new and surprising idea!

- (i) How might you gather evidence to support your hypothesis?

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---

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- (ii) What evidence would support your hypothesis?

---

---

(iii) What evidence would refute it?

---

---

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9. Label the monocular microscope shown below and indicate briefly each part's function.

A

---

---

H

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B

---

---

I

---

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C

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J

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D

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K

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E

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L

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F

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M

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G

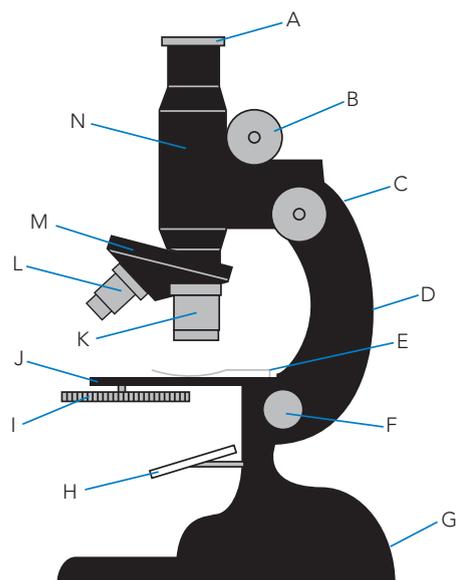
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N

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10. Outline the steps you would take to prepare a wet mount of some onion tissue, staining it with iodine solution, to highlight some of the cell's structures.

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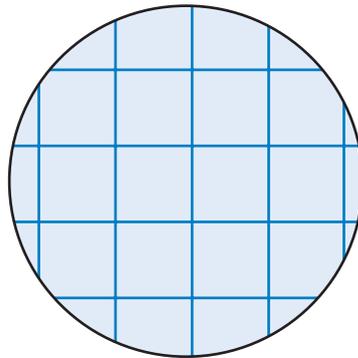
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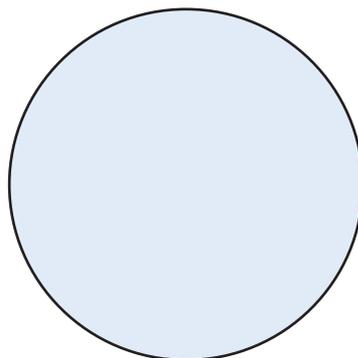
11. A student has made up a slide of a piece of 1 mm graph paper and observes this with her microscope. Using an ocular of 10x and an objective of 4x, she sees the image of the graph paper as shown below.



- (i) What was the magnification used above? \_\_\_\_\_
- (ii) Estimate the diameter of the field of view at this magnification:
- (a) in mm \_\_\_\_\_ (b) in  $\mu\text{m}$  \_\_\_\_\_

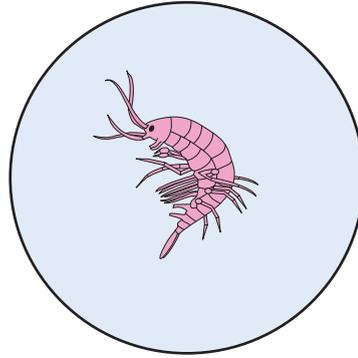
Using the same microscope, the student changed the objective to 10x.

- (iii) Draw lines on the circle below to indicate, approximately, the new image that she would observe.



- (iv) Calculate the diameter of the field of view on this second magnification:
- (a) in mm \_\_\_\_\_
- (b) in  $\mu\text{m}$  \_\_\_\_\_

- (v) Later that day, while using the second magnification, she observed an organism which she drew carefully as shown below.



Estimate the organism's:

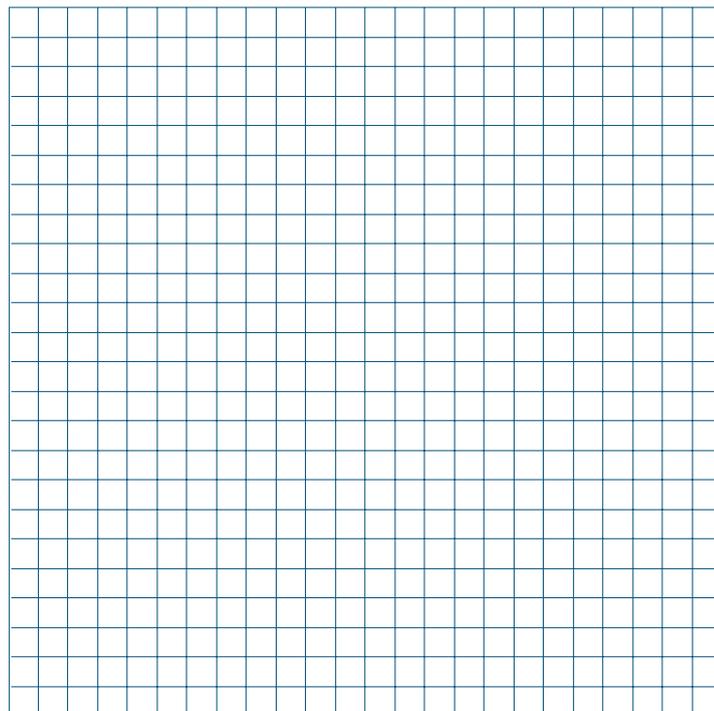
(a) length \_\_\_\_\_ mm or \_\_\_\_\_  $\mu\text{m}$

(b) width \_\_\_\_\_ mm or \_\_\_\_\_  $\mu\text{m}$

12. The data in the table below was collected from a large sample of the population.

- (i) Graph this information in an appropriate form (use the grid provided).

CHOLESTEROL CATEGORY (weight per unit of blood volume)	HEALTH CATEGORY
120-159 mg/dl	Very Good
160-199 mg/dl	Good
200-239 mg/dl	Borderline
240-279 mg/dl	Poor
280-319 mg/dl	Very Poor



(ii) What general conclusions can you make from the data?

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(iii) How might an individual's health category be determined?

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13. A scientific report may be written up under the following headings:

a) Title b) Aim c) Materials d) Procedure e) Results f) Conclusion g) References

Briefly describe what kind of information is generally given under each heading.

a)

---

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b)

---

---

c)

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---

d)

---

---

e)

---

---

f)

---

---

g)

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---

## 6.2 SCIENCE AS A HUMAN ENDEAVOUR 2

Study these terms

### Terminology

These are some of the terms from this section which you should know. Write the meaning of each term in the space provided.

(i) electron

---

(ii) ethanol

---

(iii) fermentation

---

(iv) fluorescence

---

(v) fluorophore

---

(vi) microorganism

---

(vii) model

---

### Review Questions

1. (i) Which invention led to the discovery of cells in the mid-seventeenth century?

---

(ii) Discuss the image of the cell membrane using a light microscope.

---

2. (i) Which technology has enabled biologists to develop the fluid mosaic model of the cell membrane?

---

(ii) How does this technology provide scientists with better evidence for this current model?

---

(iii) The early images of cell membranes produced using electron microscopes indicated that they consisted of two rows of molecules (not one as previously thought). What are these two rows?

---

(iv) Compare the magnification and resolution of the light and electron microscopes.

---

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---

(v) Why are there differences between these two types of microscope?

---

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(vi) Discuss the advantages and disadvantages of each type.

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---

---

3. Explain how transmission and scanning electron microscopes differ.

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4. (i) What is fluorescent microscopy?

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---

(ii) Discuss one application of this technology.

---

---

5. (i) What is a biofuel?

---

(ii) How do microorganisms produce biofuels?

---

---

(iii) What are the roles of photosynthesis and respiration in the production of ethanol?

---

---

6. (i) How are microorganisms used to break down rubbish?

---

---

(ii) Discuss the value of this process to the environment.

---

---

7. (i) Name the microorganisms that are used to produce food and beverages.

---

---

(ii) Give examples of each.

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8. Explain each of the following strategies which form the basis for the ethical treatment of animals in scientific research.

(i) replacement

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---

(ii) reduction

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---

(iii) refinement

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# TRIAL TEST 1: BIODIVERSITY AND CLASSIFICATION



<b>Time allowed:</b> 60 minutes	<b>Section 1</b> – Multiple Choice	20 marks
<b>Total marks:</b> 100	<b>Section 2</b> – Short Answer	60 marks
	<b>Section 3</b> – Short Answer	20 marks

## SECTION 1 – MULTIPLE CHOICE (20 MARKS)

- The stability of an ecosystem is most likely to depend on its:
  - proximity to the equator.
  - exposure to extremes of temperature.
  - genetic biodiversity.
  - proximity to human settlement.
- Terrestrial ecosystems near the poles are likely to have less biodiversity than those near the equator. The reasons for this difference include:
  - less light energy and more water at the poles.
  - less light energy and less water availability at the poles.
  - lower temperatures and more water at the poles.
  - less oxygen in the water in polar regions.
- In any ecosystem the number of animal species is likely to exceed the number of plant species. This is because:
  - plants have more specific requirements than animals.
  - plants provide organic food for animals.
  - plants are less likely to colonise hostile environments than animals.
  - each plant provides many different foods and microhabitats for different animal species.
- The scientific name for a domestic dog is *Canis familiaris*.

Which of the following is true according to the rules of biological nomenclature?

  - “familiaris” cannot be used for any other mammal.
  - “Canis” can be used in any other phylum.
  - “familiaris” can be used for naming an organism in another genus.
  - neither “Canis” nor “familiaris” can be used in naming another species.
- Which of the following criteria is likely to be used to help classify two male birds that belong to the same genus but to different species?
  - type of body covering.
  - size.
  - number of heart chambers.
  - feather colour.
- Which of the following criteria is likely to be used to help classify two vertebrates which belong to different classes?
  - type of body covering.
  - type of diet.
  - size of adult.
  - colour of skin.

7. Scientific names for organisms are used by scientists because they:
- (a) are easily understood.
  - (b) are simple to write.
  - (c) consist of just two words.
  - (d) are universal.
8. Which list starts with organisms that are least closely related and progresses to organisms that have the greatest number of characteristics in common?
- (a) species, genus, family, order, class, phylum.
  - (b) phylum, class, order, family, genus, species.
  - (c) species, genus, order, family, class, phylum.
  - (d) phylum, class, family, order, genus, species.
9. Taxonomy is a branch of biology involved in:
- (a) collecting data related to climate change.
  - (b) classifying and naming living things.
  - (c) preparing preserved specimens of living things.
  - (d) comparing the biodiversity of different ecosystems.
10. A herbarium is:
- (a) an area of land reserved for the growing of herbs.
  - (b) a small part of a herb associated with its reproduction.
  - (c) a museum for the study of plants.
  - (d) a group of herbs which are unique to a particular place.
11. In an ecosystem, genetic diversity is likely to be greatest in a:
- (a) family.
  - (b) species.
  - (c) community.
  - (d) variety.
12. Biological classification is based on all but one of the following. Which one is it NOT based on?
- (a) molecular sequences.
  - (b) methods of food capture.
  - (c) methods of reproduction.
  - (d) anatomical structure.
13. Which two organisms are likely to have the most recent common ancestor?
- (a) The domestic cat (*Felis catus*) and the jaguar (*Panthera onca*).
  - (b) The dingo (*Canis lupus*) and the Chihuahua dog (*Canis lupus*).
  - (c) The Western red kangaroo (*Macropus rufus*) and the Rottnest Island quokka (*Setonix brachyurus*).
  - (d) The Wedge-tailed eagle (*Aquila audax*) and the osprey (*Pandion haliaetus*).
14. Two organisms that belong to the same family but to different genera are likely to:
- (a) be very similar in size.
  - (b) have identical DNA.
  - (c) live in the same ecosystem.
  - (d) have a recent common ancestor.
15. If two species share a very recent common ancestor which is a common ancestor to no other species, it is probable that they will belong to:
- (a) the same genus.
  - (b) different classes but the same phylum.
  - (c) different genera but the same family.
  - (d) the same genus but different families.

16. The male *donkey* and a female *horse* interbreed to produce an infertile hybrid animal called a mule, a male horse and a female donkey may interbreed to produce an infertile hybrid animal called a hinny. The horse and the donkey are not classified in the same species because:
- (a) the two animals do not produce viable offspring.
  - (b) their offspring do not resemble either parent.
  - (c) they are morphologically very different.
  - (d) they belong to different genera.
17. The horse has 64 chromosomes in each somatic cell while the donkey has 62. How many chromosomes is a mule likely to have in its somatic cells?
- (a) 126
  - (b) 64
  - (c) 63
  - (d) 62
18. Two plants are likely to share more similar DNA if they:
- (a) are both aquatic.
  - (b) are both flowering.
  - (c) belong to the same phylum.
  - (d) are both vascular.
19. Because the two plants in question 18 have similar DNA, they will also:
- (a) produce viable offspring.
  - (b) have similar proteins.
  - (c) look the same.
  - (d) belong to the same species.
20. One of the criteria used to classify organisms is their “molecular sequences”. The molecular sequences used by scientists include:
- (a) those associated with their metabolic processes.
  - (b) sugar sequences in their carbohydrates.
  - (c) the stages in chromosomal changes during their cell division.
  - (d) nucleotide sequences on their DNA.



## SECTION 2 – SHORT ANSWER (60 MARKS)

Answer each question in the space provided.

1. (i) Which two organisms listed below are likely to be most similar?

- a) *Helichrysum pungens*
- b) *Hibbertia longiflora*
- c) *Acacia longiflora*
- d) *Hibbertia scandens*.

---

[1 mark]

(ii) Explain your choice.

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[2 marks]

2. The following lists show the scientific name and the common name of some native Australian plants.

SCIENTIFIC NAME	COMMON NAME
<i>Leucopogon attenuatus</i>	Old Man's Beard
<i>Dichondra repens</i>	Kidney weed
<i>Phytoloba nodiflora</i>	Fog-fruit
<i>Sceranthus biflorus</i>	Alpine moss
<i>Eucalyptus torquata</i>	Coral gum

(i) Explain why a scientist would use the names in the left column, whereas a nurseryman is more likely to use the common names in the right column.

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[2 marks]

(ii) Why are two words used in the scientific naming system?

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[2 marks]

(iii) What **rules** are followed in writing the scientific name?

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[2 marks]

(iv) The second part of the name generally has a special significance. What is special about the second name?

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[1 mark]

3. (i) Complete the table for the birds below:

<b>Phylum</b>	Chordata			
<b>Class</b>	Aves			
<b>Order</b>	Falconiformes		Coraciiformes	Pelecaniformes
<b>Family</b>	Falconidae	Alcedinidae		Pelecanidae
<b>Genus</b>	<i>Falco</i>	<i>Alcyone</i>	<i>Alcyone</i>	<i>Pelecanus</i>
<b>Species</b>	<i>peregrinus</i>	<i>azurea</i>	<i>pusilla</i>	<i>conspicillatus</i>

[4 marks]

(ii) Which two birds are most closely related?

---

[1 mark]



5. Use the key below to classify the bird shown. Write your answers below.

**KEY**

1. a)	Small bird, less than 13 cms long	2
1. b)	Bird larger than 13 cms long	<i>Phaps elegans</i>
2. a)	Beak suited to nectar feeding	3
2. b)	Beak suited to seed cracking	<i>Melopsittacus undulatus</i>
3. a)	Colour of breast feathers similar shade to wings	<i>Mirafra javanica</i>
3. b)	Colour of breast feathers a lighter shade than wings	4
4. a)	Curved bill	<i>Phylidonyris novaehollandiae</i>
4. b)	Straight bill	<i>Climacteris picumnus</i>



(i) Bird Species \_\_\_\_\_

[2 marks]

(ii) Write the choices you made in arriving at your answer.

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[2 marks]

6. (i) Which organisms are likely to be most similar?

(a) Two that belong to the same order but to different families, or

(b) Two that belong to the same genus but to different species?

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[1 mark]

(ii) Explain your answer.

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[2 marks]

7. (i) How could a biologist determine whether two mammals belonged to the same species or not?

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[2 marks]

- (ii) To determine whether bacteria are the same species other tests would be required. Why is this necessary and what tests might be used?

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[2 marks]

8. (i) What is the “Linnaean system of binomial nomenclature”?

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[2 marks]

- (ii) Why is this system used?

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[1 mark]

9. What is a species?

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[2 marks]

10. (i) How could you determine whether two flowering plants growing in different places are the same species when they appear to be different in their growth form and height?

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[2 marks]

- (ii) If they do belong to the same species why might they be so different?

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[2 marks]

11. (i) How do biologists identify an unfamiliar organism that they may find?

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[2 marks]

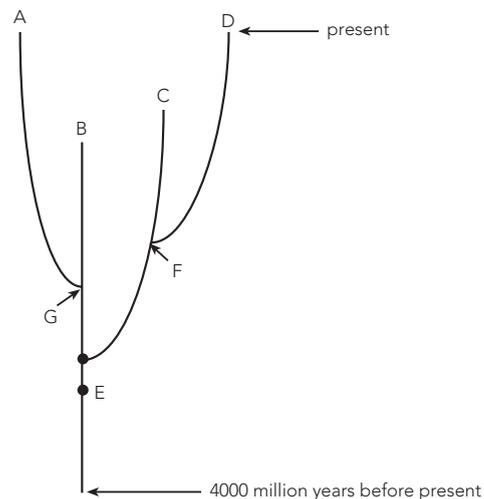
- (ii) When a new species is discovered does this increase the biodiversity of the area in which it is found? Explain.

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[2 marks]

12. (i) Describe what this evolutionary “tree of life” shows.



Note: A, B, C, D and E represent different species. G and F represent processes.

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[4 marks]

(ii) Which living species appears to be most closely related to species C?

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(iii) How would its position on the tree have been determined?

[1 mark]

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[2 marks]

(iv) On this diagram, which species are extinct?

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[2 marks]

(v) Which species is likely to have genes most similar to species B?

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[1 mark]

(vi) Describe what has happened at node F.

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[2 marks]

(vii) Which species is the most common recent ancestor of A and D?

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[1 mark]







## TRIAL TEST 2: ECOSYSTEMS

**Time allowed: 60 minutes**

**Total marks: 100**

**Section 1 – Multiple Choice**

**Section 2 – Short Answer**

**Section 3 – Short Answer**

20 marks

60 marks

20 marks

### SECTION 1 – MULTIPLE CHOICE (20 MARKS)

- Ecosystems consist of both biotic and abiotic factors. A biotic factor found in most ecosystems is:
  - plants.
  - light.
  - water.
  - soil.
- Parasites are organisms that:
  - feed on the dead remains of other organisms.
  - invade the bodies of other organisms leading to the host's death.
  - live on or in other organisms to the detriment of the host.
  - carry disease from one organism to another.
- Competition often occurs between individuals of the same species. This competition is called:
  - extraspecific.
  - interspecific.
  - intraspecific.
  - nonspecific.
- Predation is a relationship that is often seen between two species. An example of such a relationship is:
  - a parrot feeding on the fresh fruit of a eucalypt.
  - a mosquito drawing the blood from a dog.
  - a cow consuming the grass that is growing in a paddock.
  - a fox killing and eating a possum.
- An ecosystem which is likely to have the greatest range of biotic factors is probably:
  - near the equator.
  - in a mild temperate region.
  - close to either of the poles.
  - in a semi-desert region.
- The difference between mutualism and commensalism is that:
  - in mutualism only one species benefits by the association whereas in commensalism both species benefit.
  - in mutualism both species benefit by the association whereas in commensalism only one species benefits.
  - in mutualism one species benefits by the association whereas in commensalism one species is harmed.
  - in mutualism both species benefit by the association whereas in commensalism neither species benefit.

7. The most significant abiotic factor in an aquatic ecosystem is its:
- (a) temperature.
  - (b) air pressure.
  - (c) biodiversity.
  - (d) humidity.
8. In naming ecosystems several factors are often used. If a biologist refers to a granite outcrop as an ecosystem, the factor being used to name this ecosystem is the:
- (a) low density of vegetation on the ground.
  - (b) dominant plant species present.
  - (c) percentage of ground covered in shade at midday.
  - (d) substrate and geomorphology.
9. Which of the following would always be described as a manipulated ecosystem?
- (a) a farm.
  - (b) an estuary.
  - (c) a fresh water lake.
  - (d) a lagoon.
10. A single termite would be unable to build a termite mound to incubate its eggs. The activities of thousands of termites in carrying out this role could be described as:
- (a) accommodation.
  - (b) collaboration.
  - (c) mutualism.
  - (d) cooperation.
11. Diseases caused by organisms are known as pathogenic diseases. A pathogen is most often:
- (a) a toxin.
  - (b) a microorganism.
  - (c) an invertebrate.
  - (d) a vector.
12. In most cases it is not in the interests of a parasite to kill its host. This is because the parasite:
- (a) always needs its host in order to reproduce its offspring.
  - (b) loses its source of food if the host dies.
  - (c) is not able to become dormant.
  - (d) would find another host difficult to locate.



Read the following statements and answer the eight questions that follow them.

- A. A tapeworm may live inside the intestines of a horse. It extracts nutrients from the horse and releases toxins which reduce the health of the horse, sometimes making it thin and susceptible to other diseases.
- B. Two trees growing in very close proximity cast shade on one another and share the same ground water and minerals.
- C. Grain-borer beetles cannot individually eat through the outside coat of a wheat grain. However, working together, a group of these beetles is able to remove the protective coat of a wheat seed and reach the stored food.
- D. In lichen, an alga and a fungus co-exist. The alga photosynthesises carbohydrate on which the fungus lives too. The fungus provides water and shelter for the alga.
- E. Fish are commonly introduced into ponds in order to eat mosquito larvae.
- F. Orchids sometimes grow on the branches of larger trees. They do not harm the trees but the orchids benefit through the habitat the trees provide.
- G. Some bacteria which invade the intestines of an animal may produce poisons which make the animal sick and may even cause its death.

13. The statement which best describes a **predator-prey** relationship is:

- (a) A (b) B (c) C (d) D (e) E

14. Relationships in which no harm is done to either organism include:

- (a) D and E (b) E and F (c) F and G (d) D and F

15. A good example of **collaboration** is seen in:

- (a) A
- (b) B
- (c) C
- (d) D

16. A **parasitic** relationships is described in:

- (a) A
- (b) B
- (c) C
- (d) D

17. **Competition** is illustrated by:

- (a) A
- (b) B
- (c) C
- (d) D

18. A **commensal** relationship exists between the organisms in:

- (a) C
- (b) D
- (c) E
- (d) F

19. **Disease** is evident in:

- (a) B
- (b) C
- (c) E
- (d) G

20. An example of a **host** in the above statements would be:

- (a) the horse.
- (b) a grain-borer beetle.
- (c) the mosquito larvae.
- (d) the bacteria.

## SECTION 2 – SHORT ANSWER (60 MARKS)

Answer each question in the space provided.

1. (i) A rainforest community has the greatest diversity and abundance of species of all communities. The number of different plant species has an effect on the number of animal species. Explain why this is so.

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[3 marks]

- (ii) What types of interaction occur between the animal species and the plant species in such a community?

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- (iii) Explain, using examples, what the following terms mean:

[2 marks]

- (a) interspecific competition

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- (b) intraspecific competition

[1 mark]

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[1 mark]

- (iv) (a) Mutualism, commensalism and parasitism have one thing in common. What is it?

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[1 mark]

(b) What collective name is given to such relationships?

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[1 mark]

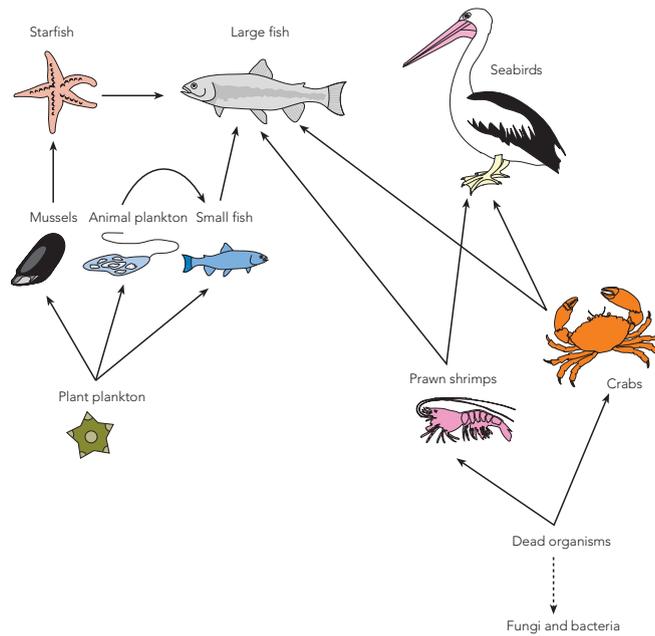
(c) How do the first two relationships differ from the last?

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[1 mark]

2. The diagram below represents a food web in an aquatic community.



In this community:

(i) Which organisms are the producers?

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[1 mark]

(ii) Which organisms are the decomposers?

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[1 mark]

(iii) Name three first order consumers.

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[1 mark]

(iv) What does each arrow in the diagram show?

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[1 mark]

(v) Describe how matter is recycled in the community.

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[1 mark]

(vi) If the mussels are “fished out” by over enthusiastic fishermen, how might this affect the starfish population?

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[2 marks]

(vii) What other effects might the disappearance of the mussels have?

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[2 marks]

3. What are four **abiotic** factors that make up an earthworm’s environment?

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[2 marks]

4. List four **biotic** factors that make up a kangaroo’s environment.

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[2 marks]

5. (i) Which of the following **abiotic** factors make up part of a fresh water fish's environment? (Underline your choices).

*Temperature, light, dissolved gases, humidity, viscosity, pH, salinity, soil type, topography, wind, water currents, buoyancy.*

[2 marks]

- (ii) For each of those which you have not underlined, explain why they are not part of the fresh water fish's environment.

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[4 marks]

6. A new Jarrah seedling which germinates in a forest in spring has a small chance of survival. Explain how the following biotic factors are likely to affect its chances.

- (i) insect species

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- (ii) large herbivores

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- (iii) similar seedlings

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- (iv) larger nearby plants

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- (v) soil microorganisms

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(vi) airborne fungal spores

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[6 marks]

7. Using one word, indicate the relationship the Jarrah seedling might have with:

(i) Parasitic fungi \_\_\_\_\_

(ii) Other Jarrah seedlings \_\_\_\_\_

(iii) Herbivores \_\_\_\_\_

[3 marks]

8. (i) Orchids are often beautiful flowering plants which photosynthesise producing glucose for themselves and for the fungi which live in their roots. The fungi assist the orchids to obtain nutrients. How would you describe this relationship? Explain your answer.

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[2 marks]

(ii) Grain borer beetles cannot singularly bore through the outer coat of wheat grains. However, if the beetles work collectively as a group they are able to break through to the stored starch inside the wheat seeds. What name is given to the grain borer beetles' relationship to one another?

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[1 mark]

9. Plants have a very important effect on their environment. Explain how plants may affect the following factors in a terrestrial environment.

(i) humidity

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(ii) temperature

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(iii) rainfall

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(iv) wind speed

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(v) animal diversity

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[5 marks]

10. Complete the table below.

ORGANISM	ONE FUNCTION WITHIN THE ECOSYSTEM	TWO EXAMPLES
Producer		
Primary consumer		
Secondary consumer		
Omnivore		
Parasite		
Detrivore		
Decomposer		

[14 marks]





## TRIAL TEST 3: ENERGY AND MATTER

**Time allowed: 60 minutes**

**Total marks: 100**

**Section 1 – Multiple Choice**

**Section 2 – Short Answer**

**Section 3 – Short Answer**

20 marks

60 marks

20 marks

### SECTION 1 – MULTIPLE CHOICE (20 MARKS)

- In a natural ecosystem:
  - matter and energy are recycled.
  - energy is recycled but matter is lost to other ecosystems.
  - energy is lost to the atmosphere but most matter is recycled.
  - both matter and energy are entirely transferred to other ecosystems.
- The reason that most food chains can be represented as a pyramid of biomass is that:
  - the biomass of autotrophs must be greater than the biomass of first order consumers.
  - some biomass is not transferred from each lower trophic level to the next.
  - some higher trophic organisms migrate to other ecosystems.
  - decomposers break down some organisms at each trophic level.
- Which of the following is considered to be a part of the **abiotic** component of an ecosystem?
  - respiration.
  - plants.
  - carbon dioxide.
  - photosynthesis.
- Plants are an important part in the movement of water through the biotic component of an ecosystem. This is because plants:
  - take up water and convert most of it to carbohydrates in photosynthesis.
  - absorb water through their roots and lose most of it to the atmosphere through transpiration.
  - remove most of the water from the soil and pass this on to animals.
  - prevent erosion by absorbing most of the water that falls as rain.
- Fungi and bacteria break down the carbon compounds in the dead remains of plants and animals producing:
  - free carbon.
  - ammonia.
  - carbon dioxide.
  - sugars.
- Carbon dioxide is released when limestone is heated to produce lime:

**limestone (calcium carbonate) + heat → lime (calcium oxide) + carbon dioxide**

Lime (calcium oxide) is used to make cement. This suggests that a contribution to rising atmospheric carbon dioxide levels may be:

- the increasing world population.
- the use of limestone in cement.
- the release of carbon dioxide from limestone.
- the increasing use of cement in modern buildings.

7. Carbon dioxide, which is an important component of the atmosphere, is removed from the atmosphere mainly by:
- plants which use it in photosynthesis.
  - animals which use it in respiration.
  - being trapped in fossil fuels.
  - being dissolved in the lakes and rivers on the earth's surface.
8. The dry weight of plant material taken from a square metre of bushland provides a measure of the mass of the organic matter per square metre in that environment. The dry weight of the plants does not include the mass of which substance:
- water.
  - minerals.
  - vitamins.
  - carbohydrates.
9. In a typical community, which of the following trophic levels would contain the greatest biomass?
- high order consumers.
  - primary consumers.
  - producers.
  - decomposers.
10. From the following food chain:

**Wheat → Rats → Eagles**

a pyramid of energy can be drawn as below.

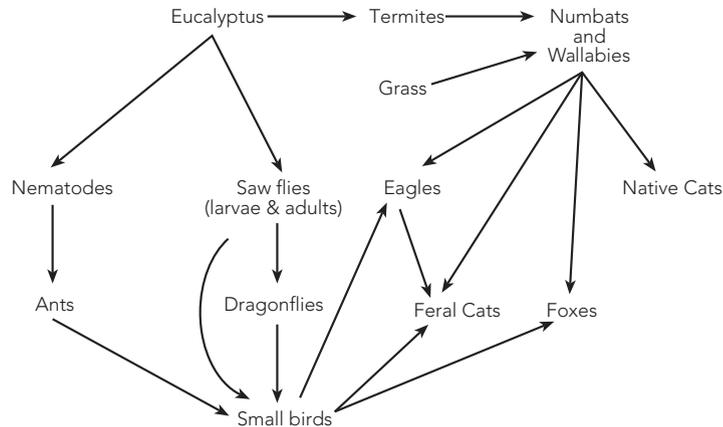


The reason for the pyramid shape is that:

- the mass of each lower trophic level must be greater than the mass of the trophic level above it.
  - energy is lost as heat to the atmosphere at each trophic level.
  - the number of wheat seeds is greater than the number of rats and the number of rats is greater than the number of eagles.
  - it would not be balanced if it was not a pyramid shape.
11. The best definition of an ecosystem would include a description of:
- the total number of species in the system.
  - the living and non-living parts of the environment and their interactions.
  - the cycling of energy in the system.
  - the loss of matter from the system.
12. In a food web not all the plant biomass is passed on as food to the first order consumers because:
- consumers cannot consume the quantity of plant biomass produced.
  - some plant biomass must be retained in the food web for plant reproduction.
  - some biomass is lost as heat at each trophic level.
  - some plant biomass is not edible organic matter.
13. In any ecosystem the number of animal species is likely to exceed the number of plant species. This is because:
- plants have more specific requirements than animals.
  - plants provide organic food for animals.
  - plants are less likely to colonise hostile environments than animals.
  - each plant provides many different foods and microhabitats for different animal species.

14. Which of the following refers to a biotic part of an ecosystem?
- light energy.
  - soil particles.
  - water.
  - fungi.
15. In a natural ecosystem, which of the following lists contain only recycled things?
- carbon, calcium, chemical energy.
  - nitrogen, sodium, light energy.
  - carbon, calcium, sodium.
  - nitrogen, water, light energy.

Use the food web to the answer the five questions below.

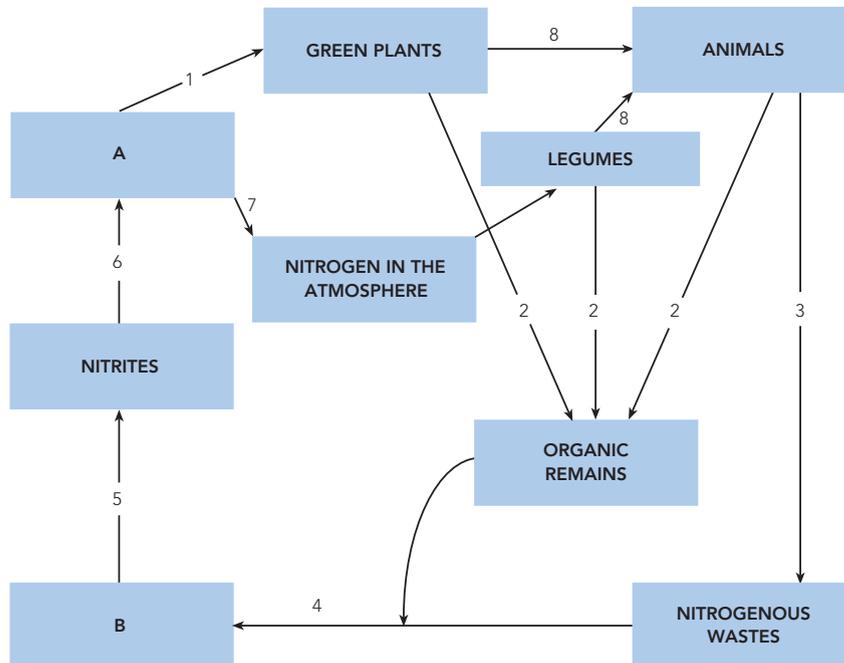


16. Which of the following organisms are likely to have the greatest total biomass?
- nematodes.
  - eucalyptus.
  - ants.
  - small birds.
17. Most of the carbon intake of the ants in this food web is in the form of:
- protein.
  - carbohydrates.
  - vitamins.
  - sugar.
18. Ants in turn pass carbon either directly or indirectly to:
- small birds only.
  - small birds and dragonflies.
  - nematodes only.
  - small birds, eagles and feral cats.
19. Nitrogen is obtained by the grasses from the:
- soil as nitrates.
  - atmosphere as nitrogen gas.
  - soil as amino acids.
  - water as dissolved ammonia.
20. The energy in this food web originates from the:
- producers (grasses and eucalyptus) synthesising organic molecules.
  - breakdown of organic molecules in respiration.
  - movement of the animals as they search for food.
  - sunlight absorbed by the producers.

## SECTION 2 – SHORT ANSWER (60 MARKS)

Answer each question in the space provided.

1. Study the diagram of the Nitrogen Cycle below before answering the questions which follow it.



- (i) What substance should be written in box A? \_\_\_\_\_

[1 mark]

- (ii) How do legumes obtain nitrogen from the atmosphere?

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[2 marks]

- (iii) What gas should be written in box B? \_\_\_\_\_

[1 mark]

- (iv) If each of the numbered arrows represent a process, write down what that process is.

- |          |          |
|----------|----------|
| 1. _____ | 5. _____ |
| 2. _____ | 6. _____ |
| 3. _____ | 7. _____ |
| 4. _____ | 8. _____ |

[4 marks]

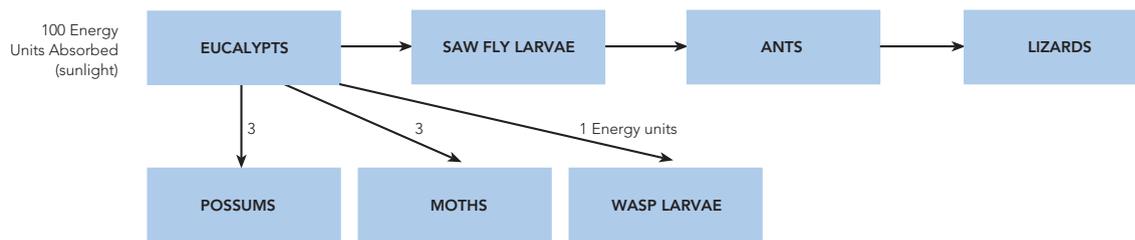
2. (i) If only ten percent of the energy absorbed at each level is passed on to a successive trophic level, how many units of energy are available to the lizards in the following food chain?

[1 mark]



- (ii) If the eucalypts are eaten by several other first order consumers as shown below, how much energy is available to the lizards in this case?

[1 mark]



- (iii) Which of the above is closest to what might occur in nature? Explain.

[2 marks]

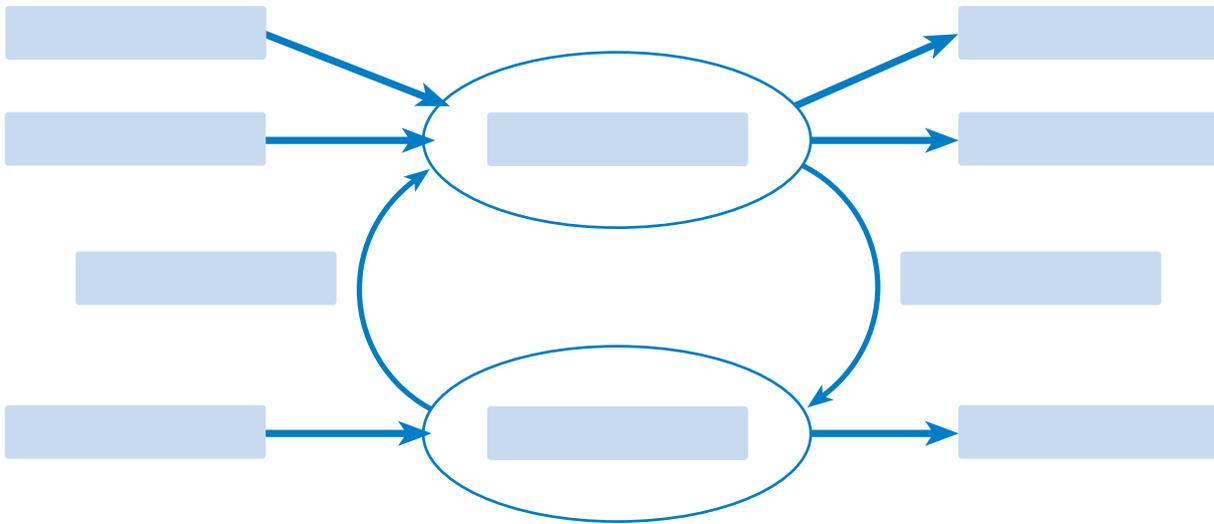
- (iv) Is it likely that the lizards will have the amount of energy predicted in (ii)? Explain.

[2 marks]



3. (i) Use the following list of terms and phrases to label the model of a natural ecosystem drawn below.

*abiotic component, biotic component, heat energy, inorganic input, inorganic input from other ecosystems, inorganic output, inorganic output to other ecosystems, light energy, organic input, organic output.*



[5 marks]

- (ii) Which of the above are recycled?

\_\_\_\_\_

[2 marks]

- (iii) Which of the above come from other parts of the biosphere?

\_\_\_\_\_

[2 marks]

- (iv) Where does the organic output go to? \_\_\_\_\_

[1 mark]

- (v) Where does the light energy come from? \_\_\_\_\_

[1 mark]

- (vi) Where does the heat energy go to? \_\_\_\_\_

[2 marks]

4. (i) Define the term "ECOSYSTEM".

\_\_\_\_\_

\_\_\_\_\_

[2 marks]

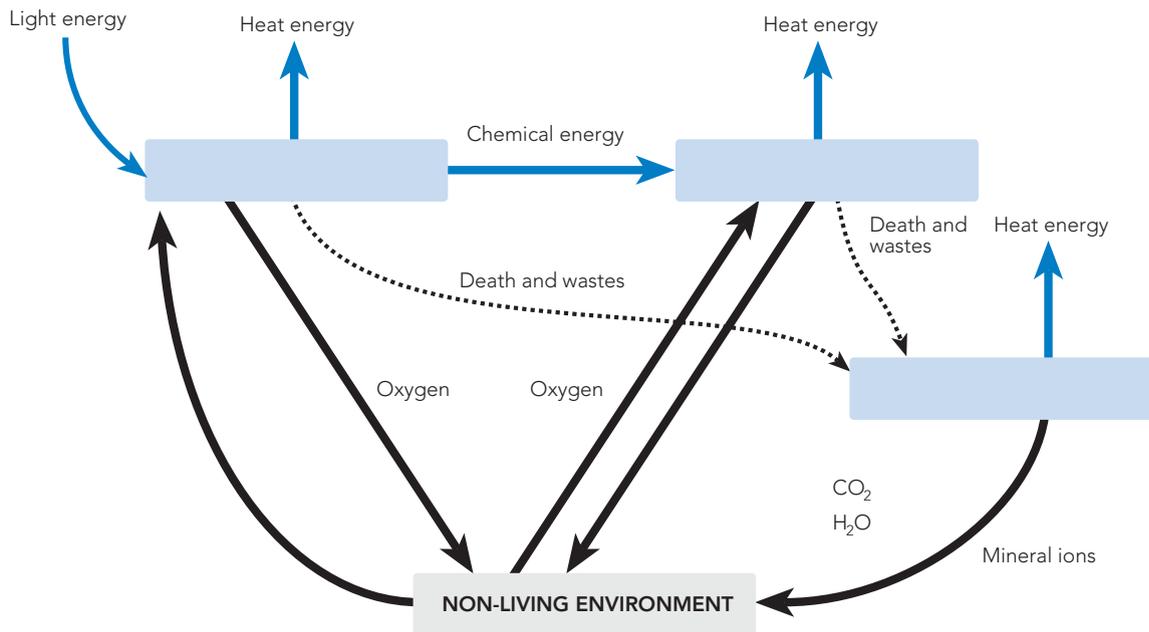
(ii) What is meant by referring to an ecosystem as “stable”?

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[1 mark]

(iii) By writing a single word in each of the three boxes complete the diagram which shows the energy and matter movements in an ecosystem.



[1 mark]

(iv) Why is heat released from the living environment?

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[1 mark]

(v) Is energy recycled in the ecosystem? Explain.

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[1 mark]

(vi) From where do the decomposers obtain their energy and in what form is this energy?

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[1 mark]

(vii) What is taken up by producers from their non-living environment?

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[2 marks]

(viii) What is returned to the non-living environment by both animals and plants?

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[2 marks]

(ix) How are decomposers different from other consumers?

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[1 mark]

5. A fish farmer with two fish tanks which are located near one another obtains 350 kilos of fish in one year from one tank (A) and 250 kilos, in the same time, from the other (B).

(i) What factors might have caused the difference in productivity between the two tanks?

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[2 marks]

(ii) Describe how the farmer might improve the productivity of both tanks?

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[1 mark]

(iii) If each tank contained 30 000 litres of water, calculate the productivity of each tank in grams per litre per week. Assume the weight of the fingerlings introduced into each tank was negligible.

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[6 marks]

6. The table below shows the mean net primary productivity for a number of different ecosystems.

ECOSYSTEM	PRODUCTIVITY (g/m <sup>2</sup> /yr)
Tropical rainforest	2200
Temperate evergreen forest	1300
Woodland	700
Desert and semi-desert scrub	90
Cultivated land	650

- (i) Why is the productivity of a tropical rain forest greater than that of a temperate evergreen forest?

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[2 marks]

- (ii) By how much on average is the productivity of a tropical rainforest greater than that of desert scrub?

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[1 mark]

- (iii) What effect is the difference in (ii) likely to have on the biomass of first order consumers in each ecosystem type?

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[2 marks]

- (iv) If the productivity of a tropical rain forest is so high, how would its absorption of CO<sub>2</sub> compare with that of other ecosystems?

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[2 marks]

- (v) The biomass of the tropical rain forests of the world represent about 41% of the Earth's biomass. However, the area occupied by tropical rain forest is 3% of the Earth's total area. How is this reflected in the density of the biomass in tropical rain forests?

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[2 marks]

- (vi) How could you measure the productivity of an ecosystem?

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[3 marks]





## TRIAL TEST 4: POPULATIONS

**Time allowed: 60 minutes**

**Total marks: 100**

**Section 1 – Multiple Choice**

**Section 2 – Short Answer**

**Section 3 – Short Answer**

20 marks

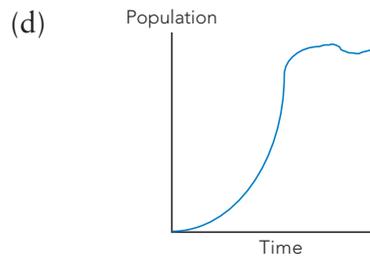
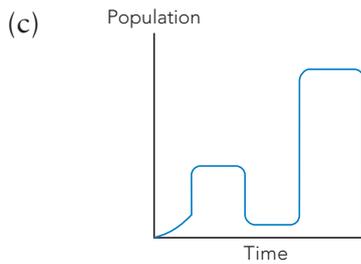
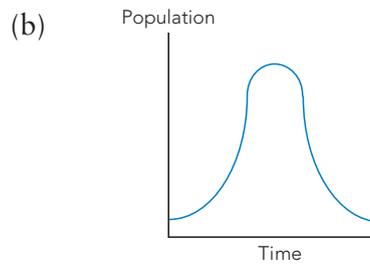
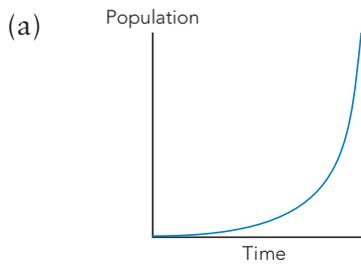
60 marks

20 marks

### SECTION 1 – MULTIPLE CHOICE (20 MARKS)

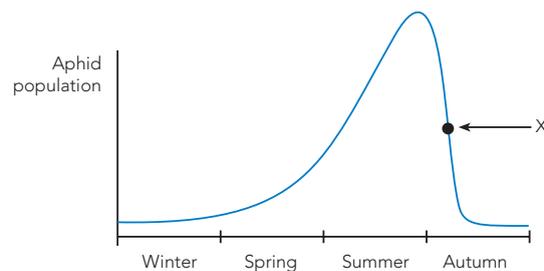
- A population is:
  - the number of species living in a community at a particular time.
  - the number of a particular species living in a particular place at a particular time.
  - the number of species in one genera.
  - the number of adults in one species living in a particular place.
- The principle that states that “no two species can occupy the same niche in the same environment for an extended period of time”:
  - only applies to some populations.
  - has serious implications for the fate of feral animals in Australia.
  - does not apply to cane toads as they appear to thrive in competition with native amphibians.
  - provides a warning to people endeavouring to preserve native plants and animals.
- The principle in question 2 above probably applies because:
  - there is likely to be a lack of space for both species.
  - one species is likely to outcompete the other for scarce resources.
  - one species is likely to reproduce more rapidly than the other.
  - life spans are different therefore one species will persist for longer than the other.
- Which of the following most accurately describes the bee’s niche?
  - Bees live in terrestrial ecosystems which contain angiosperms, pollinate them and makes honey to feed their young.
  - Bees have a sting and are social insects.
  - Bees fly from flower to flower carrying pollen which is essential for the reproduction of all flowering plants.
  - Bees live in hives in large populations where they produce honey for human consumption.
- The carrying capacity of a particular environment refers to the maximum:
  - size of a community that an ecosystem can feed over a prolonged period of time.
  - size of a particular population that the environment can support over a long period of time.
  - space available in the environment to accommodate a particular species.
  - available breeding places the environment has to accommodate a particular species.
- Which of the following factors which may reduce a population size is **density-independent**?
  - floods.
  - water availability.
  - food availability.
  - nesting sites.

7. Which of the following factors, which may limit a population size, is **density-dependent**?
- disease.
  - fire.
  - flooding.
  - drought.
8. The carrying capacity of a particular terrestrial environment could be determined by all but one of the factors below. Which one?
- the number of predators in the environment.
  - the reproductive rate of the organism concerned.
  - the soil quality.
  - the annual rainfall in the environment.
9. Which of the following graphs corresponds to an ecosystem which has reached its carrying capacity for a particular organism?



10. As the human population increases with few limiting factors, its impact has generally caused:
- an increase in biodiversity in natural ecosystems.
  - the creation of more national parks.
  - pollution, particularly in nearby ecosystems.
  - an increase in the carrying capacity in nearby ecosystems.
11. The rate of growth of a population ( $r$ ) is determined by four factors, the birth rate ( $b$ ), the death rate ( $d$ ), the immigration rate ( $i$ ) and the emigration rate ( $e$ ). To calculate  $r$  a biologist can use the formula:
- $r = (b + d) - (i + e)$ .
  - $r = (b + i) - (d + e)$ .
  - $r = (b + e) - (d + i)$ .
  - $r = b + i - d + e$ .
12. Which of the following is most likely to influence the birth rate of an animal population?
- the size of the population.
  - the age composition of the population.
  - the carrying capacity of the environment.
  - the area of the animals' distribution.

13. If a large number of foxes were introduced to Rottnest Island, how is this likely to affect the quokka population on this island:
- the quokka population would not be affected, as they have an herbivorous diet.
  - the foxes would prey only on young quokkas, this would result in an increase in older quokkas.
  - the foxes would only prey on young quokkas and slower old quokkas. This would result in more quokkas of reproductive age.
  - the quokka population would be reduced or even caused to become extinct on the island, as quokkas have no defence against foxes.
14. As foxes are not normally present on Rottnest, other factors may limit the size of the quokka population. These are likely to include:
- disease.
  - emigration.
  - immigration.
  - scavenging silver gulls.
15. Epidemics probably become a factor in limiting an animal's population size as the population's:
- density increases.
  - distribution increases.
  - emigration rate increases.
  - resource use increases.
16. Which of the following indicates a situation in which a population is growing?
- $(b + d) > (e + i)$
  - $(b + i) > (d + e)$
  - $(b + e) < (d + i)$
  - $(b + i) < (d + e)$
17. If the graph below shows the growth of a population of aphids feeding on roses over a period of a year:



At the point marked X on the graph, which formula below could apply:

- $(b + i) > (d + e)$
  - $(b + i) < (d + e)$
  - $(b + e) = (d + i)$
  - $b = d$
18. Population dynamics refers to a population's change in:
- composition and size.
  - location and size.
  - location and composition.
  - size only.
19. The population 'doubling time' refers to the time taken for:
- a population to reach a carrying capacity for its ecosystem.
  - half the population to replace itself in number through reproduction.
  - the population to become twice its present size.
  - adults in a population to reach a reproductive age.

20. As populations grow their doubling time generally:
- (a) increases with the size of the population.
  - (b) stays the same unless the population has reached the carrying capacity of environment.
  - (c) shortens as the numbers cause an exponential growth rate.
  - (d) cannot be predicted as organisms behaviour does not conform to mathematical formulae.

## SECTION 2 – SHORT ANSWER (60 MARKS)

Answer each question in the space provided.

1. (i) Describe how **intraspecific** competition may affect the population of dugites on an island.

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[2 marks]

- (ii) Is this factor density-dependent or density-independent? Explain.

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[2 marks]

- (iii) The White-tailed Black cockatoo is threatened with extinction, largely because its habitat is disappearing. The removal of banksias and other native trees on which it feeds has reduced its ability to reproduce. The availability of its resources has declined. Is this factor density-dependent or density-independent? Explain.

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[2 marks]

- (iv) (a) Territorial behaviour which is exhibited by many mammals and birds is likely to reflect in the distribution of these organisms. Explain why this is the case.

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[1 mark]

- (b) The density of these organisms will also be determined by the carrying capacity of the environment. Explain.

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[2 marks]

2. Describe the effects a farmer in Western Australia may have on his property if he exceeds the carrying capacity of his land by introducing too many sheep or cattle per acre.

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[2 marks]

3. What impact does the increasing urban population of Perth have on:

- (i) the surrounding bush ecosystems.

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[2 marks]

- (ii) Swan/Canning river ecosystems.

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[2 marks]

- (iii) the nearby marine ecosystem.

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[2 marks]

4. (i) The population of marron in a dam is 5,100 at the beginning of the year. During the year, 615 new marron hatch and 205 die or are eaten by predators. The farmer restocks with 500 marron from another dam and removes 600 to start a new population in another dam. What is the total population at the beginning of the following year? (Show all your calculations).

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[2 marks]

- (ii) If the area of the dam was 0.5 hectares what would the density of the marron have been at the beginning of the first year? (Write your answer as a number per square metre).

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[2 marks]

- (iii) Calculate the **rate of change** (r).

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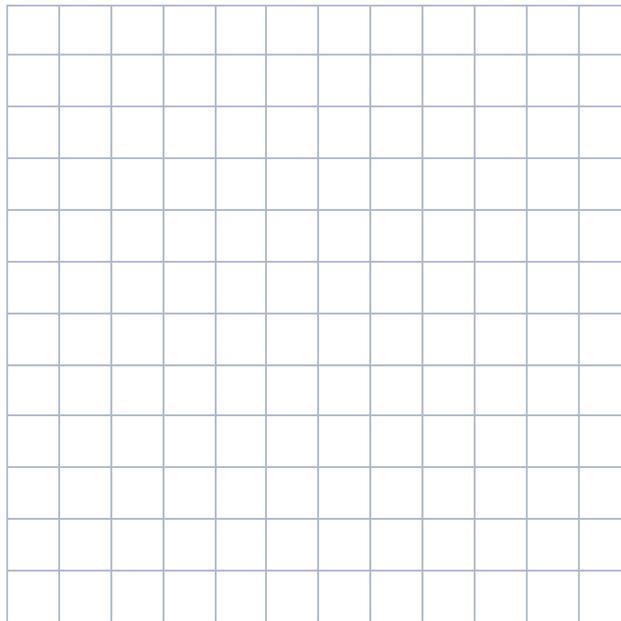


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[2 marks]

5. (a) Suppose a biologist obtained the following data, collected from a Karri forest. Present the data in a graphical form.

QUADRAT	PLANT SPECIES							
	A	B	C	D	E	F	G	H
1	2	2	5	7	8	1	0	4
2	3	1	4	8	5	0	0	7
3	2	3	7	5	7	3	1	8
4	4	1	3	9	7	1	2	3
5	2	1	4	7	6	0	0	2
6	1	2	5	5	5	2	3	4
7	0	0	1	1	0	0	2	3
8	1	3	7	3	3	1	1	3
9	1	2	4	8	3	1	2	5
10	0	0	3	5	4	0	0	4



[3 marks]

- (b) If the area of each quadrat used was  $20\text{m}^2$ , calculate the density of plant species E in the forest (show your working out).

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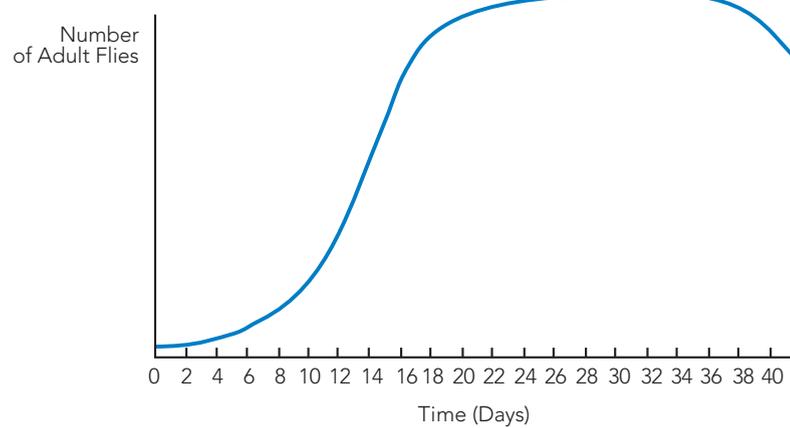
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[2 marks]

6. The graph below shows the growth of an experimental population of fruit fly over several weeks.



- (i) During which days was the population growing at its fastest? Explain.

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[2 marks]

(ii) When did the population stop increasing? Explain.

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[2 marks]

(iii) Why might the population have stopped increasing?

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[1 mark]

(iv) What would be the approximate value of “r”, growth rate, on day 36?

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[1 mark]

(v) On what day does “r” become negative? Explain how “r” could become negative.

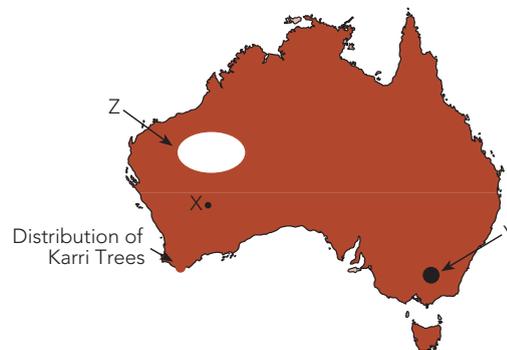
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[2 marks]

7. Karri trees are confined to the south-west corner of Western Australia.



(i) Why might a Karri seedling, transplanted to point X on the map, not survive?

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[1 mark]

(ii) Why are there no Karri trees growing naturally in area Y?

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[1 mark]

(iii) Rabbits sometimes occur in the area marked Z, but generally disappear for lengthy periods (years). Why might this occur?

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[1 mark]

(iv) Rabbit populations have in the past reached plague proportions in southern areas of Australia. What effect is this likely to have on the environment in which this occurs?

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[2 marks]

8. (i) Using the human population of Australia as an example, explain how a declining birth rate and a declining death rate may impact on the age composition of the population over a number of years.

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[2 marks]

(ii) How is a high immigration rate likely to affect the age structure in Australia?

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[1 mark]

9. (i) What do biologists mean by the term “niche”?

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[2 marks]

(ii) Describe the niche of a:

(a) tree near a farm house.

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(b) kangaroo population living on the Darling Scarp.

[2 marks]

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[2 marks]

10. Describe and explain the likely outcome when feral foxes invade an environment occupied by native cats (or chuditches).

(i) in the short term.

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(ii) in the long term.

[2 marks]

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[2 marks]

11. (i) How might the composition of one human population differ from that of another human population?

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(ii) What causes these differences?

[1 mark]

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[2 marks]

(iii) Describe how similar differences could arise in plant populations.

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[1 mark]

(iv) Describe how the composition of a population affects its growth rate.

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[2 marks]

### SECTION 3 – EXTENDED ANSWER (20 MARKS)

1. (i) As a population grows, it generally starts slowly, moves into an exponential growth rate but then the population begins to plateau. Explain why these changes in the growth rate occur.

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[6 marks]

(ii) Describe how density-independent and density-dependent factors affect population growth.

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[6 marks]





## TRIAL TEST 5: ECOSYSTEM CHANGE

**Time allowed:** 60 minutes

**Total marks:** 100

**Section 1** – Multiple Choice

**Section 2** – Short Answer

**Section 3** – Short Answer

20 marks

60 marks

20 marks

### SECTION 1 – MULTIPLE CHOICE (20 MARKS)

1. A species which has a relatively higher than expected influence on the stability of an environment, although its numbers and biomass may be small is called:
  - (a) an index species.
  - (b) an apex predator.
  - (c) a primary consumer.
  - (d) a keystone species.
2. Frequent fires in bush areas which have not experienced many fires in the past are likely to:
  - (a) promote all the plant species reproduction and growth.
  - (b) inhibit some plants and promote others reproduction and growth.
  - (c) promote plant growth but inhibit animal populations.
  - (d) enrich the soil with added organic nutrients.
3. Which animal populations are likely to be affected most by a bush fire?
  - (a) mammals.
  - (b) soil microorganisms.
  - (c) birds.
  - (d) insects.
4. The intensity of a bush fire is **least** dependent on the:
  - (a) amount of organic matter or fuel load on the ground.
  - (b) weather conditions at the time of the fire.
  - (c) moisture content of the leaf litter on the ground.
  - (d) prevailing wind direction at the time of the fire.
5. The carrying capacity of an ecosystem is determined largely by:
  - (a) the number of plants growing.
  - (b) the type of animals present.
  - (c) the weather conditions at the time.
  - (d) the climate.
6. If an animal population reaches a magnitude that its environment cannot support the population generally:
  - (a) plateaus and remains constant.
  - (b) experiences a more gradual increase than expected.
  - (c) experiences a more gradual decline.
  - (d) declines often to numbers initially well below the carrying capacity.

7. If a jarrah forest is now not able to support the population of White-tailed Black cockatoos that it supported in the past, this may be because:
- (a) the birds have eaten most of the available food.
  - (b) nesting sites previously available to the cockatoos have been occupied by feral bees.
  - (c) climate change has changed the forest soil so that it has become less productive.
  - (d) the structure of the food webs in the forest has changed.
8. The removal of old “habitat trees” which have large hollow holes in their trunks from an Australian forest is likely to:
- (a) reduce the forest’s biodiversity.
  - (b) reduce the carrying capacity of the forest for cockatoos.
  - (c) reduce the carrying capacity of the forest for possums.
  - (d) all of the above.
9. Organisms that colonise a bare area of soil exposed by erosion are called:
- (a) pioneers.
  - (b) settlers.
  - (c) arrivals.
  - (d) colonisers.
10. The organisms that colonise an area first are likely to be:
- (a) secondary producers.
  - (b) plants.
  - (c) animals.
  - (d) microorganisms.
11. A volcanic island which emerges from the ocean and initially has no life at all on its surface is likely to undergo change due to:
- (a) changes in the atmospheric temperature.
  - (b) colonisation by birds.
  - (c) a combination of biotic and abiotic changes.
  - (d) colonisation by windblown seeds.
12. Spatial succession is what a biologist could measure by means of:
- (a) transects taken from the high water mark at the beach into the surrounding sand dunes.
  - (b) periodic records of quadrats in the same area in a forest conducted over a number of years.
  - (c) periodic records of quadrats in different areas in a forest conducted over a number of years.
  - (d) data collected from quadrats conducted over the area of a wheat crop.
13. Because *Banksia prionotes* flowers in late summer in the south-west of W.A. it is often the only source of nectar for the honey eaters at this time of the year. Through the year the honeyeaters are responsible for pollinating grevilleas and many other flowering plants. Snakes are frequent predators of the honey eaters, taking their eggs and chicks while in the nest.

The keystone species in this account is the:

- (a) banksia.
- (b) honeyeater.
- (c) grevillea.
- (d) snake.

14. The first plant organisms likely to colonise a rocky outcrop are:
- (a) grasses.
  - (b) mosses.
  - (c) lichens.
  - (d) ferns.
15. Larger vascular plants will not grow on exposed rocky outcrops until:
- (a) sufficient insects are available to pollinate their flowers.
  - (b) there is sufficient water to support their growth.
  - (c) there is enough leaf litter to keep the soil moist in summer.
  - (d) the depth of soil is sufficient for their roots.
16. Fires are believed to stimulate the flowering of grass trees and remove many of the parasites that infest the plants when their dead leaves accumulate under their living leaves. The dry dead leaves form what is known as a “skirt”. A solution to the problem of diseased grass trees that never flower in metropolitan areas may be to:
- (a) spray them with biodegradable insecticides on a regular basis.
  - (b) set fire to them when it is safe to do so.
  - (c) remove them from metropolitan areas.
  - (d) prune the skirt on a regular basis.
17. The presence of native pines, plants that have evolved in cold climates near the poles, on Rottneest Island near Perth, is evidence that:
- (a) conditions on the island have changed greatly in recent years.
  - (b) climatic conditions were much colder on Rottneest in the past.
  - (c) exotic plants are very adaptable.
  - (d) the climate on Rottneest is different to that of the mainland.
18. Pioneer plants change the abiotic environment in primary succession so that it becomes more suited to more complex plants because they:
- (a) contribute to the formation of soil.
  - (b) attract animals to the area.
  - (c) trap moisture for higher plants.
  - (d) form microclimates that make promote change.
19. The presence of particular organisms in sedimentary rock can provide evidence of the climate at the time the rock was formed. This can be useful in helping to:
- (a) determine how the rock was formed.
  - (b) measure the complexity of life in the past.
  - (c) estimate the abiotic changes that have occurred in the area.
  - (d) support the theory of evolution.
20. Sedimentary rock may contain a multitude of different pollen grains. These can be useful in determining:
- (a) how plants reproduced in the past.
  - (b) the biodiversity of vascular plants that lived in past ecosystems.
  - (c) angiosperm biodiversity at the time the rock was formed.
  - (d) how often plants flowered in the past.

## SECTION 2 – SHORT ANSWER (60 MARKS)

Answer each question in the space provided.

1. (i) There are many orchids which are dependent on particular insect species for their pollination. How might the disappearance of the insect species affect orchid populations?

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[2 marks]

- (ii) These two species, the orchid and the insect, are reliant on one another as the orchids provide the only food for the insect at certain times of the year. How do biologists describe their relationship?

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[1 mark]

- (iii) The insect species may pollinate many other flowering plants at times when the orchid is not flowering. How might the disappearance of the orchid species affect these other flowering plants?

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[2 marks]

- (iv) Why is the orchid species in this example called a keystone species?

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[2 marks]

2. A student placed batches of 10 healthy wattle seeds in hot water for varying times as shown in the table below. She removed them from the water, placed them on moist cotton wool in petri dishes and kept them all in a warm dark cupboard for 20 days. She recorded the number of seeds that had germinated on the days shown. The data collected is recorded in the table below.

TIME IN WATER (secs)	NUMBER OF WATTLE SEEDS	CUMULATIVE NUMBER OF SEEDS GERMINATED							
		Day							
		1	2	3	4	8	12	16	20
0	10	0	0	0	0	0	0	0	0
30	10	1	2	2	2	2	2	2	2
60	10	0	3	3	5	6	6	6	6
90	10	1	4	6	8	8	8	8	8
120	10	0	3	8	8	8	8	8	8
240	10	0	2	6	9	9	9	9	9

(i) Write the likely hypothesis that the student was testing.

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(ii) How could she improve the experiment? [2 marks]

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(iii) What conclusions can be drawn from the data she obtained?

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(iv) What relevance does this study have to wattles that germinate in their natural environment?

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(v) After a bush fire, wattles are frequently the first plants to begin to regrow in the area. Explain this observation.

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(vi) If the bush fire is not particularly severe or hot, why are wattles not the first plants to reappear?

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3. (i) What is meant by primary succession?

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(ii) Describe an example of primary succession.

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[2 marks]

(iii) What is meant by secondary succession?

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[2 marks]

(iv) Describe an example of secondary succession.

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[2 marks]

4. (i) Many native plants have lignotubers, these are swollen roots either partially or wholly beneath the surface of the ground. Describe how these may help a plant to survive a bush fire.

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[2 marks]

(ii) When a fire “destroys” an area of bush, it may change the biodiversity of the area. Describe what changes to the biodiversity may occur and explain why these changes come about.

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[3 marks]

5. What adaptations might the following native animals have to enable them to survive a bush fire?

(i) insects

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[2 marks]

(ii) reptiles

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[2 marks]

(iii) birds

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[2 marks]

(iv) mammals

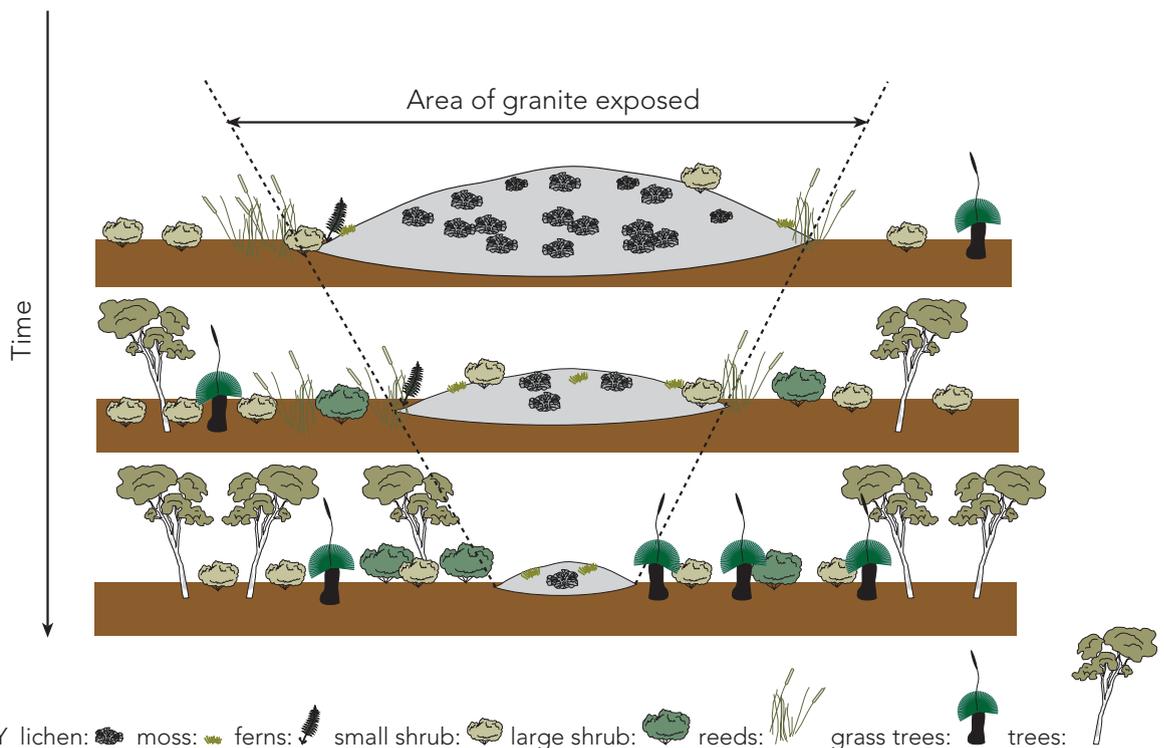
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[2 marks]

6. The questions that follow refer to the diagram of a section of a granite outcrop in the Jarrah forest that is shown below.



- (i) Explain why lichens are likely to be the first visible pioneers on the surface of the rock.

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[2 marks]

- (ii) Other microscopic organisms precede the lichens. What type of organisms are they? Why do they colonise the rock first?

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[2 marks]

- (iii) Describe how rapid temperature changes alter the surface of the rock.

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[2 marks]

- (iv) What role does water play in the transition of rock to soil in this succession?

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[3 marks]

- (v) Describe the succession of plants that is likely to follow the lichens.

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[2 marks]

- (vi) What factors could interrupt this succession? Explain.

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[2 marks]

- (vii) If the succession proceeds uninterrupted, a “climax community” may become established. What is a “climax community”?

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[2 marks]

- (viii) Describe briefly what the climax community is likely to consist of in the environment shown here.

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[2 marks]

- (ix) Explain why this example of succession is described as a ‘temporal’.

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[2 marks]

- (x) Why is the study of the process of succession important in conservation biology?

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[2 marks]







## TRIAL TEST 6: HUMAN ACTIVITIES, CONSERVATION AND PREDICTING ECOSYSTEM CHANGE

**Time allowed:** 60 minutes

**Total marks:** 100

**Section 1** – Multiple Choice

**Section 2** – Short Answer

**Section 3** – Short Answer

20 marks

60 marks

20 marks

### SECTION 1 – MULTIPLE CHOICE (20 MARKS)

- The introduction of cattle and sheep to a natural ecosystem in Australia is likely to:
  - reduce the abundance of plants in the area only.
  - reduce the abundance and biodiversity of plants in the area.
  - reduce the biodiversity of plants in the area only.
  - reduce the biodiversity of plants and other animals in the area.
- An agricultural ecosystem is likely to be less stable than a natural ecosystem. This is because:
  - natural ecosystems have a greater biodiversity than agricultural ecosystems.
  - disease is more likely in an agricultural ecosystem.
  - changes in the climate will not affect natural ecosystems.
  - agricultural ecosystems are not natural.
- The main cause of rising salinity levels in many areas of the wheat belt farming area in Western Australia has been:
  - the increased use of irrigation.
  - excessive use of fertilisers.
  - overgrazing of domestic animals.
  - overclearing of native plants.
- Increased algal growth may occur in a freshwater lake when the level of fertilisers in the lake rises (i.e. when eutrophication occurs). However, the algae and some other aquatic life often die shortly afterwards. The main reason for their death and decay is because:
  - the organisms lack sufficient oxygen for respiration.
  - there is insufficient carbon dioxide for photosynthesis.
  - the growth rate of the algae exceeds the rate that nutrients can be absorbed.
  - the increased carbon dioxide levels reduce the pH of the water (i.e. make the water acidic).

Study the table below before answering questions 5 and 6.

ORGANISM	CONCENTRATION OF A PESTICIDE (P.P.M.)
1	0.08
2	0.10
3	4
4	1

- Which is likely to represent the food chain from which this data was collected?
  - 1 → 2 → 3 → 4
  - 1 → 2 → 4 → 3
  - 3 → 4 → 2 → 1
  - 4 → 3 → 2 → 1

6. If a pesticide builds up in the body of an organism during its lifetime, this is called:
- (a) biomagnification.
  - (b) bioaccumulation.
  - (c) biodepletion.
  - (d) biotoxicity.
7. Which of the following adaptations is most likely to occur in an ecosystem that experiences frequent fires?
- (a) Plants that can store water in their leaves.
  - (b) Microorganisms that live close to the soil surface.
  - (c) Trees that have a thick bark.
  - (d) Leaves that curl as they lose excess water.
8. The harvesting of natural resources in a natural ecosystem may be considered ecologically sustainable if:
- (a) the organisms in the ecosystem can maintain viable populations.
  - (b) there is no output of organic matter from the ecosystem.
  - (c) no matter is lost or gained from the ecosystem.
  - (d) the ecosystem continues to recycle its energy.
9. The stability of an ecosystem is determined by:
- (a) how well it recovers from change in its abiotic or biotic factors.
  - (b) the biomass of its producers.
  - (c) the biomass of all its organisms.
  - (d) whether it is managed or natural.
10. Before European settlement, many Australian rivers could be described as oligotrophic, that is having little dissolved nutrients. This has changed in many areas because:
- (a) fertilisers have leached into waterways.
  - (b) salt has contaminated waterways.
  - (c) many trees and deep rooted plants have been cleared from water catchment areas.
  - (d) all of the above.
11. Habitat fragmentation caused by land clearing for agriculture results in small isolated pockets of remnant vegetation often designated as conservation areas. The organisms on these “islands” have limited opportunities to interbreed with their neighbours. This results in inbreeding and reduced variation within the populations.
- What is the main problem facing these populations?
- (a) a threat of extinction.
  - (b) a possibility that they will evolve into different species.
  - (c) limited food may result in population decline.
  - (d) useful adaptations will not be shared across the populations.
12. A practical though partial solution to this problem is to:
- (a) enlarge the size of these reserves.
  - (b) remove any organisms that show new useful adaptations.
  - (c) create corridors of protected vegetation that will enable interbreeding to occur.
  - (d) return all agricultural land to its original native state by replanting lost native vegetation.
13. A DNA profile may be most useful in conservation because it could be used to:
- (a) determine whether or not timber has been illegally logged.
  - (b) determine whether or not an animal is rare and endangered.
  - (c) find the source of plantation timber.
  - (d) identify the parents of an abandoned organism.

14. Seeds banks and captive breeding programs represent conservation which is:
- (a) in situ.
  - (b) extra environmental.
  - (c) extra situ.
  - (d) ex situ.
15. Desertification can be caused by all of the following except one. Which is **not** the cause?
- (a) overgrazing.
  - (b) overstocking.
  - (c) overcropping.
  - (d) overwatering.
16. To ensure that the best plants are reintroduced into an area to be restored it is most useful to know the:
- (a) genotypes of organisms that have evolved in the area.
  - (b) type of adaptation required to survive there.
  - (c) genotypes of animals that live in that area.
  - (d) phenotype of all the organisms that live in the area.
17. Where an environment is changing too quickly for a species to adapt naturally it may be necessary to:
- (a) introduce younger organisms into the area.
  - (b) develop new strains of the existing species.
  - (c) use biological control.
  - (d) create national parks.
18. Creating a protected area in order to conserve species represents what is commonly called:
- (a) an ecological strategy.
  - (b) a genetic strategy.
  - (c) a managerial strategy.
  - (d) an environmental strategy.
19. When cleared land is allowed to return to its natural state for conservation purposes, the best models of how the recovery should take place may be obtained from studies of:
- (a) succession.
  - (b) biodiversity.
  - (c) reforestation.
  - (d) regeneration.
20. Data collected from ecological surveys is reliable if:
- (a) many samples are randomly obtained.
  - (b) at least two results are almost identical.
  - (c) the observed results match the expected results.
  - (d) there is no error involved in the measuring instruments.

## SECTION 2 – SHORT ANSWER (60 MARKS)

Answer each question in the space provided.

1. Which gases are the main contributors to:

(i) climate change? \_\_\_\_\_

[1 mark]

(ii) ozone layer depletion? \_\_\_\_\_

[1 mark]

Name two processes which contribute towards each of the following:

(iii) climate change.

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(iv) ozone layer depletion.

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(v) desertification.

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[6 marks]

2. (i) Name two native animals which have a greatly reduced distribution as a result of European settlement.

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[1 mark]

(ii) Describe where their distribution has changed.

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[1 mark]

(iii) Name two feral animals which have become widely dispersed in Australia.

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(iv) Describe these feral animals' present distribution.

[1 mark]

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[2 marks]

3. (i) How does clearing land of trees affect the depth of the water table?

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(ii) Explain why this occurs. [2 marks]

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(iii) Why does this affect salt levels in the soil near the surface? [2 marks]

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(iv) How is the water in creeks and rivers affected by this change? [1 mark]

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(v) Discuss two ways in which this problem might be reduced. [1 mark]

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(vi) What would be the likely consequence of ignoring the salt problem in Australia? [2 marks]

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(vii) How might people who live in urban areas help to reduce this problem? [1 mark]

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4. Swamps in and around the metropolitan area have often in the past been filled with household and industrial wastes. They were then covered with sand and used for building developments or playing fields.

(i) How does filling the swamps with waste affect the ground water in the vicinity of the swamps?

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[2 marks]

(ii) How does this “reclaiming” of swampland affect native swamp communities?

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[2 marks]

(iii) What effects does this have on migratory and resident birds?

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[2 marks]

(iv) What are three benefits of retaining the lakes and swamps that remain?

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[3 marks]

5. (i) Outline an example of biological control used in Australia to reduce the population of an introduced feral animal

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[4 marks]

(ii) How successful was the example you have given? Explain.

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[2 marks]

(iii) Outline an example of biological control used in Australia to reduce the population of an introduced exotic plant.

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[4 marks]

(iv) Discuss how successful the example you have given was.

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[2 marks]

6. (i) Ozone depletion has had a number of causes. List three of the causes.

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[3 marks]

(ii) How does ozone depletion affect life on Earth?

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(iii) What measures have been taken to reduce the problem?

[2 marks]

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(iv) What type of conservation strategy are these measures?

[2 marks]

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[1 mark]

7. Describe how each of the following strategies can help to conserve native species

(i) Seed banks

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(ii) Captive breeding programs

[2 marks]

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[2 marks]



- (ii) Describe how two named introduced plant species which have become pests in Australia could be controlled.

[6 marks]

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- (iii) Discuss why the effective conservation of biodiversity within natural ecosystems is justified.

[4 marks]

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# TRIAL TEST 7: INQUIRY SKILLS AND HUMAN ENDEAVOUR 1



<b>Time allowed:</b> 60 minutes	<b>Section 1</b> – Multiple Choice	20 marks
<b>Total marks:</b> 100	<b>Section 2</b> – Short Answer	60 marks
	<b>Section 3</b> – Short Answer	20 marks

## SECTION 1 – MULTIPLE CHOICE (20 MARKS)

- The statement that “life exists on planets in distant galaxies” is:
  - an observation.
  - a hypothesis.
  - a theory.
  - none of the above.
- A “possible explanation of a problem” is properly called:
  - a hypothesis.
  - a theory.
  - a prediction.
  - an observation.
- Which of the following could be considered a scientific hypothesis?
  - the school’s cricket team is better than its football team.
  - brand ‘x’ pens last longer than brand ‘y’.
  - there is water on the driveway.
  - oranges taste better than apples.

Read the following paragraph and then answer questions 4-6 which follow it.

In order to test the effectiveness of a new fertiliser, a farmer divided a flat paddock into two halves. He added his new fertiliser to one half before planting his wheat seeds. No fertiliser was added to the other half before he planted seeds there. At harvest time he measured and compared the productivity of each half by measuring the number of standard bags of wheat obtained from each.

- In the above experiment the dependent variable was the:
  - area of each wheat crop.
  - type of wheat seed used.
  - wheat yield from each crop.
  - type of fertiliser used.
- The amount of fertiliser used on each crop is called the:
  - productivity.
  - output variable.
  - control variable.
  - independent variable.
- To improve the farmer’s experiment, which of the following would be most appropriate?
  - use a different fertiliser.
  - use a different wheat variety.
  - use more fertiliser.
  - use a larger paddock.

7. Which of the following indicates the normal order for a scientific study?
- data recorded, hypothesis made, problem recognised, conclusion made.
  - problem recognised, data recorded, hypothesis made, conclusion made.
  - problem recognised, hypothesis made, data recorded, conclusion made.
  - data recorded, hypothesis made, conclusion made.
8. A taxonomic key can be used to:
- open a new investigation.
  - classify an organism.
  - test a hypothesis.
  - identify a previously undiscovered species.
9. When using quadrats to study the distribution of a plant species in a given environment, it is important to place the quadrats:
- in those areas where the plants are known to occur.
  - randomly in the study area.
  - away from disturbed areas.
  - in a long line across the area.
10. It is important to check pit traps regularly because:
- it assists in obtaining accurate results.
  - it allows a better average count to be obtained.
  - it is more reliable and valid to do so.
  - it is more humane to do so.
11. If an experiment is carefully conducted a number of times, which aspect of the experiment is likely to improve? Its:
- reliability.
  - validity.
  - accuracy.
  - precision.
12. The underlying principle used in the capture-recapture method of estimating population size is that:
- the number of organisms tagged represents a particular proportion of the total population.
  - the number of organisms tagged must be about equal to the number of organisms re-captured.
  - no organisms can immigrate or emigrate from the area.
  - the population is constant.
13. If a scientist was to propose the hypothesis that UV radiation increases the level of vitamin D in the blood, a relevant prediction that could be made from this hypothesis is that:
- a person who lives in a cave and only emerges at night is likely to have high levels of vitamin D in her blood.
  - if a person has excess exposure to UV radiation, then she may develop skin cancer.
  - if a dark skinned person lives in a northern European country e.g. Denmark, she may have a vitamin D deficiency.
  - if a fair skinned person lives near the equator, she is likely to have high levels of vitamin D in her blood but may develop skin cancer.
14. Which of the following procedures would help to make an experiment valid?
- choose only healthy individuals for experiments.
  - use a control group.
  - use a small sample size.
  - repeat the same experiments many times.

15. The body that is responsible for listing the World Heritage Sites is:
- (a) WHO.
  - (b) UNESCO.
  - (c) OXFAM.
  - (d) NATO.
16. The main difficulty with the concept of a “keystone species” is:
- (a) a lack of an agreed definition of the term i.e. it means different things to different people.
  - (b) that there is no clear understanding of the term by most biologists.
  - (c) that there is disagreement over which species is a keystone species.
  - (d) all species in a food web are equally important.
17. A “biodiversity hotspot” is an environment in which:
- (a) the biodiversity is threatened by climate change.
  - (b) there is great biodiversity and many native species.
  - (c) many endemic species are seriously threatened by a range of factors.
  - (d) there is great biodiversity near the equator.
18. The main advantage of satellite sensing is that it can obtain data
- (a) quickly.
  - (b) accurately.
  - (c) reliably.
  - (d) cheaply.
19. International agreements are particularly important in the case of whale conservation because many whale species:
- (a) are seriously threatened with extinction.
  - (b) are large mammals with great intelligence.
  - (c) occupy international waters during much of their migration.
  - (d) cannot defend themselves against many predators.
20. Once an organism is classified and is assigned a genus and species name, it:
- (a) cannot be changed as its name will be recorded internationally.
  - (b) can be reclassified if something new is discovered about it.
  - (c) can be given a second name if an individual biologist finds a better name.
  - (d) may have its species name changed but not its genus name.

## SECTION 2 – SHORT ANSWER (60 MARKS)

Answer each question in the space provided.

1. In order to estimate the population of snails in their school’s vegetable garden a group of students collected 50 live snails from the garden and marked them with a non-toxic white paint. A white dot of paint was placed on the shell of each snail captured. They were then returned carefully to the garden.

Two weeks later the students spent 30 minutes capturing as many snails as they could in the garden. A total of 124 snails were found. Only 17 were marked with a white dot.

- (i) What method of estimating population size were the students using?

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[1 mark]

- (ii) Write the formula to estimate the snail population using this method. (Use a key to show what each letter means.)

[2 marks]

- (iii) Calculate the size of the population using the formula.

[2 marks]

- (iv) What errors could occur in this estimate?

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2. Define each of the following terms. [2 marks]

- (a) Observation

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- (b) Hypothesis

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- (c) Prediction

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- (d) Data

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- (e) Random

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(f) Quadrat

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(g) Variable

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(h) Sample

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---

(i) Replicate

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(j) Procedure

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[10 marks]

3. (i) Design an experiment to test the following hypothesis:

*“If peas are frozen immediately after picking they retain more vitamin C than peas that are kept at room temperature.”*

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[5 marks]

(ii) Name four variables which need to be controlled in your experiment.

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(iii) (a) What is the independent variable in this experiment? [2 marks]

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[1 mark]

(b) What is the dependent variable in this experiment?

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[1 mark]

(iv) (a) What results would support the hypothesis?

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[1 mark]

(b) What results would refute the hypothesis?

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[1 mark]

(v) What would make you more confident of your results?

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[1 mark]

4. The following diagrams show the average size of a beetle species over a number of weeks. (They are drawn to scale).

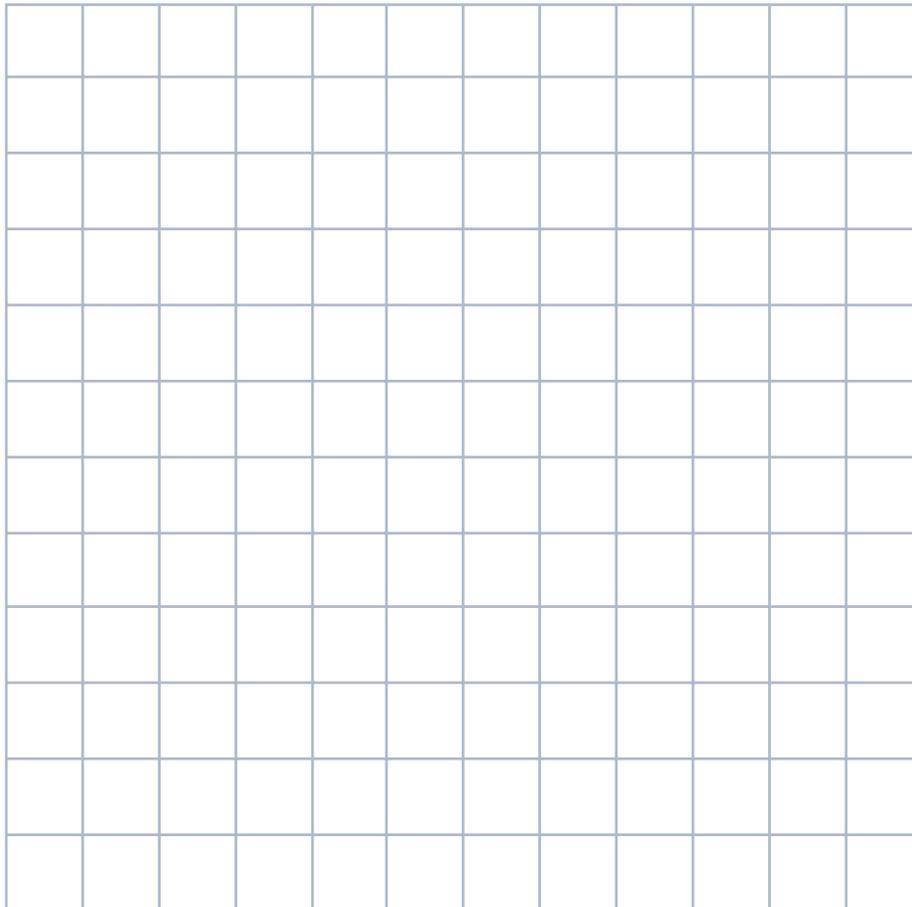


- (i) Construct a table to record the average length of the beetle over the period shown.

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[2 marks]

- (ii) Graph these results below:



[4 marks]

(iii) When collecting the data on the beetles' length, what measurement errors are likely to occur?

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(iv) How could these errors be reduced? [2 marks]

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(v) To become more confident of the reliability of the results, what further information is required? [2 marks]

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(vi) What is the relationship between the length of the beetles and their age? [1 mark]

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5. (i) Briefly describe an experiment that you have conducted (or read about) that required a risk assessment before it began. [1 mark]

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(ii) Outline the steps involved in carrying out the risk assessment. [3 marks]

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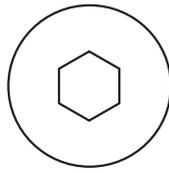
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[3 marks]

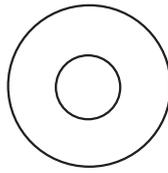
6. Use the diagrams below to construct a dichotomous key to classify these objects.



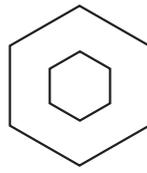
sibble



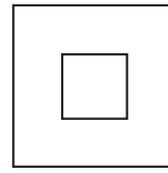
gromal



glunk



yobul



slunk

Use this space for your working out.

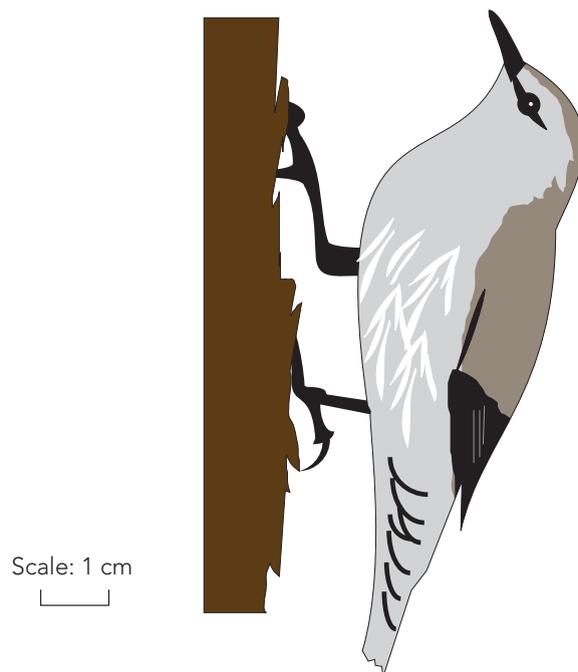
**KEY**


[4 marks]

7. Use the key below to classify the bird shown. Write your answers below.

**KEY**

1. a)	Small bird, less than 13 cms long	2
1. b)	Bird larger than 13 cms long	<i>Phaps elegans</i>
2. a)	Beak suited to nectar feeding	3
2. b)	Beak suited to seed cracking	<i>Melopsittacus undulatus</i>
3. a)	Colour of breast feathers similar shade to wings	<i>Miraфра javanica</i>
3. b)	Colour of breast feathers a lighter shade than wings	4
4. a)	Curved bill	<i>Phylidonyris novaehollandiae</i>
4. b)	Straight bill	<i>Climacteris picumnus</i>



(i) Bird Species

\_\_\_\_\_

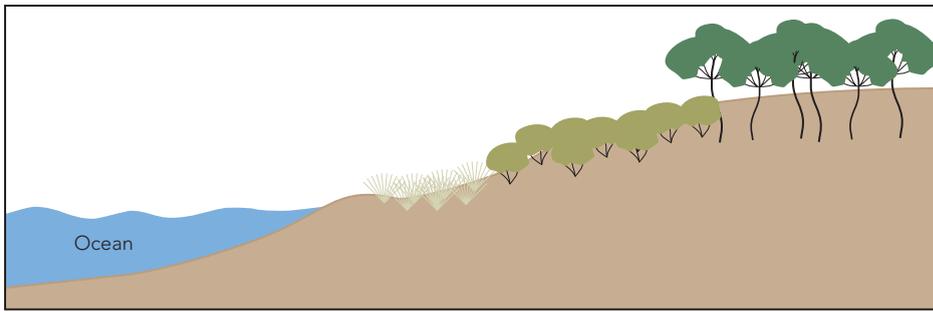
[1 mark]

(ii) Write the choices you made in arriving at your answer.

\_\_\_\_\_

\_\_\_\_\_

[2 marks]



8. The profile diagram above shows the distribution of some plants on the dunes close to the ocean.

(i) Describe how you might obtain the data necessary to draw such a profile.

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[2 marks]

(ii) Propose an hypothesis to explain why some plants do not grow closer than 50 metres to the ocean.

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[2 marks]

(iii) How could you test your hypothesis?

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[2 marks]



# TRIAL TEST 8: PROKARYOTIC AND EUKARYOTIC CELLS



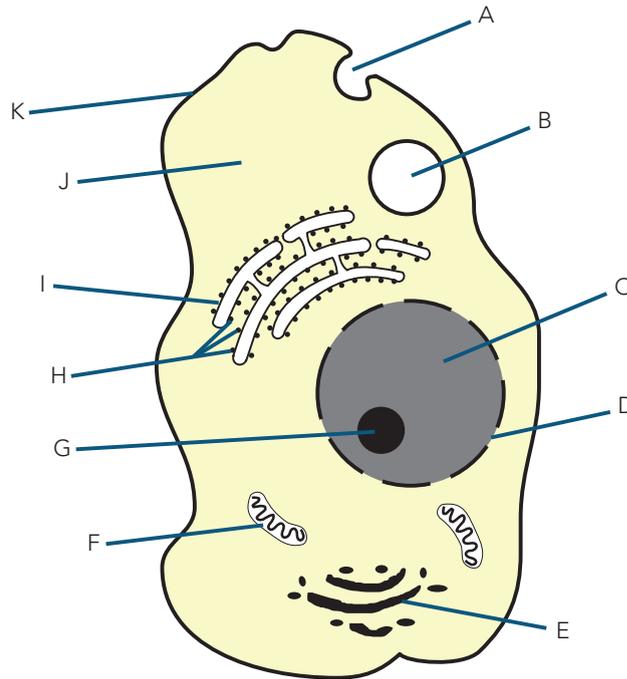
<b>Time allowed:</b> 60 minutes	<b>Section 1</b> – Multiple Choice	20 marks
<b>Total marks:</b> 100	<b>Section 2</b> – Short Answer	60 marks
	<b>Section 3</b> – Short Answer	20 marks

## SECTION 1 – MULTIPLE CHOICE (20 MARKS)

- Which of the following do plants need to take from their environment?
  - carbohydrates.
  - vitamins.
  - proteins.
  - nitrogen.
- Animals obtain their energy from the food they eat. Plants obtain their energy directly from:
  - the sun.
  - carbohydrates.
  - lipids.
  - heat.
- Animals need to remove metabolic wastes from their internal environment mainly because the wastes:
  - may accumulate.
  - may break down.
  - may become toxic.
  - add extra weight.
- Only one of the following correctly shows a word equation for aerobic respiration. Which one is it?
  - glucose + oxygen  $\rightarrow$  lactic acid + energy.
  - glucose + oxygen  $\rightarrow$  carbon dioxide + water + energy.
  - glucose  $\rightarrow$  ethanol + carbon dioxide + energy.
  - carbon dioxide + water + energy  $\rightarrow$  glucose + oxygen.
- Photosynthesis requires the absorption of energy from the environment. Respiration, however, involves:
  - the release of chemical energy to the environment.
  - the transfer of chemical energy from one chemical to another.
  - the release of some heat energy to the environment.
  - the conversion of heat energy to chemical energy.
- Which of the following compounds is made up of a long chain of monosaccharide molecules?
  - sugar.
  - protein.
  - lipid.
  - starch.

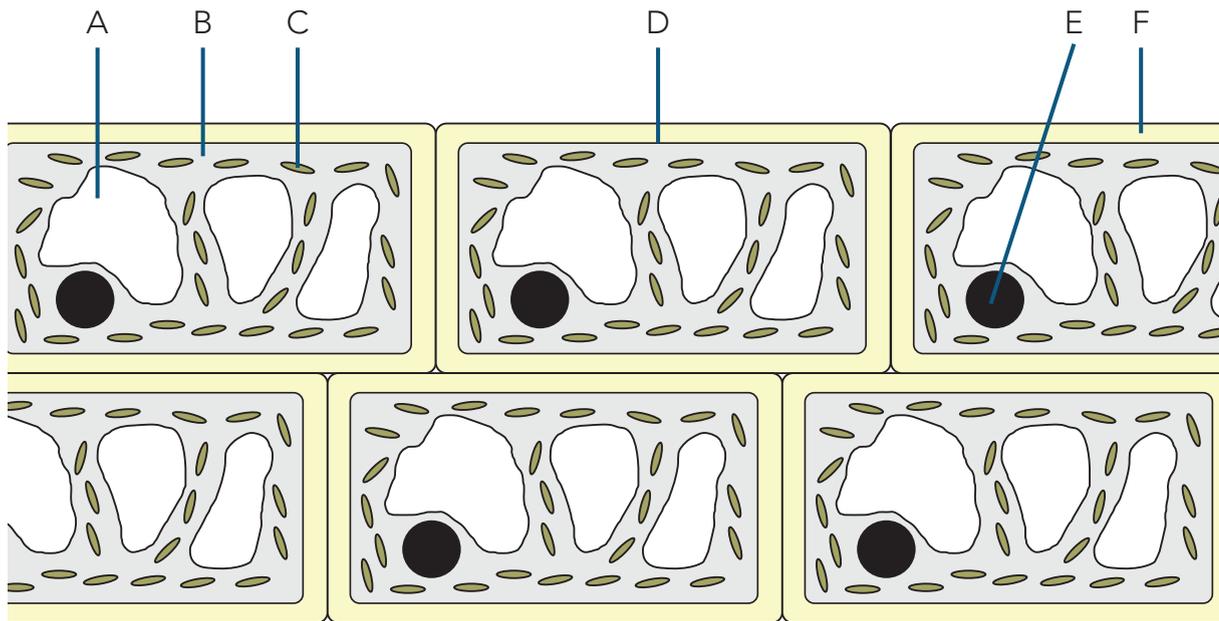
7. Thousands of proteins are found in living cells. Their main role in cells is to:
- provide energy.
  - provide structure and catalyse chemical reactions.
  - assist other chemicals to break down.
  - provide the physical structural components of membranes.

The diagram below shows detail of the main parts of an animal cell. Use the diagram to answer questions 8-11.



8. Which organelles are most directly involved in protein synthesis?
- K and B.
  - C and E.
  - E and F.
  - C and H.
9. The organelle which is essential for aerobic respiration is:
- I
  - F
  - G
  - B
10. Which two organelles are found in plant cells but are missing in this cell?
- endoplasmic reticula and ribosomes.
  - chloroplasts and cell wall.
  - cell membrane and Golgi body.
  - vacuoles and cell membrane.
11. The diagram is that of a eukaryotic cell because it:
- appears to contain membrane bound organelles.
  - is a bacterium.
  - contains chromosomes.
  - has a plasma membrane.
12. Prokaryotic cells include:
- algae and bacteria.
  - viruses and bacteria.
  - bacteria and cyanobacteria.
  - fungi and bacteria.

The diagram below shows a number of cells located in a leaf. Use this diagram to answer questions 13 and 14.



13. The presence of which organelles suggest that these are plant cells?
- organelles A and D.
  - organelles F and E.
  - organelles E and D.
  - organelles F and C.
14. Which organelle is likely to contain the highest proportion of water and minerals?
- A
  - B
  - E
  - F
15. The concentration of dissolved solutes in the external environment of a cell may be different from the concentration of these same solutes inside a cell.
- The concentration gradient is maintained directly by the cell's:
- nucleus.
  - plasma membrane.
  - cell wall.
  - mitochondria.
16. The cell's energy comes from:
- the building up of smaller molecules into larger molecules.
  - chemical reactions which change matter into energy.
  - changing chemical energy into potential energy.
  - changing chemical compounds into new chemical compounds that contain less energy.
17. Which of the following lists contains only nutrients?
- carbohydrates, hormones, proteins, lipids.
  - antibodies, carbohydrates, proteins.
  - proteins, carbohydrates, vitamins, mucus.
  - vitamins, proteins, carbohydrates, lipids.

18. Chemical tests show that a particular compound found in mitochondria can break down a carbohydrate into simple sugars and it can be broken down itself into amino acids. The compound is probably:
- (a) a hormone.
  - (b) a mineral.
  - (c) an enzyme.
  - (d) a vitamin.
19. Human sperm cells use a large amount of energy in swimming from the cervical region up into the uterine tube. These cells therefore would contain:
- (a) a large amount of sugar.
  - (b) many different vitamins.
  - (c) a large number of mitochondria.
  - (d) a large number of ribosomes.
20. The net effect of metabolism is to:
- (a) absorb heat energy.
  - (b) release energy as heat.
  - (c) convert light energy to chemical energy.
  - (d) convert small molecules into more complex molecules.

## SECTION 2 – SHORT ANSWER (60 MARKS)

Answer each question in the space provided.

1. Explain why a **heterotroph** requires each of the following.

- (i) organic compounds

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[1 mark]

- (ii) oxygen

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[1 mark]

- (iii) water

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[1 mark]

(iv) mineral ions

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[1 mark]

2. Explain why an **autotroph** requires each of the following.

(i) carbon dioxide

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[1 mark]

(ii) water

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---

[1 mark]

(iii) light energy

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---

[1 mark]

(iv) mineral ions

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[1 mark]

3. Why is it necessary for an animal to have some means of removing metabolic wastes from its internal environment?

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[2 marks]

4. The table below lists four cell organelles. For each describe its structure and functions and draw a simple image as it would be seen with the aid of an electron microscope.

ORGANELLE NAME	STRUCTURE	FUNCTIONS	DIAGRAM
plasma/cell membrane			
chloroplast			
mitochondrion			
nucleus			

[12 marks]

5. (i) Unlike plant cells, animal cells do not have cell walls. Explain what role the plant cell wall plays and why animal cells do not need this organelle.

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[4 marks]

- (ii) Unlike plant cells, animal cells do not have chloroplasts. Explain why animal cells do not need chloroplasts.

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[2 marks]

6. (i) How are prokaryotic cells different from eukaryotic cells?

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[3 marks]

(ii) What do eukaryotes and prokaryotes have in common?

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[3 marks]

(iii) Which organelles in eukaryotic cells resemble prokaryotic cells?

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[2 marks]

(iv) Describe how these two organelles found in eukaryotic cells are similar to prokaryotic cells.

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[4 marks]

(v) What is the significance of these observations?

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[2 marks]

7. As they mature, red blood cells lose their nuclei and consequently room is made available in their cell cytoplasm for more haemoglobin. Explain why red blood cells therefore have a limited life span. They only last on average 120 days.

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[2 marks]

8. A cell appears in the field of view of a microscope as shown in figure 1. Using the same microscope a piece of mm graph paper looks like figure 2.

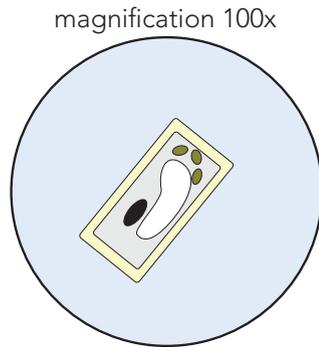


Figure 1

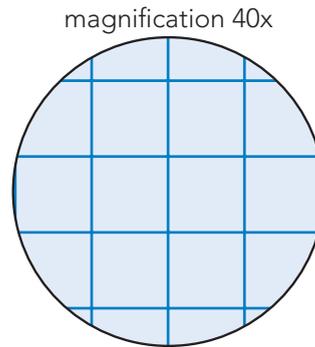


Figure 2

- (i) What is the diameter of the field of view when using each of the two magnifications?

a)  $40 \times$  \_\_\_\_\_ mm or \_\_\_\_\_  $\mu\text{m}$

b)  $100 \times$  \_\_\_\_\_ mm or \_\_\_\_\_  $\mu\text{m}$

[2 marks]

- (ii) What is the length and breadth of this cell?

a) length \_\_\_\_\_  $\mu\text{m}$

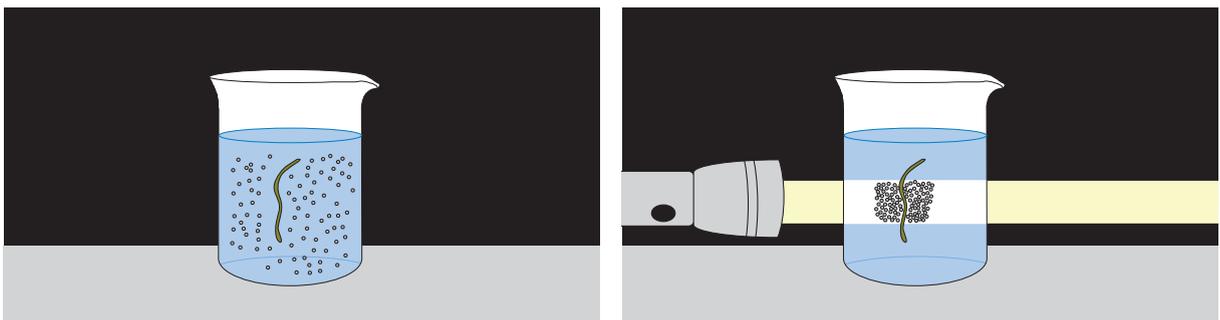
b) breadth \_\_\_\_\_  $\mu\text{m}$

[1 mark]

- (iii) How many cells could fit side by side across the field of view with the  $40 \times$  magnification?

[1 mark]

9. Imagine a population of bacteria in a beaker of water with a single strand of filamentous alga in a darkened room. A light shines through the beaker and illuminates part of the alga. The bacteria shortly afterwards accumulate around the filament as shown.



- (i) To what stimulus are the bacteria responding?

[1 mark]

(ii) What is the bacteria's response?

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[1 mark]

(iii) How might the bacteria move toward the alga?

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[1 mark]

(iv) In their natural habitat, where are these bacteria likely to live?

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[1 mark]

10. (i) What is meant by the term metabolism?

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[2 marks]

(ii) What is an anabolic reaction?

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[1 mark]

(iii) Does an anabolic reaction require an input of energy? Explain.

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[2 marks]

(iv) What is a catabolic reaction?

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[1 mark]

(v) Does a catabolic reaction require an input of energy? Explain.

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[2 marks]



# TRIAL TEST 9: CELL MEMBRANES



Time allowed: 60 minutes  
Total marks: 100

Section 1 – Multiple Choice  
Section 2 – Short Answer  
Section 3 – Short Answer

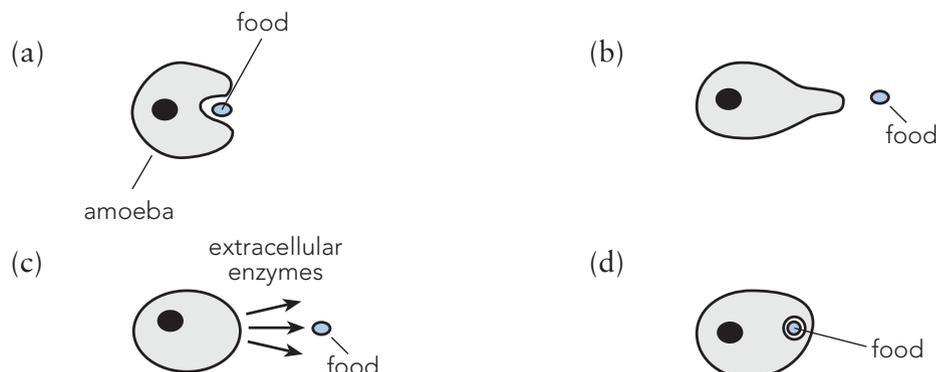
20 marks  
60 marks  
20 marks

## SECTION 1 – MULTIPLE CHOICE (20 MARKS)

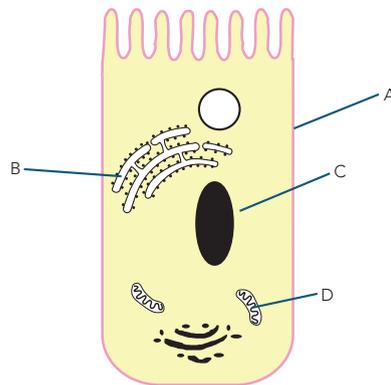
- A good definition of osmosis is:
  - the movement of dissolved particles from an area of high concentration to an area of low concentration.
  - the movement of a solvent from an area of high solute concentration to an area of low solute concentration.
  - the movement of a solute through a selectively-permeable membrane.
  - the diffusion of a solvent through a selectively-permeable membrane.
- Diffusion and osmosis are regarded as passive processes because both:
  - are energy efficient processes.
  - use glucose as a source of energy.
  - do not rely on an external source of energy.
  - are naturally occurring processes within cells.
- Potato tissue cut into cylinders and placed in distilled water is likely to:
  - shrink as minerals from the potato cells diffuse into the surrounding distilled water.
  - enlarge as water moves by osmosis into the potato cells.
  - become flaccid as water leaves the tissue and moves into the surrounding distilled water.
  - remain unchanged as the surrounding water is of a similar concentration to the cytoplasm of the cells.
- The concentration of dissolved solutes in the external environment of a cell may be different from the concentration of these same solutes inside a cell.

This concentration gradient is maintained directly by the cell's:

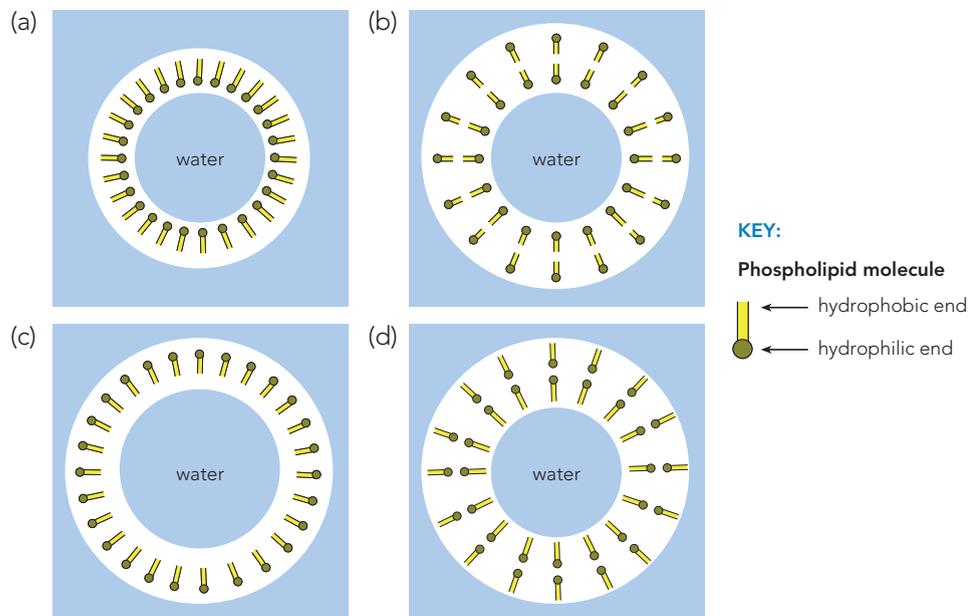
- nucleus.
  - plasma membrane.
  - cell wall.
  - mitochondria.
- An amoeba is capable of ingesting **solid** food particles in its watery environment. The process in which this could happen can be represented by:



6. Cell membranes are mainly composed of:
- proteins.
  - carbohydrates.
  - lipids.
  - enzymes.
7. The most important difference between diffusion through a membrane and facilitated diffusion is that in facilitated diffusion:
- a protein carrier molecule is involved.
  - no input of energy from ATP is required.
  - small fat soluble molecules are transported.
  - only the movement of molecules out of the cell occurs.
8. Which labeled structure on the cell below is the site of active transport?



- A
  - B
  - C
  - D
9. The function of the cell's microvilli is to:
- increase the surface area of the cell for absorption.
  - enable extra storage within the cell cytoplasm.
  - provide a surface to join to other similar cells.
  - increase the volume of the cell for efficiency.
10. If a phospholipid molecule can be represented as shown below (see key), which diagram shows the likely arrangement of phospholipid molecules around a drop of water in a water bath?

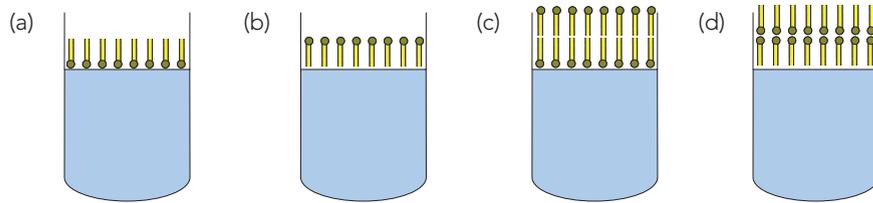


- A
- B
- C
- D

11. Which of the diagrams in question 10 most closely represents a cell membrane?

- (a) A      (b) B      (c) C      (d) D

12. A lipid which is less dense than water floats on the surface of the water. Which of the following would most closely resemble a film of this lipid floating on water?



- (a) A      (b) B      (c) C      (d) D

13. The currently accepted model of the cell membrane is the fluid mosaic model. The reason for the development of this particular model by scientists is that:

- (a) it makes the actual structure more easily understood.  
(b) it cannot be observed clearly even with an electron microscope.  
(c) scientists cannot agree on its actual structure.  
(d) it makes complex concepts easier to explain.

14. Alcohol passes readily through a cell membrane because it:

- (a) is small enough to squeeze between the membranes molecules.  
(b) is soluble in water.  
(c) dissolves lipids.  
(d) is more concentrated on the outside of the cell than on the inside.

15. Which of the following compounds are found in cell membranes?

- (a) lipids, proteins and carbohydrates.  
(b) lipids, proteins and minerals.  
(c) proteins, vitamins and carbohydrates.  
(d) lipids, nucleic acids and carbohydrates.

16. A large droplet of oil that is absorbed by a cell is likely to be taken in by:

- (a) active transport.  
(b) facilitated diffusion.  
(c) endocytosis.  
(d) pinocytosis.

17. Which of the following is absorbed by facilitated diffusion when its concentration outside the cell is greater than it is inside?

- (a) water.  
(b) sodium ions.  
(c) detergent.  
(d) glucose.

18. When a cell divides the daughter cells will have the advantage in terms of growth of:

- (a) an increase in volume to surface area ratio.  
(b) a decrease in surface area to volume ratio.  
(c) a decrease in total surface area.  
(d) an increase in surface area to volume ratio.

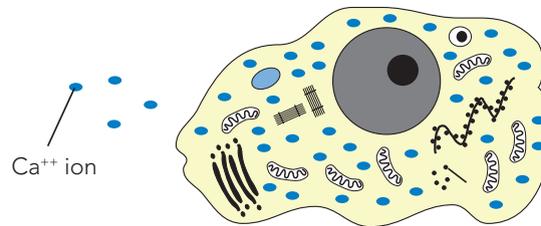
19. The advantage referred to in question 18 relates to the daughter cells capacity to

- (a) absorb nutrients more rapidly from their surroundings.  
(b) absorb nutrients more rapidly per unit of their volume.  
(c) absorb nutrients and remove wastes more rapidly.  
(d) absorb nutrients and remove wastes more rapidly per unit of their volume.

20. Gases must move through cell membranes to support metabolic processes. A plant cell that is undergoing photosynthesis in strong sunlight is likely to have the following exchange of gases occurring across its cell membrane:
- oxygen moving into the intracellular fluid, carbon dioxide moving into the extracellular fluid.
  - carbon dioxide moving into the intracellular fluid, oxygen moving into the extracellular fluid.
  - both carbon dioxide and oxygen moving into the intracellular fluid.
  - both carbon dioxide and oxygen moving into the extracellular fluid.

## SECTION 2 – SHORT ANSWER (60 MARKS)

Answer each question in the space provided.



1. If the amoeba cell is surrounded by an extracellular fluid containing very few calcium ions (as shown), a mineral it requires:

- (i) How might the amoeba obtain calcium ions against the concentration gradient?

\_\_\_\_\_

[1 mark]

- (ii) Since this is not a passive process, what compound supplies the energy needed?

\_\_\_\_\_

[1 mark]

- (iii) Write a word equation to show how the energy is supplied by this compound.

\_\_\_\_\_

[1 mark]

- (iv) Name three other processes for which the amoeba may need the compound as a source of energy.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

[3 marks]

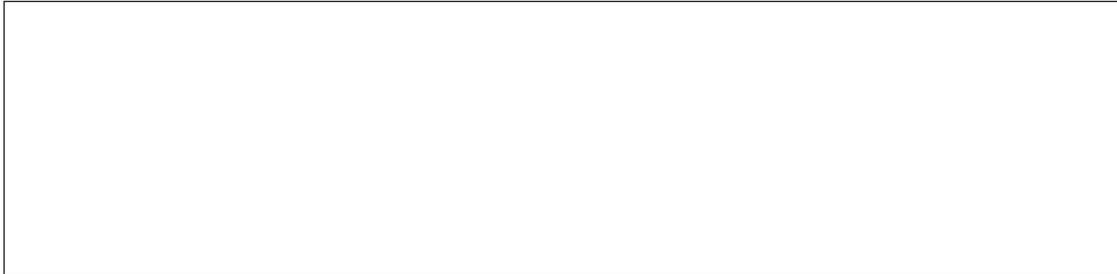
2. (i) What happens to the surface (spacing) area : volume ratio of a particular cell as it grows?

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[1 mark]

- (ii) Illustrate your answer using a cube of dimensions of one cm and a cube of two cm. Show their respective SA : Vol ratios below a diagram of each cube.

[4 marks]



- (iii) How might an increase in size of a cell affect its survival? Explain your answer.

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---

[2 marks]

3. (i) Draw a diagram of a microscopic section of a cell (plasma) membrane.



Label the following: phospholipids (hydrophobic and hydrophilic ends), protein, extracellular fluid, intracellular fluid, glycolipid, glycoprotein

[10 marks]

- (ii) Why is this called the fluid mosaic model of the cell membrane?

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[3 marks]

(iii) The model explains why some substances pass through the membrane while others do not. Use the model to explain briefly why each of the following types of substance passes through the membrane.

(a) fat soluble

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(b) small uncharged atoms

---

(c) water

---

[3 marks]

(vi) Explain why not all proteins are likely to pass through a membrane easily.

---

[1 mark]

4. Particles move into cells through the cell membrane by active processes and passive diffusion. In the table below list those processes that are passive and those that are active.

PASSIVE	ACTIVE

[6 marks]

5. Study the two diagrams below and answer the questions that follow them.

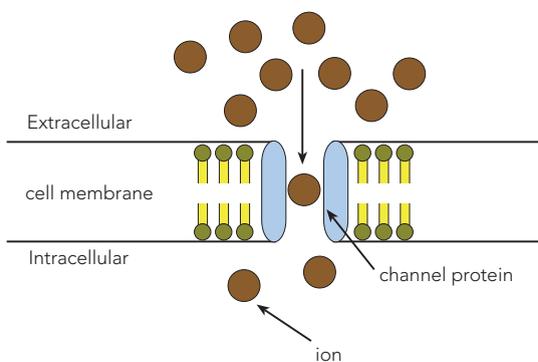


figure 1

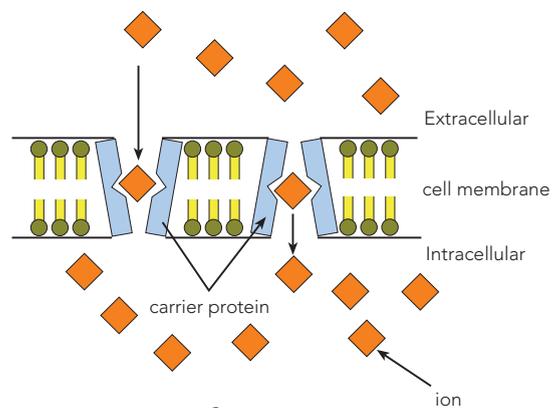


figure 2

(i) Why is the particle moving into the intracellular area in figure 1?

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[1 mark]

(ii) How are these particles allowed to move through the membrane?

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[2 marks]

(iii) What is this process called? \_\_\_\_\_

[1 mark]

(iv) If the process continues equilibrium may be reached. What does this mean?

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[2 marks]

(v) In what circumstance might equilibrium not be reached in a living cell that is metabolising normally?

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[2 marks]

(vi) How does this second situation (figure 2) differ from the first (figure 1)?

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[3 marks]

(vii) Name the process that is occurring in the second situation.

---

[1 mark]

6. When a cell engulfs an oil droplet a vacuole is formed.

(i) Draw a series of simple labeled sketches to show this process as it occurs.



[3 marks]

(ii) What is this process called?

\_\_\_\_\_

[1 mark]

(iii) Describe the structure of the vacuole's membrane.

\_\_\_\_\_

\_\_\_\_\_

[2 marks]

(iv) If the cell were to engulf another smaller cell, would the membrane be the same? Explain using a simple diagram.



[3 marks]

7. Name three factors that affect the exchange of materials across cell membranes.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

[3 marks]





## TRIAL TEST 10: BIOCHEMICAL PROCESSES AND ENZYMES

**Time allowed: 60 minutes**

**Total marks: 100**

**Section 1 – Multiple Choice**

**Section 2 – Short Answer**

**Section 3 – Short Answer**

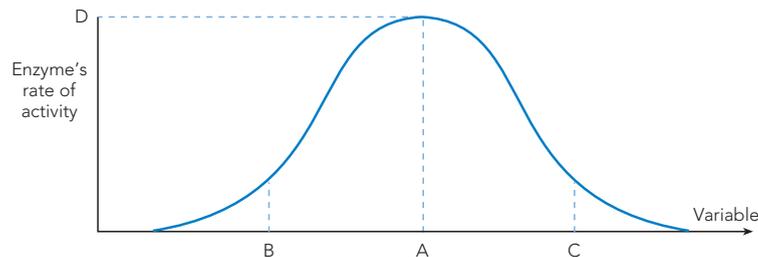
20 marks

60 marks

20 marks

### SECTION 1 – MULTIPLE CHOICE (20 MARKS)

- A living cell will function within a narrow temperature range. The range of conditions between which it can live is called its:
  - optimum range.
  - range of tolerance.
  - range of fluctuation.
  - limits of fluctuation.
- Any enzyme within an organism's cells is sensitive to changes. This is represented in the following graph. The X axis could represent any one of several variables.



- The optimum conditions for these cells is shown at point:
- A
  - B
  - C
  - D
- Glycogen, a complex carbohydrate, is synthesised from smaller molecules called
    - amino acids.
    - fatty acids.
    - monosaccharides.
    - nucleic acids.
  - Haemoglobin, a protein molecule synthesised within the human body is made up of a long chain of:
    - amino acids.
    - fatty acids.
    - monosaccharides.
    - nucleic acids.
  - Lipids which are stored in adipose tissue within the human body are composed largely of:
    - amino acids.
    - fatty acids.
    - monosaccharides.
    - nucleic acids.

6. Nucleotides are the basic building blocks of:
- proteins.
  - lipids.
  - carbohydrates.
  - nucleic acids.
7. A competitive inhibitor is a chemical that:
- occupies the active site of an enzyme preventing the substrate from entering the enzyme.
  - attaches to the substrate preventing it from entering the enzyme.
  - pushes the enzyme away from the substrate.
  - forms a link between the enzyme and the substrate.
8. A non-competitive inhibitor is a chemical that changes:
- the substrate's normal shape.
  - the enzyme into a shape that suits the substrate.
  - the enzyme into a shape that no longer fits the substrate.
  - the shape of the enzyme so that it is denatured.
9. Enzymes catalyse specific chemical reactions by:
- increasing the speed of the reacting particles.
  - removing the final products rapidly.
  - increasing the concentration of the reactants.
  - lowering the activation energy.
10. In living cells enzymes provide a benefit in that:
- no energy input is required to start the reactions.
  - less heat energy is given out by catabolic reactions.
  - more energy is absorbed in anabolic reactions.
  - less heat energy is needed to initiate reactions.
11. The chloroplast in a plant cell is the site of photosynthesis. The glucose which is formed is converted to a disaccharide called sucrose for transport to other parts of the plant. The consequence of allowing glucose to build up or accumulate in the chloroplast would be:
- a slowing down in the production of glucose.
  - more light would be required for photosynthesis to occur.
  - more water would be needed for the rate of photosynthesis to be maintained.
  - an increase in the rate of sucrose production.
12. When the sucrose produced in photosynthesis reaches its storage tissue in the plant it is converted into a long chained polymer called:
- protein.
  - starch.
  - amino acid.
  - cellulose.
13. Glycogen is a carbohydrate polymer which is formed and stored in the liver and muscles of animals. The monomer which makes up glycogen is:
- fatty acid.
  - amino acid.
  - sucrose.
  - glucose.

14. The property of enzymes that describes their capacity to catalyse a particular reaction is called its:
- (a) particularity.
  - (b) selectivity.
  - (c) specificity.
  - (d) activity.
15. Which of the following organelles both have an internal and an external membrane layer?
- (a) mitochondrion and Golgi body.
  - (b) chloroplast and mitochondrion.
  - (c) Golgi body and chloroplast.
  - (d) plasma membrane and mitochondrion.
16. Glycerol is part of the molecular structure of:
- (a) proteins.
  - (b) lipids.
  - (c) carbohydrates.
  - (d) nucleic acids.
17. In order to synthesise proteins from their monomers energy is provided by:
- (a) heat in the cytoplasm.
  - (b) ADP and P molecules.
  - (c) ATP molecules.
  - (d) activation energy.
18. Protein synthesis requires energy because it is:
- (a) a catastrophic reaction.
  - (b) an anabolic reaction.
  - (c) a catabolic reaction.
  - (d) an exothermic reaction.
19. Which is the correct order of ascending size?
- (a) polypeptide – peptide – amino acid
  - (b) polypeptide – amino acid – peptide
  - (c) amino acid – peptide – polypeptide
  - (d) peptide – amino acid – polypeptide
20. Which of the following lists contains a term that does not belong with the other two terms?
- (a) monosaccharide, disaccharide, polysaccharide.
  - (b) lipid, oil, phospholipid.
  - (c) protein, amino acid, polymer.
  - (d) sugar, starch, glycogen.



## SECTION 2 – SHORT ANSWER (60 MARKS)

Answer each question in the space provided.

1. (i) List three cellular uses of proteins.

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---

[3 marks]

- (ii) Describe the structural differences between different proteins.

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[4 marks]

2. Discuss how enzyme function is affected by each of the following:

- (i) pH

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- (ii) temperature

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- (iii) presence of inhibitors

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- (iv) co-enzymes and co-factors

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(v) concentration of reactants

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(vi) concentration of products

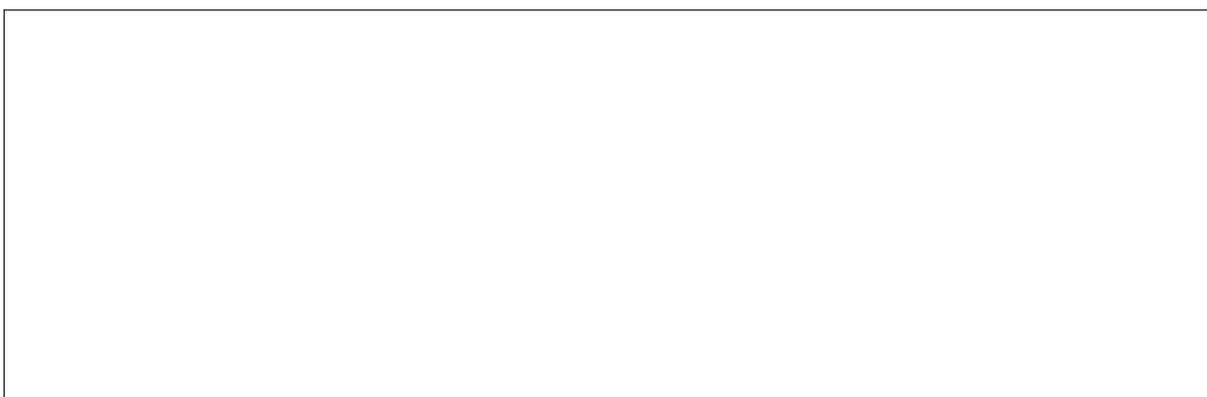
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[18 marks]

3. (i) Draw a simple labeled diagram of a mitochondrion in the space below.



[3 marks]

(ii) What is the function of a mitochondrion?

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[2 marks]

(iii) Describe how the inner membrane is different to the outer membrane.

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[2 marks]

(iv) How does this membrane arrangement assist the organelle in carrying out its function?

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---

[2 marks]

- (v) What is the advantage of having the metabolic processes that occur within the mitochondrion isolated from the cytoplasm outside it?

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[3 marks]

4. (i) Describe the endoplasmic reticulum in a typical cell.

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[3 marks]

- (ii) Why are ribosomes frequently located on the endoplasmic reticulum?

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[2 marks]

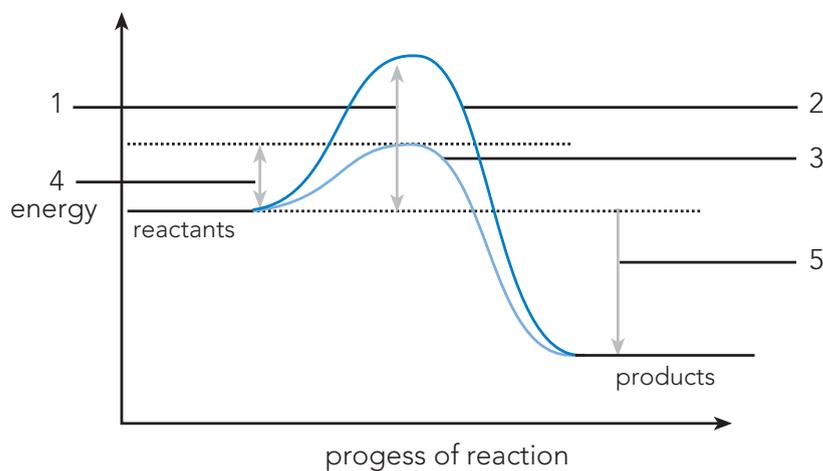
- (iii) Of what value to the cell is having this arrangement of rough endoplasmic reticular?

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[2 marks]

5. Enzymes are known to lower the activation energy required by a reaction. This is shown in the graph below.



- (i) Use the label lines (1–5) to label this graph with the following:
- A. Catalysed reaction (with enzyme)
  - B. Uncatalysed reaction (without enzyme)
  - C. Overall energy change of reaction
  - D. Activation energy of catalysed reaction
  - E. Activation energy of uncatalysed reaction.

[5 marks]

(ii) Is the example shown a catabolic or an anabolic reaction? Explain your answer.

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[3 marks]

(iii) Enzymes are only required in very small concentrations. Explain.

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[2 marks]

(iv) Explain what is meant by an enzyme's:

(a) primary structure

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[2 marks]

(b) secondary structure

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(c) tertiary structure

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[2 marks]





# TRIAL TEST 11: PHOTOSYNTHESIS AND CELLULAR RESPIRATION



Time allowed: 60 minutes

Total marks: 100

Section 1 – Multiple Choice

Section 2 – Short Answer

Section 3 – Short Answer

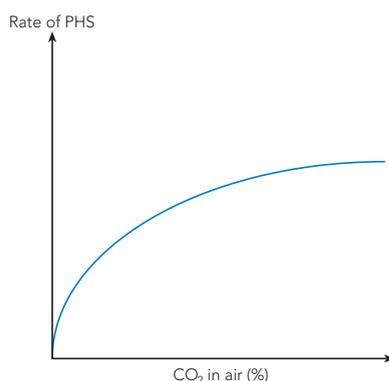
20 marks

60 marks

20 marks

## SECTION 1 – MULTIPLE CHOICE (20 MARKS)

1. The graph below shows the results of an experiment designed to investigate factors affecting the rate of photosynthesis.



The best interpretation of the graph is that:

- (a) the level of  $\text{CO}_2$  in the air is determined by the rate of photosynthesis.
  - (b) the percentage of  $\text{CO}_2$  in the air is not the only factor which determines the rate of photosynthesis.
  - (c) photosynthesis will not occur above a certain temperature.
  - (d) the rate of photosynthesis ceases to increase above a particular percentage of  $\text{CO}_2$  in air.
2. A simple word equation for photosynthesis can be written as shown below:

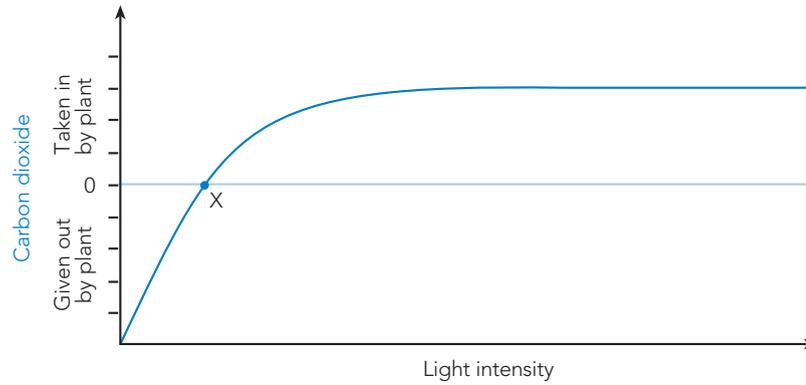


The role of the chlorophyll is to:

- (a) trap light energy and pass this energy on to ADP and P.
  - (b) trap energy in the form of ATP.
  - (c) act as an enzyme in the conversion of the reactants to the products of photosynthesis.
  - (d) transfer energy from the carbon dioxide and water to the glucose and oxygen.
3. Which of the following is a correct comparison?

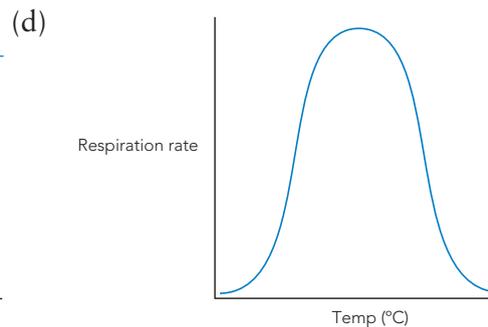
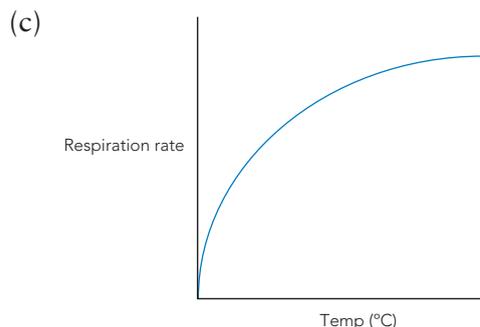
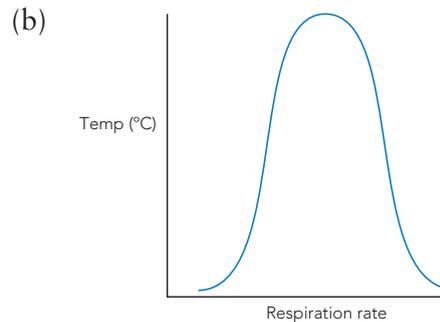
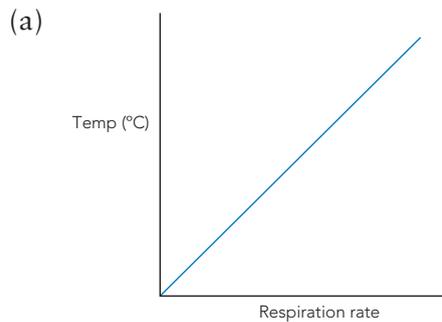
	Photosynthesis	Respiration
(a)	Is an anabolic process	Is a catabolic process
(b)	Releases energy	Requires energy
(c)	Proceeds rapidly all the time	Proceeds slowly only some of the time
(d)	Only occurs in chloroplasts	Only occurs in mitochondria

4. The graph below shows how the exchange of carbon dioxide between a plant and the air around it changes with light intensity.



From the graph, it would be reasonable to assume that at point X the rate of:

- (a) photosynthesis exceeds the rate of respiration.  
 (b) the light intensity is too low to promote photosynthesis.  
 (c) the rate of respiration exceeds the rate of photosynthesis.  
 (d) the rate of respiration and the rate of photosynthesis are the same.
5. Which of the following comparisons is valid?
- | <b>Anaerobic Respiration</b>        | <b>Aerobic Respiration</b>               |
|-------------------------------------|--|
| (a) Results in pyruvate             | Results only in carbon dioxide and water |
| (b) Occurs only in plants           | Occurs only in animals                   |
| (c) Requires no oxygen              | Requires oxygen                          |
| (d) Occurs only in the mitochondria | Occurs only in the cytoplasm             |
6. Which of the graphs below most closely represents the effect of temperature on the rate of respiration in living cells:



7. Respiration and photosynthesis are similar in that both:
- (a) require many enzymes in order to proceed.  
 (b) release energy for cellular activities.  
 (c) release carbon dioxide to the atmosphere.  
 (d) produce chemical products which are more complex than the reactants.

8. The chemical equation for photosynthesis can be written as shown below:

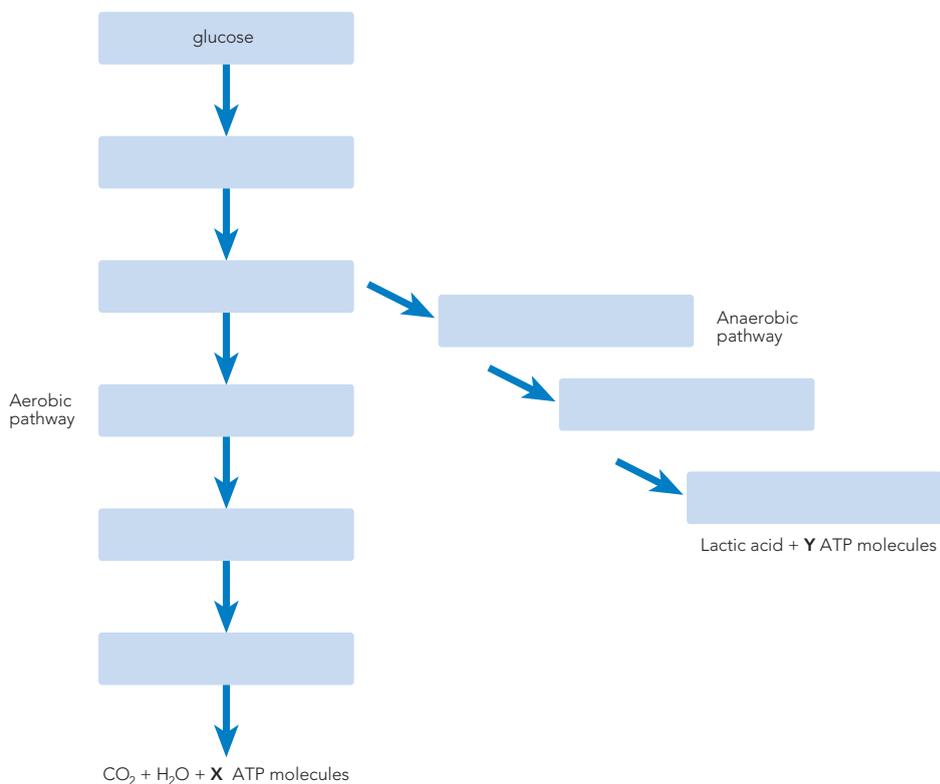


The \* indicates radioactive oxygen

A reasonable interpretation from this information is that:

- (a) the hydrogen and the oxygen in the water become part of the glucose.
- (b) the carbon in the carbon dioxide becomes part of the glucose and the oxygen in the carbon dioxide is released as oxygen gas.
- (c) no oxygen from the carbon dioxide is used to produce the oxygen gas.
- (d) only half of the oxygen in the oxygen gas that is produced, comes from the water.

The diagram below represents the series of chemical changes that occur in aerobic and anaerobic respiration:



Use these diagrams to answer the following four questions (9 to 12).

9. If **one** molecule of glucose was respired, the values for X and Y respectively could be:

- (a) 1 and 36.
- (b) 36 and 1.
- (c) 36 and 2.
- (d) 2 and 36.

10. Both pathways shown could occur in the cells of:

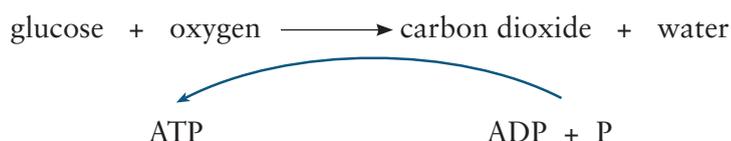
- (a) any two plants.
- (b) either a plant or an animal.
- (c) a plant only.
- (d) an animal only.

11. The processes in both pathways are controlled by enzymes. Therefore the rates at which both occur depend on:

- (a) the temperature in the cells.
- (b) both the temperature and the pH in the cells.
- (c) only the pH in the cells.
- (d) the available oxygen.

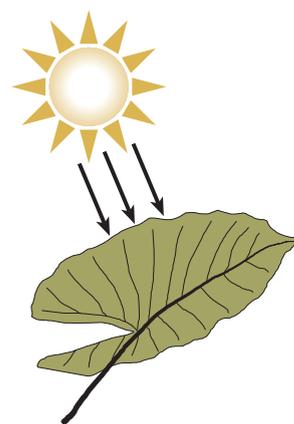
12. If oxygen is not available in a plant cell, the product/s would be:
- carbon dioxide and water.
  - lactic acid.
  - alcohol and carbon dioxide.
  - alcohol, carbon dioxide and ATP.

When glucose is respired aerobically and ATP is formed, the energy relationship between the two reactions can be shown as:



Use this to answer questions 13 – 15.

13. The diagram indicates that as chemical energy is released from the glucose molecule:
- ADP + P are formed.
  - ATP absorbs the energy.
  - ADP + P release ATP.
  - ADP + P absorb the energy.
14. Not all the energy in the glucose is transferred. Some of the energy:
- remains in the products and some is lost as heat.
  - forms heat and light.
  - is absorbed by the mitochondria.
  - is actively transported from the cell.
15. The ATP that is formed is used as an energy store and can be used by the cell in many processes. Which of the following lists contains only processes which use ATP as a source of energy?
- cell division, protein synthesis and diffusion.
  - cell division, osmosis and photosynthesis.
  - protein synthesis and osmosis.
  - protein synthesis and active transport.
16. The rate of photosynthesis is most affected by:
- light intensity, carbon dioxide and temperature.
  - light intensity, oxygen and temperature.
  - oxygen, carbon dioxide and light intensity.
  - carbon dioxide, temperature and oxygen.



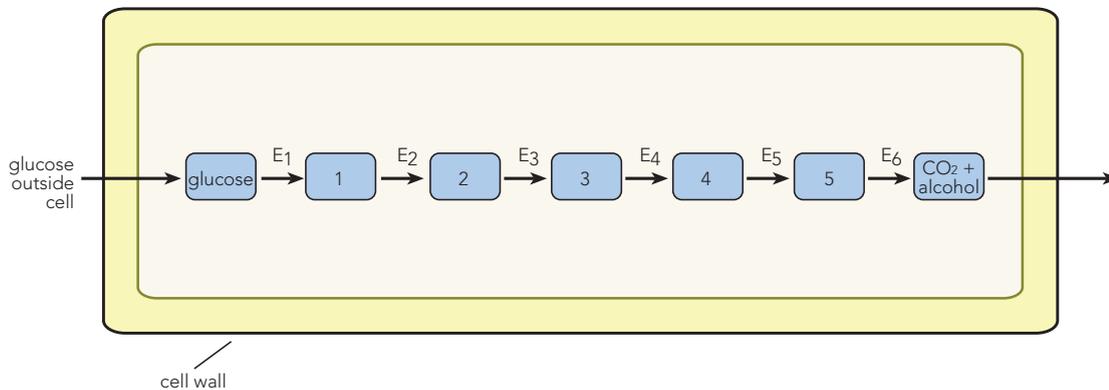
17. A plant that is growing in a hot, dry environment may have its stomata closed for long periods of time during the day. As a result the plant is likely to grow:
- slowly as it will draw little water from the ground.
  - mostly at night when its stomata open and allow CO<sub>2</sub> into the leaves.
  - slowly as photosynthesis will be limited by low levels of CO<sub>2</sub> during the day.
  - at a rate that is similar to that of other plants in more temperate climates.
18. The process called glycolysis:
- takes place in the cytosol.
  - requires oxygen.
  - occurs in the mitochondrion.
  - only occurs in bacteria.

19. Bacteria in the gut of animals often respire anaerobically. They frequently produce a gas called:
- carbon monoxide.
  - methane.
  - nitrogen.
  - hydrogen.
20. Some microorganisms that respire anaerobically produce alcohol. These microorganisms include:
- yeasts and viruses.
  - bacteria and viruses.
  - yeasts and bacteria.
  - only prokaryotes.

## SECTION 2 – SHORT ANSWER (60 MARKS)

Answer each question in the space provided.

1. The following diagram illustrates the action of enzymes in a plant cell converting glucose into carbon dioxide and ethyl alcohol. This occurs when the cell is ‘fed’ glucose in the absence of oxygen.



The breakdown of glucose involves the intermediate compounds represented by the numbers 1 to 5 and each stage of the reaction is controlled by a different enzyme represented by the letters E<sub>1</sub> to E<sub>6</sub>.

- (i) What would happen if the enzyme E<sub>6</sub> was not present in the cell?

---



---

[1 mark]

- (ii) Normally CO<sub>2</sub> and alcohol move out of the cell into the extracellular fluid. What might happen if alcohol accumulated in the cell while the CO<sub>2</sub> moved out?

---



---

[2 marks]

- (iii) If the alcohol was allowed to diffuse from the cell's cytoplasm, but the carbon dioxide remained, how might this affect the breakdown of glucose?

---

---

[2 marks]

- (iv) If the cell was slowly heated to a temperature which well exceeded the normal temperature of the cell, how might this affect the process?

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- (v) Explain your answer to (iv) in terms of the 'lock and key' hypothesis.

---

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[3 marks]

- (vi) If glucose is broken down to  $\text{CO}_2$  and alcohol and these products are lost to the cell, of what use to the cell is the breakdown process?

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[2 marks]

- (vii) If oxygen were introduced with the glucose, explain how the process would change.

---

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[2 marks]

- (viii) What would be the difference in energy yield?

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[1 mark]

(ix) What are the a) general, and b) specific names for the two processes described above?

a)

---

b)

---

[3 marks]

(x) In which part of the cell does the sequence shown in the original diagram occur?

---

[1 mark]

(xi) If this had been an amoeba supplied with glucose under the same anaerobic conditions, what changes would you make to the diagram? Sketch your answer below.

[2 marks]

(xii) If the end product was allowed to accumulate in the amoeba, how might this affect the cell?

---

[1 mark]

2. Both aerobic and anaerobic respiration produce some heat.

(i) Explain why.

---

---

---

[2 marks]

(ii) Which respiration releases the greatest quantity of heat? Explain.

---

---

---

[2 marks]

(iii) How might you demonstrate that heat is produced by a micro-organism when it respire?

---

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[4 marks]

3. (i) Write a simple word equation for photosynthesis.

---

[2 marks]

(ii) Write the chemical formula for each substance involved.

---

---

[2 marks]

(iii) Why is this called an anabolic chemical reaction?

---

---

[1 mark]

(iv) Why is the process of photosynthesis so important to life on Earth? Provide two reasons.

a)

---

---

b)

---

---

[2 marks]

- (v) List three factors that may change the rate of photosynthesis and discuss why each factor plays a part.

FACTOR	WHY THIS AFFECTS THE RATE OF PHS

[6 marks]

4. (i) Name and describe the two stages in which photosynthesis takes place.

Stage 1

---

---

---

[3 marks]

Stage 2

---

---

---

[3 marks]

(ii) Where does each stage take place in a chloroplast?

Stage 1 \_\_\_\_\_

Stage 2 \_\_\_\_\_

[2 marks]

5. The rate of respiration in cells depends on external environmental factors and an organism's internal factors.

(i) List three factors that may change the rate of respiration and discuss why each factor plays a part.

FACTOR	WHY THIS AFFECTS THE RATE OF RESPIRATION

[6 marks]

(ii) Describe how a cell's structure can influence the rate of respiration that it carries out.

---

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---

[3 marks]





## TRIAL TEST 12: RESPIRATORY AND DIGESTIVE SYSTEMS

**Time allowed:** 60 minutes

**Total marks:** 100

**Section 1** – Multiple Choice

**Section 2** – Short Answer

**Section 3** – Short Answer

20 marks

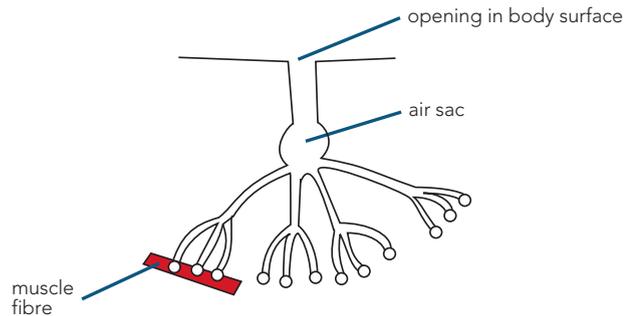
60 marks

20 marks

### SECTION 1 – MULTIPLE CHOICE (20 MARKS)

- Which is the order of increasing complexity and size?
  - system – organ – tissue – cell.
  - organ – tissue – cell – system.
  - tissue – cell – system – organ.
  - cell – tissue – organ – system.
- A person who studies tissues and tissue types is involved in a branch of biology called
  - biotechnology.
  - physiology.
  - histology.
  - cytology.
- Both animals and plants have many types of cells within their bodies and yet each is derived from one single cell, the zygote. This diversity of cells is brought about by:
  - mitosis.
  - differentiation.
  - adaptation.
  - specialisation.
- Which of the following is correctly described as an organ?
  - the heart.
  - a sperm.
  - an amoeba.
  - muscle.
- Which of the following lists includes only parts of one system?
  - lung, nasal cavity, oesophagus.
  - stomach, rectum, kidney.
  - uterus, uterine tube, ovary.
  - vertebra, cranium, ear.
- A herbivore's diet consists of plant matter including cellulose. Cellulose presents a problem because:
  - animals do not produce enzymes that break down cellulose.
  - there is little energy in cellulose so that they need to eat continuously.
  - cellulose has little nutrient value which means that they can suffer deficiency diseases.
  - cellulose needs to be physically digested before it can be absorbed.
- A non-ruminant herbivore would be expected to have a:
  - very large stomach.
  - small intestine.
  - large intestine.
  - large caecum.

8. Earthworms, which live in burrows under the ground, are known to gradually increase their length as the oxygen supply within the burrow diminishes. The most likely reason for this behaviour is that it:
- increases access to untapped oxygen supplies.
  - increases their surface area to absorb more oxygen.
  - decreases their volume to increase their surface area.
  - reduces their need for oxygen by increasing their surface area to volume ratio.
9. Which of the following organisms is likely to have a respiratory system that could be represented as in the following diagram?



- an insect.
  - a bird.
  - a reptile.
  - a fish.
10. In the respiratory system of a mammal, in order for the concentration gradient of oxygen between the alveolus and the blood to remain high:
- there must be a rapid flow of blood through the lung capillaries.
  - carbon dioxide needs to move rapidly from the blood into the alveoli.
  - the air in the lungs needs to be changed regularly.
  - oxygen needs to move rapidly from the alveoli into the capillaries.
11. The gills of a fish have a much greater surface area than the lungs of similarly sized mammals. The best explanation for this difference is that:
- fish are generally more active than mammals.
  - fish live in aquatic environments whereas mammals are generally terrestrial.
  - fish use aerobic respiration more than mammals.
  - the oxygen concentration in aquatic environments is lower than in the air.
12. Which one of the following has walls one cell in thickness and is well supplied with blood?
- bronchioles.
  - bronchi.
  - alveoli.
  - trachea.
13. The main function of the nasal cavity in mammals is to:
- warm and filter air.
  - act as a resonating chamber for sound.
  - provide a surface to detect odours.
  - supply mucus.
14. Air enters the lungs during inspiration because:
- there is a vacuum in the alveoli.
  - air pressure outside the body is greater than in the lungs.
  - the intercostal muscles push outwards and stretch the lungs.
  - the lungs are attached to the diaphragm which is raised.

15. Which of the following is true of gaseous exchange through the wall of the alveolus?
- (a) Nett diffusion of oxygen is from alveolus to the blood capillaries.
  - (b) Diffusion of carbon dioxide occurs at the same rate in both directions.
  - (c) Nett diffusion of carbon dioxide is from alveolus to the blood capillaries.
  - (d) Diffusion of oxygen occurs at the same rate in both directions.
16. Oxygen passes from the alveolus to the blood in capillaries by:
- (a) osmosis.
  - (b) diffusion.
  - (c) active transport.
  - (d) all of these.
17. In most vertebrates the substance to which oxygen becomes chemically bonded within the red blood cells is:
- (a) oxyhaemoglobin.
  - (b) haemoglobulin.
  - (c) haemoglobin.
  - (d) carboxyhaemoglobin.
18. The molecules that result from the complete digestion of proteins and carbohydrates share some characteristics. These include both:
- (a) are short chains of complete monosaccharides.
  - (b) contain amino acids.
  - (c) are small enough to pass through cell membranes.
  - (d) contain carbon, hydrogen and nitrogen.
19. The mammalian lungs and intestines have similar structures related to each of the following except:
- (a) a large surface area enabling rapid diffusion of molecules into the blood.
  - (b) a thin surface lining separating the internal and external environments.
  - (c) a rich supply of blood.
  - (d) a large number of air spaces between the cells to reduce the weight of the organs.
20. Which of the following mammalian organs is primarily involved in the absorption of water and the formation of faeces:
- (a) ileum.
  - (b) stomach.
  - (c) duodenum.
  - (d) colon.



## SECTION 2 – SHORT ANSWER (60 MARKS)

Answer each question in the space provided.

1. Which organisms exchange gases through:

(i) moist skin?

---

(ii) gills?

---

(iii) lungs?

---

(iv) spiracles?

---

[4 marks]

2. Describe one problem the organism has in obtaining oxygen and outline what adaptations solve the problem in each example below:

	PROBLEM IN OBTAINING OXYGEN	ADAPTATIONS
(i) moist skin		
(ii) gills		
(iii) lungs		
(iv) spiracles		

[8 marks]

3. The table below shows the approximate % of the gases in inhaled air and air that is exhaled when a person is resting and when exercising.

	INHALED AIR	EXHALED AIR WHEN RESTING	EXHALED AIR WHEN EXERCISING
Nitrogen	78%	78%	78%
Inert gases	1%	1%	1%
Oxygen	21%	16%	11%
Carbon dioxide	0.03%	4.5%	9.5%
Water vapour	variable	saturated	saturated

- (i) Which gases are not involved in respiration?

---

[1 mark]

- (ii) By how much does the percentage of CO<sub>2</sub> in exhaled air increase when a person who is resting begins to exercise?

---

[1 mark]

- (iii) By approximately how much does the percentage of oxygen used increase when an adult, who has been resting, begins to exercise?

---

[1 mark]

- (iv) Explain why these percentages change when a person is exercising.

---

[1 mark]

- (v) How does breathing affect the level of water in our blood plasma?

---

[1 mark]

4. (i) Give a brief account of the diet of each of the following:

(a) carnivore \_\_\_\_\_

(b) herbivore \_\_\_\_\_

(c) omnivore \_\_\_\_\_

(d) detritivore \_\_\_\_\_

[4 marks]

(ii) An organism that feeds on another living organism is called a:

\_\_\_\_\_

[1 mark]

(iii) An organism that feeds on the dead remains of another organism is called a:

\_\_\_\_\_

[1 mark]

5. Write the appropriate term or words for each of the phrases below:

(i) A process in which nutrients are broken down into small molecules so that they can be absorbed by the body.

\_\_\_\_\_

(ii) A collection of organs that carries out at least one major function in a multicellular organism.

\_\_\_\_\_

(iii) A protein which acts as a catalyst either inside or outside cells.

\_\_\_\_\_

(iv) The acid which is secreted into the gastric pits in the human stomach.

\_\_\_\_\_

(v) Any enzyme that catalyses the breakdown of lipids.

\_\_\_\_\_

(vi) Proteins are long chains of smaller sub-units called

\_\_\_\_\_

(vii) The mucosa (lining) of many animals' small intestines have small finger-like projections called

\_\_\_\_\_

(viii) Food moves along the digestive tract due to the contraction of muscles along its length. The contractions are called

\_\_\_\_\_

(ix) The mammal's tooth type most responsible for crushing and grinding food.

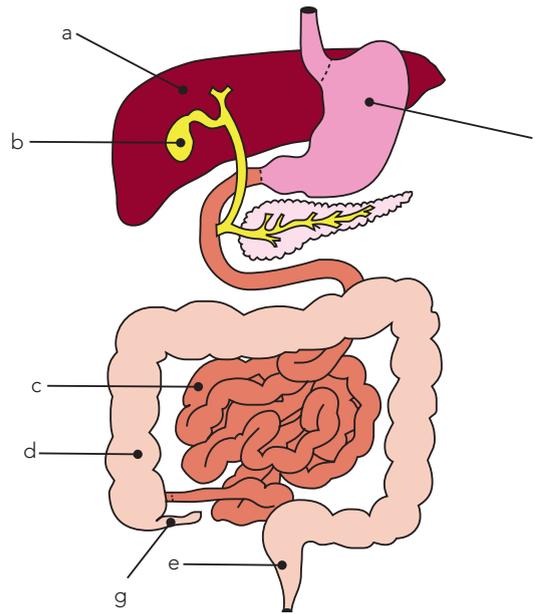
\_\_\_\_\_

(x) A gut with only one opening.

\_\_\_\_\_

[10 marks]

6. The diagram below shows a typical omnivore's alimentary canal and associated organs.



(i) Use the diagram to complete the table.

LETTER LABEL	NAME OF PART	FUNCTION OF PART
a		
b		
c		
d		
e		
f		

[12 marks]

(ii) What is the function of the part labeled “g” in:

(a) an omnivore

---

(b) a carnivore

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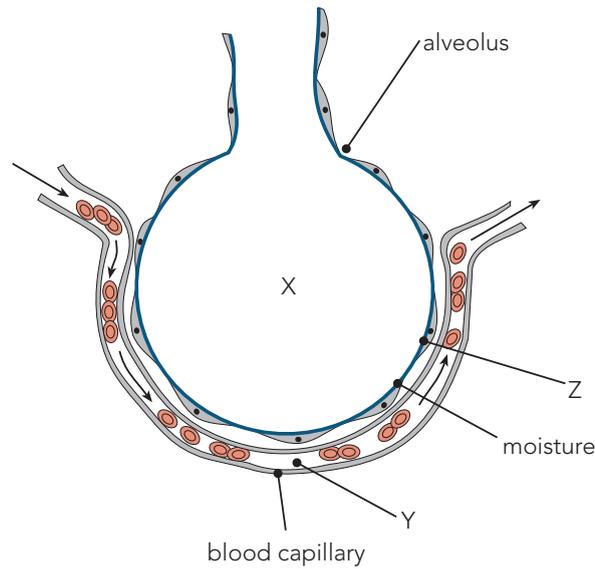
(c) a non-ruminant herbivore

---

(d) a ruminant herbivore

---

7. The diagram below shows the structural relationship between an alveolus and a blood capillary.



- (i) After inhalation explain why oxygen moves from X to Y and carbon dioxide from Y to X.

---

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[2 marks]

- (ii) As the oxygen moves into the blood plasma, how does it travel in the blood?

---

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[1 mark]

- (iii) Why must the lining of the alveolus Z remain moist?

---

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[1 mark]

- (iv) What special features enable the alveoli to absorb sufficient oxygen for an adult's needs?

---

---

[2 marks]

8. (i) Why is the digestive tract different in herbivores and carnivores?

---

---

[1 mark]







## TRIAL TEST 13: CIRCULATORY SYSTEMS, EXCRETION AND PLANT VASCULAR SYSTEMS

**Time allowed:** 60 minutes

**Total marks:** 100

**Section 1** – Multiple Choice

**Section 2** – Short Answer

**Section 3** – Short Answer

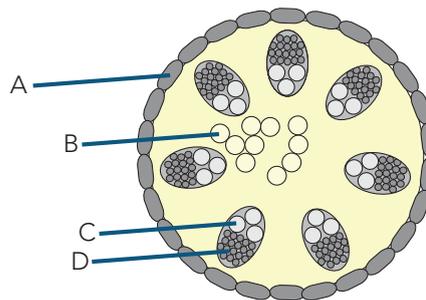
20 marks

60 marks

20 marks

### SECTION 1 – MULTIPLE CHOICE (20 MARKS)

The diagram below shows a section of vascular plant. Use it to answer questions 1 and 2.



- Which label shows the plant tissue that transports water and minerals in the plant?
  - A.
  - B.
  - C.
  - D.
- Which label shows the plant tissue that transports sucrose?
  - A.
  - B.
  - C.
  - D.
- The closed circulatory system found in more complex animals is more efficient than that of an open circulatory system found in arthropods because it:
  - delivers oxygen and nutrients to body cells and removes wastes from cells rapidly.
  - confines red blood cells to a closed circuit.
  - enables oxygen to attach to haemoglobin molecules more readily.
  - removes wastes more efficiently.
- A transport system in a large terrestrial plant is required by this organism to:
  - deliver nutrients to all its cells.
  - remove wastes from the cells so that they do not become toxic.
  - deliver oxygen to the cells which are deep within the plant's body.
  - transport water, minerals and sugar within the plant.
- A single-celled animal living in water does not require a circulatory system. This is because the animal:
  - has no need for nutrients to move within its cell.
  - has a large SA:Vol ratio so that absorption and elimination are efficient.
  - has no requirements for the elimination of wastes.
  - stores nutrients within vacuoles and removes wastes by diffusion.

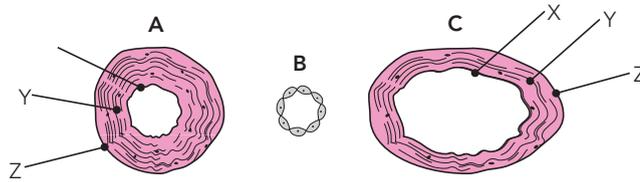
6. In mammals blood which is returning to the heart from the brain will enter the:
- (a) left atrium.
  - (b) left ventricle.
  - (c) right ventricle.
  - (d) right atrium.
7. Which human artery carries de-oxygenated blood?
- (a) aorta.
  - (b) hepatic portal.
  - (c) pulmonary.
  - (d) carotid.
8. Although the heart beats rhythmically, the blood pressure in the arteries does not drop to zero between heart beats and the blood is kept in continuous motion. Which of the following best helps to explain these observations?
- (a) The left and right ventricles contract alternately.
  - (b) The lymph that is draining into the lymphatic vessels is released steadily into veins.
  - (c) The blood expands and contracts with the pressure changes.
  - (d) The walls of the arteries are elastic.
9. Which of the following blood components have the power of amoeboid movement?
- (a) Erythrocytes.
  - (b) Macrophages.
  - (c) Platelets.
  - (d) All of the above.
10. Exchange of nutrients and waste material between the blood and the cells occurs through:
- (a) Lymph.
  - (b) Lymphatic vessels.
  - (c) Intercellular fluid.
  - (d) Intracellular fluid.
11. A person suffering from a deficiency of red blood cells is unable to carry out prolonged vigorous physical exercise. The main reason for this is that:
- (a) Waste products cannot be removed rapidly enough.
  - (b) The amount of blood sugar being carried to the body cells would not be sufficient for the energy required.
  - (c) The concentration of carbon dioxide in the extracellular fluid would become too high.
  - (d) Insufficient oxygen can be carried by the blood.
12. In a closed circulatory system the blood flow is:
- (a) confined to blood vessels and under less pressure.
  - (b) confined to blood vessels and under higher pressure.
  - (c) in direct contact with body tissues and slow.
  - (d) in direct contact with body tissues and rapid.
13. An animal with an open circulatory system that carries oxygen and nutrients would be expected to:
- (a) move rapidly and grow rapidly.
  - (b) move slowly and grow rapidly.
  - (c) move rapidly and grow slowly.
  - (d) move slowly and grow slowly.

14. In a closed circulatory system, oxygen moves out of the blood and into body cells:
- (a) via intercellular fluid.
  - (b) directly from the blood to the cells.
  - (c) via intracellular fluid.
  - (d) via plasma only.
15. The xylem and phloem in a vascular plant together carry:
- (a) sucrose, minerals and carbon dioxide.
  - (b) sucrose, minerals and glucose.
  - (c) glucose, water and minerals.
  - (d) sucrose, water and minerals.
16. Water is pulled from the roots to the leaves in a vascular plant by a combination of:
- (a) adhesion, cohesion and root pressure.
  - (b) cohesion and adhesion.
  - (c) root pressure and adhesion.
  - (d) cohesion and root pressure.
17. Which is the best description of excretion:
- (a) excreta is eliminated from the digestive tract.
  - (b) urea is produced in the liver.
  - (c) metabolic wastes from cells are removed from the body.
  - (d) deamination occurs in the liver..
18. Following the metabolic breakdown of amino acids in the liver, which substance is formed:
- (a) urea.
  - (b) bile.
  - (c) carbon dioxide.
  - (d) lactic acid.
19. Ringbarking a tree i.e. removing the living tissue on the outside of its trunk, is likely to kill the tree because this:
- (a) interrupts the flow of water to the leaves.
  - (b) prevents organic nutrients reaching the roots.
  - (c) prevents minerals circulating in the tree.
  - (d) stops oxygen flowing to the lower parts of the tree.
20. Retranslocation in vascular plants refers to a process in which;
- (a) sugars are moved from photosynthesising tissue in the leaves down to storage areas in the roots and stem.
  - (b) sugars are moved from storage tissue in the roots and stem to growing areas of the plant that need nutrients.
  - (a) minerals are moved from the roots to the leaves for the metabolism associated with photosynthesis.
  - (a) oxygen that is a byproduct of photosynthesis is moved from the leaves to a plant's other living tissue.

## SECTION 2 – SHORT ANSWER (60 MARKS)

Answer each question in the space provided.

1. The diagrams below show a vein, an artery and a capillary of a mammal.



Which is the: (i) vein \_\_\_\_\_ (ii) artery \_\_\_\_\_ (iii) capillary \_\_\_\_\_ [3 marks]

- (iv) Explain why each of the following has a different structure.

artery \_\_\_\_\_

vein \_\_\_\_\_

capillary \_\_\_\_\_

[3 marks]

- (v) Why do veins have valves along their lengths?

\_\_\_\_\_

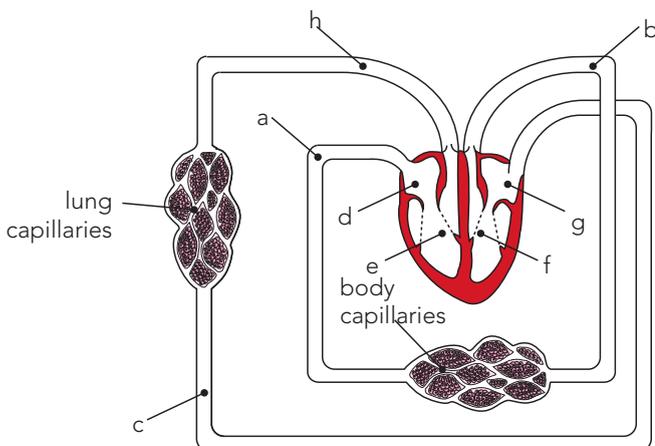
[1 mark]

- (vi) Draw labelled diagrams to show how blood is forced along a vein when nearby skeletal muscles contract.



[4 marks]

2. (i) Label the blood vessels and chambers of the heart shown in the diagram below.



a) \_\_\_\_\_

b) \_\_\_\_\_

c) \_\_\_\_\_

d) \_\_\_\_\_

e) \_\_\_\_\_

f) \_\_\_\_\_

g) \_\_\_\_\_

h) \_\_\_\_\_

[4 marks]

(ii) Using arrows show the direction of blood flow through the circulatory system on the diagram.

[2 marks]

(iii) On the diagram, which blood vessels make up the:

a) pulmonary circulation

---

[1 mark]

b) systemic circulation

---

[1 mark]

3. In what general ways is the transport system of a plant:

(i) similar to that of an animal's.

---

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---

---

[1 mark]

(ii) different to that of an animal's.

---

---

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[1 mark]

4. Briefly describe how the guard cells of a stoma control the movement of gases (water vapour, carbon dioxide and oxygen) into and out of a leaf.

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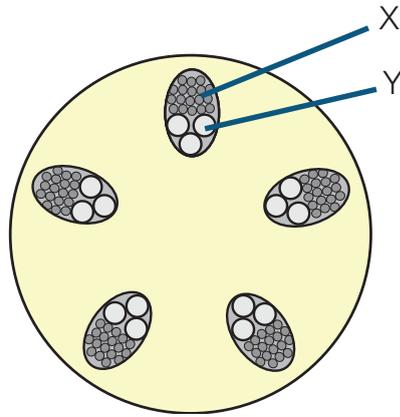
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[2 marks]

5. The diagram below shows a transverse section of a plant stem with detail of the vascular bundles.



- (i) Name the tissue labelled 'X'. \_\_\_\_\_

[1 mark]

- (ii) What is the function of tissue X?

---

---

---

- (iii) Name the tissue labelled Y.

---

[1 mark]

- (iv) What is the function of tissue Y?

---

---

[1 mark]

- (v) How are the tissues X and Y different:

- a) structurally?

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[2 marks]

b) physiologically?

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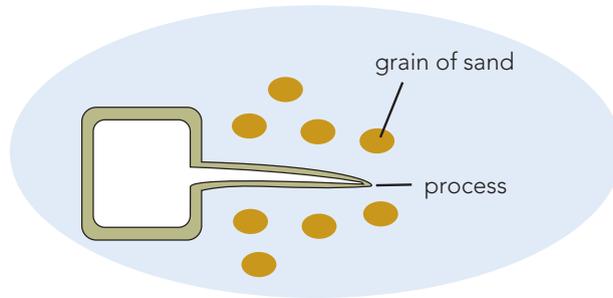
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[2 marks]

6. A root hair cell has a long extension or “process” orientated horizontally as shown.



(i) What is the function of this process (extension)?

---

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[1 mark]

As the root grows these cells die and are replaced by new root hair cells closer to the root cap.

(ii) Why are they replaced?

---

---

[1 mark]

(iii) Outline the path by which water reaches the photosynthetic cells of a leaf.

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[3 marks]

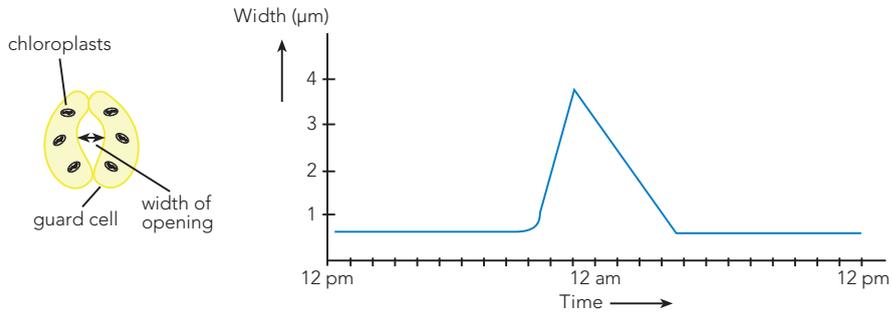
(iv) What may happen to water that is not used by the photosynthetic cells?

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---

[1 mark]

7. The graph below shows the average width of the stomatal openings (see diagram) of a plant which is growing in a hot dry environment, measured over a period of 24 hours.



- (i) At what time is the pore increasing in width most rapidly?

\_\_\_\_\_

[1 mark]

- (ii) At what time do they begin to close?

\_\_\_\_\_

[1 mark]

- (iii) What causes it to open in the morning?

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

[2 marks]

- (iv) Why do pores begin to close later in the day?

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

[2 marks]

- (v) Of what advantage to the plant is this closure?

\_\_\_\_\_

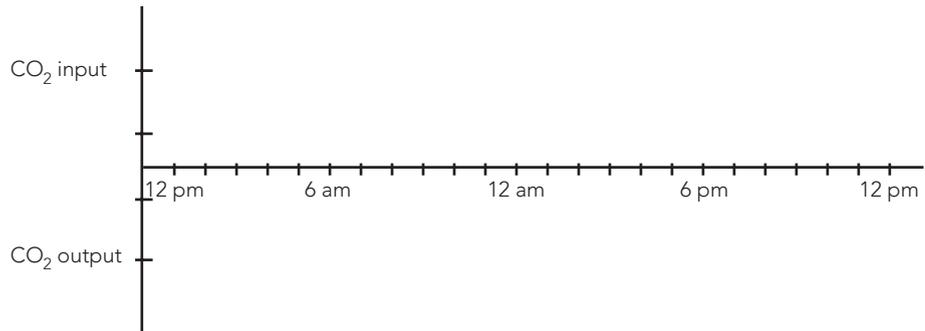
[1 mark]

- (vi) Does the closing have any disadvantage? Explain.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

[2 marks]

8. (i) On the axes below show how the same plant's CO<sub>2</sub> input and output is likely to vary over the same period of time.



[2 marks]

- (ii) How might a plant which is growing in similar temperatures and daylight but in high humidity and high soil water content compare? Use a dotted line to mark on the graph this plant's input and output of CO<sub>2</sub> over the same period.

[2 marks]

9. (i) List three environmental conditions that may limit the soil water available to the roots of a terrestrial plant.

a)

---

b)

---

c)

---

[3 marks]

- (ii) How does each of the following reduce the rate of water loss from a terrestrial plant?

a) small needle shaped leaves

---



---

[1 mark]

b) hairy (hirsute) leaves

---



---

[1 mark]

c) low number of stomata per square centimetre of leaf surface

---

---

d) shiny leaves

[1 mark]

---

---

[1 mark]

e) leaves that hang vertically

---

---

[1 mark]

f) stomata that open only at night

---

---

[1 mark]

g) leaves reduced to spines

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---

[1 mark]









## TRIAL TEST 14: INQUIRY SKILLS AND HUMAN ENDEAVOUR 2

**Time allowed:** 60 minutes

**Total marks:** 100

**Section 1** – Multiple Choice

**Section 2** – Short Answer

**Section 3** – Short Answer

20 marks

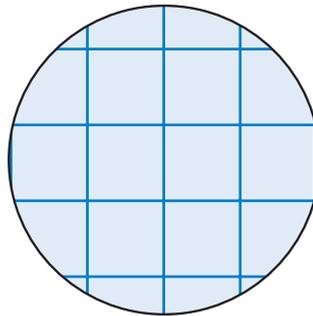
60 marks

20 marks

### SECTION 1 – MULTIPLE CHOICE (20 MARKS)

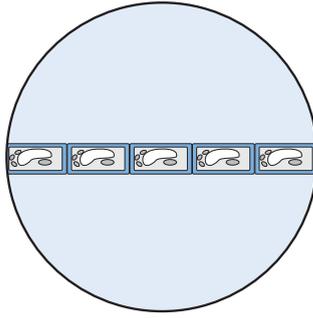
1. Which of the following can be seen with the aid of an electron microscope but not by using a light microscope?
- (a) a nucleus.
  - (b) a cell membrane.
  - (c) a chloroplast.
  - (d) a ribosome.

A biologist when looking into a light microscope at a piece of 1 mm graph paper saw the view as shown below:



2. Which is the nearest estimate of the diameter of the field of view at this magnification?
- (a) 4  $\mu\text{m}$ .
  - (b) 4,000  $\mu\text{m}$ .
  - (c) 8 mm.
  - (d) 3 mm.
3. The **area** of the field of view could be estimated by first:
- (a) counting the number of whole squares.
  - (b) counting the number of whole squares and the number of part squares.
  - (c) multiplying the number of whole squares by the number of part squares.
  - (d) increasing the magnification.
4. If the magnification was increased then the number of squares in the field of view would:
- (a) increase.
  - (b) stay the same.
  - (c) decrease.
  - (d) is unpredictable.

If the microscope in the question 2 was used to observe cells at the original magnification and the cells appeared as shown below:

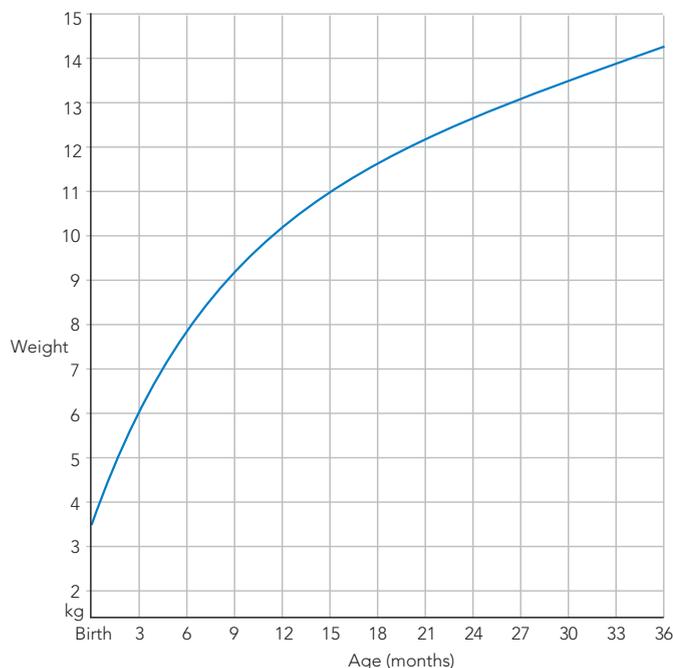


5. Which figures below provide a reasonable estimate of the dimensions of each cell?
  - (a) length 80  $\mu\text{m}$ , breadth 40  $\mu\text{m}$ .
  - (b) length 400  $\mu\text{m}$ , breadth 800  $\mu\text{m}$ .
  - (c) length 800  $\mu\text{m}$ , breadth 400  $\mu\text{m}$ .
  - (d) length 80 mm, breadth 40 mm.
  
6. In order to see more of the cells on the right of the filament (the chain of cells), the biologist would:
  - (a) increase the magnification.
  - (b) rotate the nosepiece to the right.
  - (c) move the slide to the left.
  - (d) move the slide to the right.
  
7. A scientist, while watching the movement of a protozoa on a wet mount under the microscope, noticed that when they moved near the edge of the water on the slide, they stopped and moved back towards the centre of the water. The scientist guessed that their behaviour was due to oxygen in the water near the air.

The process of making the educated guess is described as:

- (a) making an observation
- (b) analysing the data
- (c) forming a hypothesis
- (d) reaching an inference

Use the following information to answer questions 8 – 11. The graph below shows the weight of a boy from birth to three years of age.



Use the key below to answer the questions (8-11):

- (a) if the graph supports the statement
  - (b) if the graph disproves the statement
  - (c) if the graph neither supports or disproves the statement
  - (d) if the graph is related to the statement but does not provide support for it
8. The boy's weight over the three years increased most rapidly between the ages of 12 and 21 months.
9. The period of most rapid growth in weight over the three years occurs between the ages of 0 and 6 months.
10. The boy's height increased more slowly between 12 and 36 months, than between 0 and 6 months.
11. The boy's height increased more rapidly in the summer than the winter.
12. If you predicted that an experiment would produce a certain result and the result was different from what you had expected, which of the following would be your most appropriate scientific response?
- (a) "I should have carried out the experiment before making my prediction."
  - (b) "The school's equipment is obviously inadequate to get reliable results."
  - (c) "I need to improve the experiment so that the results more closely fit my prediction."
  - (d) "My prediction, experiment or observations were at fault."
13. Which of the following statements describes a scientific **theory**?
- (a) A hypothesis that has a large amount of supporting evidence.
  - (b) An educated guess which is testable.
  - (c) A prediction about what may happen in the future.
  - (d) A statement that has little supporting evidence.
14. The results of an experiment may be made more reliable by:
- (a) repeating the same experiment a number of times in order to average results.
  - (b) getting a second opinion on the hypothesis being tested.
  - (c) making sure to only record results which support the hypothesis being tested.
  - (d) approaching the experiment with a completely open mind.
15. Which of these procedures would help to make an experiment **valid**?
- (a) Repeat the same procedure many times.
  - (b) Use a control group.
  - (c) Use a small sample size.
  - (d) Choose only healthy individuals for tests.
16. The best evidence that the cell membrane is not fixed and rigid is that it:
- (a) is made up of proteins and fats.
  - (b) is differentially permeable.
  - (c) prevents organelles leaving the cytoplasm.
  - (d) is capable of endocytosis and exocytosis.
17. A major disadvantage of the electron microscope is that it allows only:
- (a) living things that have been killed and preserved to be seen.
  - (b) biological specimens to be observed.
  - (c) animal cells to be examined.
  - (d) living botanical specimens to be imaged.

18. When using a ruler to measure the distance between two objects a degree of error is always involved. This is largely due to the:
- carelessness of the experimenter.
  - instruments that have not been calibrated correctly.
  - combination of parallax error and imprecise instruments.
  - lack of time that experimenters generally have.
19. The electron microscope must have a vacuum within its barrel. This prevents specimens which are to be examined from having any moisture on their surface because the water would:
- evaporate in the vacuum and deflect the electron beam.
  - form a mist over the lenses and prevent clear images.
  - become so hot that steam would form inside the barrel.
  - tend to rust the expensive metals from which the barrel is constructed.
20. Scientific arguments are generally based on:
- critically assessed assumptions.
  - good judgement and experience.
  - observational evidence that is reliable.
  - logic and commonsense.

## SECTION 2 – SHORT ANSWER (60 MARKS)

Answer each question in the space provided.

1. A biologist counted the number of times a stationary fish, in an aquarium, opened and closed its mouth and forced water over its gills, at different water temperatures. The data which she collected is shown below.

WATER TEMPERATURE (°C)	NUMBER OF TIMES WATER FORCED OVER GILLS
5	13
10	50
15	65
20	67
25	70
30	70
35	40
40	20

- (i) What hypothesis might the scientist have been testing?

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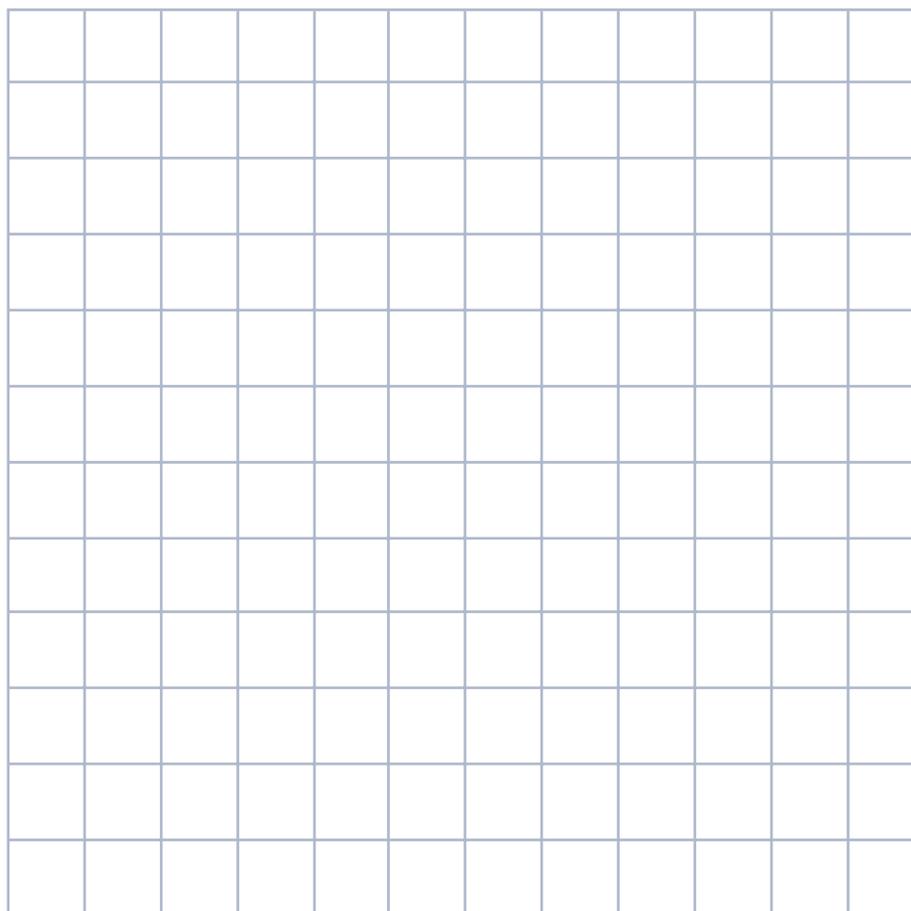
[2 marks]

- (ii) In the experiment, which variable was the:

- (a) independent \_\_\_\_\_
- (b) dependent \_\_\_\_\_

[2 marks]

(iii) Use the grid below to plot the data in the table.



[4 marks]

(iv) (a) Give one conclusion which can be made from these results.

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[2 marks]

(b) The scientist repeated the experiment using ten fish. How might this improve the results?

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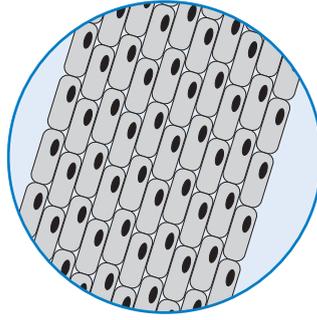
[1 mark]

(c) How would the scientist select the ten fish from a laboratory tank which contained several hundred fish of the same species?

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[1 mark]

2. Suppose that your microscope's field of view using a magnification of 40x is 3500  $\mu\text{m}$ . If you observe onion cells at this magnification they appear as shown below.



- (i) Approximately how long is an onion cell?

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[2 marks]

- (ii) Calculate the diameters of the field of view for a magnification of 100x and 400x on this microscope.

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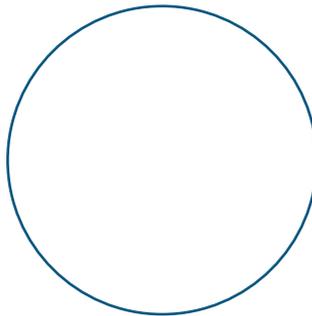
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[2 marks]

- (iii) Sketch how the onion cells would appear with a magnification of 100x.



[2 marks]

- (iv) Would you classify the onion cells observed as prokaryotic or eukaryotic? What **evidence** is there for your decision?

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[2 marks]

3. (i) When light microscopes were first developed scientists were amazed at what could be seen in a drop of pond water. Why were they so surprised by what they saw?

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[2 marks]

- (ii) When Robert Hooke first looked at cork with a simple microscope in the seventeenth century he saw what looked like small compartments. What was he actually looking at?

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[1 mark]

- (iii) Later more sophisticated light microscopes and staining techniques revealed more details within these compartments. Describe some of the details that these better instruments may have provided.

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[2 marks]

- (iv) Many small structures can be seen with a light microscope but more have been discovered with the aid of electron microscopes. The function of one of these was proposed theoretically by an Italian scientist called Golgi in the late nineteenth century, although it was not clearly visible with the aid of the light microscopes of the time and Golgi's staining techniques. When it was studied using an electron microscope and more was learned about it in the mid twentieth century, what was it called and what do scientists now think is its function?

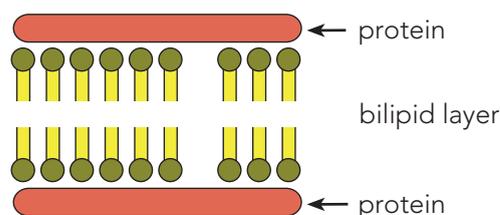
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[3 marks]

4. Before the development of the electron microscope, in the early twentieth century, many scientists believed that the cell membrane consisted of a bilipid layer with proteins on each side forming a lipid sandwich (see the diagram below).



The electron microscope provided both a higher magnification and a higher resolution of images than the light microscope.

(i) Explain what is meant by these terms, magnification and resolution.

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[4 marks]

(ii) When the cell membrane was first seen using an electron microscope it appeared as two lines. What did scientists erroneously propose regarding these two lines?

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[2 marks]

(iii) When the width between the two lines was measured and the theoretical width of a single membrane calculated it was realised that the two lines could not represent protein with a bilipid layer on the inside. A bilipid sandwich arrangement would create a much wider membrane than appeared under the e.m. What do these lines actually represent?

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[2 marks]

(iv) Is our understanding of the cell membrane likely to be complete now? Justify your answer.

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[2 marks]

5. (i) Explain the relationship between biofuels and photosynthesis.

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[4 marks]

- (ii) How are microorganisms used to break down rubbish and what environmental benefits can this have?

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[4 marks]

- (iii) How has 'probe' technology helped in the understanding of chemical processes in cells?

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[2 marks]

- (iv) Radioactive tracer elements have been used to determine where the oxygen molecules produced in photosynthesis come from. Write the word equation for photosynthesis and outline how this may have been done.

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[5 marks]

6. (i) Name and briefly describe the "three strategies" applied to the ethical treatment of animals in scientific research.

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[6 marks]

- (ii) Why have these strategies been adopted by many scientific communities?

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[1 mark]





# ANSWERS TO TERMINOLOGY AND REVIEW QUESTIONS

## 1. DESCRIBING BIODIVERSITY

### 1.1 Biodiversity

#### Terminology

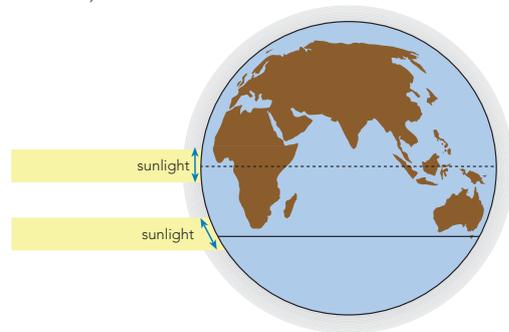
- (i) *classification* – grouping organisms according to their shared structural features (and their evolutionary relationships)
- (ii) *diversity* – the range of types of organisms living in an environment.
- (iii) *ecosystem* – the living community in a particular area, together with its nonliving surroundings and the interactions that occur between the two.
- (iv) *gene* – a section of a chromosome which codes for a particular protein
- (v) *genetic characteristic* – a trait that is determined by a gene or the combined effect of a number of genes
- (vi) *species* – a group of organisms which are interbreeding in their natural environment and producing viable offspring or a group of organisms that are structurally and functionally very similar. They have similar DNA.

#### Review Questions

1. Each plant species generally has a number of different animal species (and micro organisms) feeding or taking shelter on and in it. Where there is a great diversity of plants there will therefore be an even greater diversity of animals (and micro organisms).
2.
  - (i) **Genetic diversity:** This refers to the variations within a species, which is due largely to the number of alleles within the population.
  - (ii) **Species diversity:** This refers to the numbers of different species within an ecosystem.
  - (iii) **Ecosystem diversity:** This refers to the number of different types of naturally occurring ecosystems within an area.
3. The two main processes are sampling and classification.
4. The total number of different genes in an ecosystem will be determined by both the total variations of genes (alleles) within each species and the total number of different species in that ecosystem. This number therefore gives a good indication of the biodiversity of the ecosystem.

5.

- (i) At low latitudes (i.e. near the equator) the amount of light energy reaching the Earth's surface per unit of area is greater because of the angle of incident light rays (see diagram below).



This increases the productivity of plants near the equator because they use light for photosynthesis. Biodiversity is also influenced by temperature, climatic stability, water availability and soil quality.

- (ii) Note: Your hypothesis should be testable and an educated guess that explains this phenomenon, e.g. “The SW has not been subjected to recent glacial ice flows which eliminated much of the floral diversity in Europe in the last 50 million years.”

OR

“The SW has been isolated from other parts of the world for 65 million years which has allowed its plants to evolve without interference from humans and other organisms.”

- (iii) The most vulnerable areas are close to large populations of humans. They are more likely to be disturbed by land clearing, pollution and the introduction of exotic plant pests and feral animals.
- 6.
- (i) Differences in biodiversity between two similar ecosystem may indicate whether one or both is/are healthy or has/ have been affected by disturbance or change.
  - (ii) Measures of biodiversity in the same ecosystem over a long period may indicate whether the ecosystem is stable or whether it is changing, i.e. declining or improving in its ‘health’.

## 1.2 Classification

### Terminology

- (i) *binomial nomenclature* – a system of naming organisms in which each species is given two names – a genus name and a species name (e.g. *Homo sapiens*).
- (ii) *common ancestor* – where two species have evolved from the same species, that species is called their common ancestor.
- (iii) *criterion(plural criteria)* – a basis on which a comparison can be made.
- (iv) *dichotomous key* – an identification scheme where there are two choices at each point in the key. It is a type of taxonomic key.
- (v) *morphology* – a branch of biology that deals with the structure and form of organisms
- (vi) *taxonomic key* – a method of classifying or identifying organisms using observations of similarities or differences.

### Review Questions

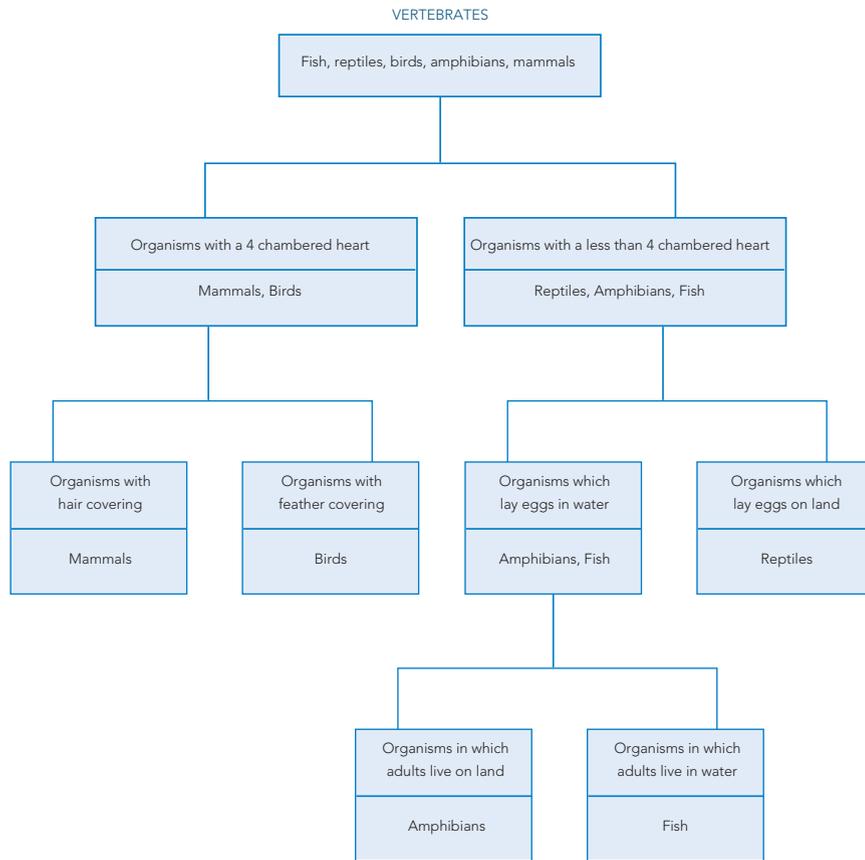
1. Kingdoms, Phyla, Classes, Orders, Families, Genera, Species.
- 2.

KINGDOM	EXAMPLES	CHARACTERISTICS
Monera	bacteria, cyanobacteria	microscopic, prokaryotes - lack nucleus
Protista	protozoa, red algae, green algae	mostly single celled, lack specialised features
Fungi	bread moulds, yeasts	secrete enzymes and absorb breakdown products, do not photosynthesise
Plantae	mosses, flowering plants	photosynthesise using chlorophyll, multicellular
Animalia	jellyfish, birds	heterotrophic - rely either directly or indirectly on photosynthetic organisms for nutrition

3. Organisms are generally classified according to their structure, e.g. animals which have a backbone are placed in the Vertebrata (sub-phylum).
4.
  - (i) Body size may be useful in some instances. However, juveniles of most species are likely to be smaller than the adults of that species.
  - (ii) Colour may change from season to season. It may 'fade' or change as the animal ages and different sexes may be different colours.
  - (iii) Behaviour varies from individual to individual in a species. It may also vary with the season and the age of the organism.
5.
  - (i) Size may be important in classifying at the subspecies level, e.g. standard and miniature breeds of dogs.

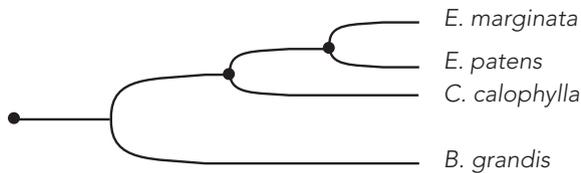
- (ii) Colour is often used to assist in classifying bird species. When two species are closely related colour may be an important distinguishing feature, e.g. Red-tailed Black cockatoo and White-tailed Black cockatoo.
  - (iii) Certain behaviour results in the characteristic webs which are constructed by various spider groups. Courtship displays are also characteristic of particular species and may assist in classifying these organisms, e.g. frog call types.
6. Type of skeleton, position of nerve cord, number of paired appendages.
    - (i) Chordata have an endoskeleton, Arthropoda have an exoskeleton. Chordata have a dorsal nerve cord, Arthropoda have a ventral nerve cord. Chordata have two pairs of appendages, Arthropoda have more than two pairs of appendages.
    - (ii) Of the criteria, only the kind of body covering is useful in distinguishing these two phyla. Another criteria is their reproduction and development but this is not given. All the other features they have in common.
  7.
    - (i) Two organisms are classified in the same species if they reproduce fertile offspring in their natural environment.
    - (ii) Many organisms reproduce asexually and it is not always easy to observe whether reproduction is occurring naturally.
    - (iii) Modern methods involve the analysis of DNA. Where two organisms have very similar DNA they are assumed to be very closely related. The degree of similarity is a measure of their relationship.
  8.
    - (i) A 'key' is a guide which helps in classifying organisms. A "dichotomous" key has two branches at each step.
    - (ii) (See next page).
  9. The name given to each species is restricted to just two words. The two words together make up the species name. The first word is the genus name and the second is the species name of the organism (e.g. *Homo sapiens*). It is called 'Linnaean' because this system was first developed by Linnaeus.
  10.
    - (i) The Jarrah and the Blackbutt. This is because they belong to the same genus and it is therefore assumed they have a recent common ancestor.
    - (ii) The Bull banksia – It is in a different genus to the other three and is morphologically different to all three, it has never been erroneously classified as belonging to the genus *Eucalyptus*.

8. (ii)



(iii) Choices: 1b, 3b, 4a. Vertebrate: Amphibian.

(iii)



- (iv) New evidence was found that suggested it had more in common with plants in the genus *Corymbia* than with those in *Eucalyptus*
- (v) On DNA similarities and differences.
- (vi) The biodiversity has not changed but the scientific understanding of it has improved.

### 1.3 Ecosystems

#### Terminology

- (i) *abiotic* – factors in the environment which are not living, e.g. temperature, humidity, are described as abiotic.
- (ii) *biosphere* – that part of the earth where living things live.
- (iii) *biotic* – describes an environmental factor which is living, e.g. predators, competitors.
- (iv) *community* – the plants, animals and microorganisms which live together in a particular place at a particular time.
- (v) *decomposer* – a heterotrophic organism which breaks down the remains and wastes

of other organisms, returning nutrients to the soil or water (bacteria and fungi).

- (vi) *habitat* – the place in an environment where a particular animal, plant or microorganism lives.
- (vii) *heterotroph* – an organism which cannot make its own food, but relies on the organic matter produced by other organisms, e.g. animals, fungi, bacteria (other than cyanobacteria and chemosynthetic bacteria).
- (viii) *interspecific* – between species. Competition for resources between two species is described as interspecific.
- (ix) *intraspecific* – within a species. Competition between two animals of the same species is intraspecific.
- (x) *productivity* – The increase in the total organic matter in a population or community in a given time. This is a measure of the difference between the rate at which organic matter is synthesized and the rate at which food is respired.
- (xi) *substrate* – in ecology this refers to the surface on which an organism lives. It may be living or non living.
- (xii) *symbiosis* – refers to any close relationship between two different species.

## Review Questions

1.

BIOTIC	ABIOTIC
Predators	Temperature
Parasite	Light
Mates	Water
Competitors	Oxygen
Prey	Humidity
Offspring	pH
Pathogens	Wind
	Soil Type

2.

- (i) *Salt Concentration* – In a freshwater lake the salt concentration is low. Organisms have a problem in that the concentration of solutes is higher in their cells than in the surrounding water. In a marine intertidal zone, at high tide the organisms are surrounded by salt water. At low tide they are surrounded by air.
- (ii) *Temperature Variation* – In a freshwater lake temperature variations are likely to be less than those in an intertidal zone. If the lake is very large the temperature is likely to remain fairly constant from week to week. In a small pond temperature fluctuations will be great, as the air temperature has a greater affect on them. In the marine intertidal zone, the temperature is likely to vary greatly between the temperature of the ocean, which may be low compared to that of the air during the day which may be hot.
- (iii) *Oxygen levels* – The amount of dissolved oxygen in the water depends on a number of factors including the water temperature, the degree of turbulence and the amount of photosynthetic plant life. Animal populations reduce the levels of oxygen. In a still fresh lake with little autotrophic life, oxygen levels may be low especially in deeper parts of the lake. In the intertidal zone of the marine environment where the water is turbulent and cold, oxygen levels will be high. When the tide is low it will be even higher, as the organism will be in air with oxygen levels up to 20% by volume.
- (iv) *Light* – The surface of the lake will receive a high light intensity. However as the depth increases light penetration becomes reduced. If the lake is disturbed and muddy light penetration will be further reduced. In the intertidal zone light intensity will generally be high even at high tide. At low tide light intensity will be very high dependent on the weather conditions.

3.

- (i) *Marine Fish* – Surrounded by fish of all sizes; some may be prey, others predators. There is a wide range of other vertebrates and invertebrates. Zooplankton, phytoplankton. Algae are the most obvious autotrophic organisms.
- (ii) *Freshwater Crustaceans* – In a lake or river, there is likely to be algae, fresh water fish, invertebrates and their larvae, frogs, molluscs and other crustaceans. Micro-organisms such as bacteria and protozoa will also be found especially in the detritus.
- (iii) *Grasshopper* – Plants – angiosperms, ferns, conifers, mosses, also fungi, bacteria. Predatory birds, reptiles and mammals. Larger herbivorous animals – sheep, cattle, kangaroos.

4.

- (i) *Shark* – The abundance of other fish, mammals and invertebrates on which sharks feed will largely determine the likely survival of the sharks. They generally have few predators.
  - (ii) *Freshwater Fish* – Availability of food depending on diet – smaller fish or algae. Populations of predators both within the water, e.g. fish and on the land, e.g. birds which feed on the fish.
  - (iii) *Fox* – Has few predators – availability of small mammals, bird eggs and insects on which to feed.
- 5.
- (i) *Salt Concentration* – marine fish are surrounded by water with a high salt concentration, fresh water fish are surrounded by water with a low salt concentration.
  - (ii) *Temperature* – marine environment will vary in temperature much less than that of a lake which may be very warm in summer but extremely cold in winter.
  - (iii) *Turbidity* – wave action and incoming river flows may cause coastal sea water to become turbid, but generally lakes are likely to be more turbid as they are often disturbed by animals. Microorganisms may also increase their turbidity, e.g. algal blooms.
  - (iv) *Light Penetration* – depend largely on the degree of turbidity and pollution. A freshwater lake is therefore more likely to have reduced light penetration and a marine environment a more constant light penetration.
  - (v) *Water Currents* – in the marine environment these are more significant as water is warmed more near the equator than at the poles and currents are stronger.

6.

- (i) *Biotic factors*  
Semi arid woodland ecosystem – less biodiversity, fewer plants and animals, smaller populations of both, plant productivity

lower, food webs less complex and the community less stable ie affected by change more readily.

Tropical rainforest ecosystem – much greater biodiversity, larger populations, more plant productivity, more complex food webs, greater stability and resistance to change.

(ii) Abiotic factors

Semi arid woodland ecosystem- more temperature extremes, less water availability, less light, more fluctuation in day length during the year if further from equator.

Tropical rainforest ecosystem – temperature and humidity generally high, less variation over the course of a day, more prone to cyclone activity, water and light availability high.

7.

(i) An organism which synthesises its own food, provides food for other organisms which cannot make their own food. Examples – photosynthetic and chemosynthetic organisms (autotrophs).

(ii) An animal which only eats plants, e.g. kangaroos, sheep, cattle.

(iii) An animal which only eats other animals, e.g. native cat (Chuditch), Numbats, foxes.

(iv) A carnivore that eats dead animals, e.g. Tasmanian devil, hyena.

(iv) An organism that lives in or on another living organism (its host) and obtains its nutrients from the host, e.g. tapeworms, some fungi.

(vi) A decomposer which breaks down the dead remains of other organisms, e.g. most fungi and bacteria.

(vii) An organism which feeds on other organisms. First order consumers (herbivores) feed on plants, second order consumers (carnivores) feed on first order consumers and so on.

(viii) An organism which shares a common resource, e.g. eats the same food, uses the same nesting site etc. with another organism.

(ix) An organism which eats detritus, i.e. dead organic matter which would otherwise accumulate in a community, e.g. earthworms.

(x) An organism which causes a disease in another organism. *Phytophthora cinnamoni* (a fungus) causes dieback disease in many plants.

8.

(i) When two organisms live together so that both benefit by their association, e.g. alga and fungus in lichen.

(ii) When two organisms live together but only one organism benefits by their association. The other is not affected or disadvantaged, e.g. sucker fish (attached to sharks).

(iii) The predator kills and eats the prey, (only one organism benefits), e.g. wedge tail eagle/ mice.

(iv) Where two or more organisms struggle to obtain the same limited resource, e.g. plants compete for light in a forest.

(v) Where an organism obtains its nutrient from another to the detriment of the latter organism, e.g. parasitic round worms living in the digestive tract of a horse.

9.

(i) Karri forest – named according to the dominant plant species (the giant Karri tree) and the amount of light penetration at midday – less than 25%. Karri forests differ in the plants that make up their understory and the percentage of other tall trees that occur with them – the name therefore does not convey this information

(ii) Coastal heath – dense growth of low closed scrub found near the coast. The short shrubs that make up heath are frequently exposed to the pruning effect of windblown sand. and salt. The name does not indicate the species or the great biodiversity of such areas or whether it is open or closed (70 - 100% cover)

(iii) Freshwater lake – named according to the important abiotic factor present – a relatively still body of water with low salt concentrations. The name gives no indication of the plant or animal species present, nor the location which may suggest what kind of community could be present

(iv) Granite outcrop – named from the substrate on which the community lives. Granite is a common hard igneous rock which has a fairly consistent mineral composition. The latitude, age and the climate that this rock is exposed to will all determine the community of organisms that inhabit it. Without these details the biodiversity on the rock would be impossible to assess.

10. Woodland is more open, more sparsely populated by plants and animals. The plants are generally lower; the trees are spaced apart more. A popular woodland definition requires the shade of trees to be less than 30% at midday in summer.

Forest is more closed, more densely populated by tall trees The trees cast over 30% shade at midday in summer or the canopy covers over 30% of the sky when looking straight up.

11. (i) The abiotic factors in a woodland are likely to include a greater variation in temperature, less water in the soil, more exposure to wind and greater light intensity on the ground.

In the forest there will be a more even temperature and it will generally be cooler during the day and warmer at night, more moisture in the soil and higher humidity, lower wind strength and less light intensity under the canopy.

(ii) The woodland provides better growing conditions for small shrubs and grasses but extremes of temperature and often low soil moisture may limit its plant productivity and the plants may require special adaptations

to survive in the environment. The forest is therefore likely to have greater biodiversity and may have greater productivity if it is a relatively young forest. An old forest may have great biomass but low productivity.

## 2. ECOSYSTEM DYNAMICS

### 2.1 Energy and Matter

#### Terminology

- (i) *bacteria* – (singular *bacterium*) microscopic single-celled organisms which have no membrane bounded organelles. Bacteria are therefore called *prokaryotes*. Saprophytic bacteria are very important in the decomposition of dead organisms.
- (ii) *biosphere* – that part of the earth where living things live. It is the sum total of all the earth's ecosystems.
- (iii) *decomposer* – a heterotrophic organism (fungi and bacteria) which breaks down the remains and wastes of other organisms, returning nutrients to the soil or water.
- (iv) *inorganic* – refers to compounds which do not contain carbon (except carbon dioxide, carbon monoxide and carbonates), e.g. water, salts.
- (v) *organic* – a relatively complex chemical compound which contains carbon (exceptions include carbon dioxide, carbon monoxide and compounds of carbonates), e.g. sugars, vitamins, proteins, lipids, nucleic acids.
- (vi) *productivity* – the increase in the total organic matter in a population or community in a given amount of time.

#### Review Questions

1.
  - A: represents light energy entering the ecosystem. A small proportion of the light is absorbed and converted to chemical energy by the autotrophic green plants.
  - B: represents chemical energy from other ecosystems which may enter this system. Animals migrate, wind and water carry plant matter from one system to another.
  - C: represents minerals, water and carbon dioxide which are taken up by the autotrophs in the living community and utilised using the light energy to make organic matter. Oxygen for respiration also makes up part of this intake.
  - D: represents minerals, water and other inorganic substances which are carried by wind and water from other ecosystems into this ecosystem.
  - E: represents the loss of part of the non-living environment. Minerals may be eroded, carbon dioxide may blow away and water may flow in rivers out of this ecosystem.

F: represents the return of mineral ions, carbon dioxide, oxygen (from photosynthesis) and water largely through complete decomposition from the living community to the non-living environment. This is carried out by fungi and bacteria.

G: represents the loss of some energy in the form of chemicals from the community. Emigration, dispersal of seeds by the wind and loss of plants and animals (either dead or alive) in rivers contribute towards this removal.

H: represents the loss of energy in the form of heat to the atmosphere. This process occurs at every trophic level from the autotrophs to the highest order consumers and decomposers. It results in all the chemical energy of an ecosystem being dissipated and none recycled.

2.

(i) Mainly autotrophic organisms i.e. green plants.

(ii) Green plants (terrestrial) absorb carbon dioxide through their leaves, mineral ions and water through their roots and, when necessary, oxygen through their roots and leaves. Oxygen and water are also absorbed by animals.

(iii) Bacteria and fungi.

(iv) Saprophytic fungi generally begin the decomposition of plants, animals and their wastes. The process is completed by the combined activities of bacteria.

(v) If the **autotrophic** organisms disappeared, no organic food would be available to the heterotrophs in the living community so the whole community would eventually disappear.

If the **decomposers** were to disappear, matter would no longer be recycled in the ecosystem. The non-living environment would be unable to provide carbon dioxide and mineral ions to the autotrophs. The living ecosystem would not be sustained. The dead bodies of both plants and animals would accumulate as life in the ecosystem ceased.

(vi) No light energy would be converted into chemical energy. No energy would flow through the system. (No food chain).

3.

(i) Photosynthesis requires light energy. The energy is first converted to chemical energy in adenosine triphosphate (ATP). This then is used as an energy source to synthesise glucose from carbon dioxide and water.

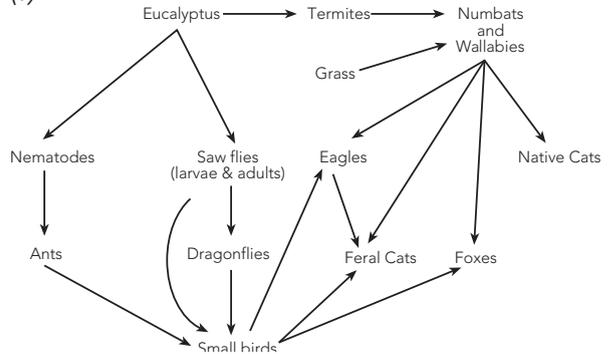
(ii) Animals obtain their energy by consuming the chemical energy in plants or by consuming other animals which have obtained their chemical energy from plants. Their chemical energy is either stored, passed to the next trophic level or lost as heat energy to the atmosphere.

- 4.
- (a) **Transpiration** – evaporation of water from a plant's leaves.  
(b) **Evaporation** – change of state from a liquid to a gas (e.g. water to water vapour).  
(c) **Precipitation** – change of state from a gas to a liquid. Rain, snow, sleet.  
(d) **Respiration** – the breakdown in cells of organic matter (usually glucose) either with or without oxygen to release energy.
  - Evaporation from the animal takes place from the skin, mouth and lung surfaces.
  - (a) Terrestrial plants absorb most water through their roots. A little may be absorbed through leaves.  
(b) Terrestrial animals absorb water through the intestines from their food and drink.
  - Water enters the atmosphere via transpiration, respiration, combustion and evaporation.
  - Water is the medium in which the organism's metabolism takes place. It also provides some support for the organism and may be used to help the organism remain cool through its evaporation during hot weather. It is also important as a medium for transport (most of the blood plasma is water).
- 5.
- Nitrogen is chemically inactive (therefore plants cannot absorb it through their leaves or roots).
  - Nitrogen-fixing micro-organisms convert nitrogen into compounds which are soluble (e.g. by combining nitrogen with oxygen) and can be absorbed by the roots of plants (e.g. nitrates).
  - Animals obtain their nitrogen by eating plants which contain compounds which contain nitrogen (e.g. proteins).
  - Both plants and animals use nitrogen in their proteins and nucleic acids.
  - It is released as ammonia ( $\text{NH}_3$ ) from the nitrogen compounds (such as protein) by saprophytic micro-organisms.
  - The nitrates may be absorbed by the roots of plants or be broken down by denitrifying bacteria into nitrogen and released back into the environment (atmosphere/water).
  - Lightning causes the free nitrogen in the atmosphere to combine with oxygen and form nitrates and nitrites which are carried by rain to the soil. These soluble compounds may then be absorbed by plant roots.
- 6.
- Carbon dioxide is absorbed by green plants in photosynthesis (a large amount may also dissolve in water bodies).
  - Carbon dioxide returns via respiration or combustion.
  - From glucose all the other compounds are formed e.g. with the addition of nitrogen, amino acids are synthesised. Lipids, nucleic acids, vitamins and the more complex carbohydrates are all made from glucose with the addition of various other elements.

- Carbon is present in all the organic compounds in animals i.e. carbohydrates, proteins, lipids, nucleic acids, hormones, vitamins and so on.

7.

(i)



- Eagles would have less food available to them and therefore their number may decline.
- Small bird numbers are likely to decline unless they can increase food intake from other sources (e.g. ants).
- Decomposers break down the wastes and the dead remains of all the organisms in the community.

8.

- This is a pyramid of biomass. It shows the total mass of organisms at each trophic level and illustrates the principle that the mass of producers usually exceeds the mass of first order consumers and so on up the food web. Sometimes a low biomass of autotrophs can sustain a higher mass of heterotrophs due to the autotrophs' high reproductive capacity.

- This is a 'pyramid' of numbers. It shows the numbers of organisms in a particular food chain and reflects the relative size of the individuals at each level.

9. Not all the chemical energy of the grass is transferred to the rabbits (even in the unlikely event that rabbits are the only animal feeding on the grass). This is because a large proportion of the chemical energy in the grass is lost as heat energy and is therefore not available to the rabbits. Also some of the mass of the grass must be conserved in order to enable reproduction to occur, i.e. the mass is passed on to the next generation. Not all of the chemicals entering the rabbits is used to build rabbit. Much is recycled into the environment as inorganic materials produced by the rabbits' respiration (e.g.  $\text{CO}_2$ ,  $\text{H}_2\text{O}$ ).

10.

- wheat → mice → eagles

(ii)



(Note: Your answer to 11 (i) must start with an autotroph.)

## 2.2 Populations

### Terminology

- (i) *carrying capacity* – the number of organisms of a particular species that a given environment can support over an indefinite period of time.
- (ii) *collaboration* – association between organisms of the same (or different) species which increases the chances of both organisms' survival and reproduction, e.g. grain bore beetles cannot individually get to centre of grain but collectively, all working together they are able to reach the food, this is collaboration.
- (iii) *commensalism* – a relationship between two organisms in which only one organism benefits by the association, but the other appears to be unaffected.
- (iv) *immigration* – the movement of organisms into a population.
- (v) *mutualism* – a relationship between two organisms of different species in which both organisms benefit, e.g. lichen consists of an alga and a fungus.
- (vi) *niche* – the role of an organism in its community. It involves its reproduction, food and the space it occupies and how it relates to the abiotic factors in the environment.
- (vii) *population density* – the number of individuals of a particular species in a given area (or volume) in an environment at a particular time.

### Review Questions

1.
  - (i) The competitive exclusion principle states that two species that require the same resources cannot exist indefinitely in the same ecosystem. The stronger competitor will eventually drive the weaker out or cause it to become extinct in the area.
  - (ii) The Red squirrel, which is native to Britain, appears to be losing the competitive battle with the Grey squirrel which was introduced from North America.  
The Chuditch, a native cat, appears to be declining in numbers due in part to competition with introduced feral cats and foxes.
2.
  - (i) The distribution of numbats has been reduced from a large area of the southern half of Australia, from W.A. across the Nullarbor Plain to S.A., to a small area in the south west of W.A.
  - (ii) Density is not indicated by these maps. However, since these animals are territorial their density in their present distribution may not have changed significantly.

3.
  - (i) Species B is more likely to be the prey, as it is not until its numbers rise that species A begins to increase in numbers. This suggests that before species A can increase there must be adequate food (i.e. species B) to support an increase in its numbers.
  - (ii) a) During months 7 and 8. This is where the slope of the graph is steepest.  
b) Begin to decline in month 11 and continues to do so in month 12. This is where the graph is sloping down.  
c) A lack of resources (e.g. food, space, water) or disease may reduce the birth rate and increase the death rate.
4.
  - (i) Land clearing, which removes the bird's source of food and nesting sites has probably increased death rate and decreased birth rate.
  - (ii) These birds may be an important agent in spreading seeds (those that are not digested) from one area to another. Breaking the fruit may also encourage growth of those seeds not eaten, on the ground below the trees. Therefore if bird numbers have declined, so too will the banksia population.
5.
  - (i) Factors which are density-dependent will not affect the survival of individual organisms within that species until their density reaches a particular threshold. Once that density is reached individuals chances of survival begin to decrease. Factors which are density-independent are not influenced by the number of organisms in a given area.
  - (ii) Density-dependent. If the density is great and resources very limited, e.g. there is little food, this shortage of food will cause the death rate to increase (i.e. a decline in their numbers) because there is strong competition for it.
  - (iii) Density-dependent. If the density of the numbats is small, predation will be reduced. More numbats will be caught by foxes if they densely populate an area. The effect of removing foxes on the population will therefore depend on the density of the numbats.
  - (iv) Density-dependent. The spread of the virus from one rabbit to the next depends on their proximity to one another. If they are densely populated, the disease will spread rapidly and increase the death rate.
6. When the availability of resources becomes limited, competition between individuals of the same species (intraspecific competition) will limit the population growth. (This is likely if conditions in the environment become adverse or when the population grows to very high numbers).
7.
  - (i) Nesting sites (hollows in old trees). Available food, e.g. banksia seeds. Competition for

shelter and nesting sites with other parrots.  
Number of predators.

- (ii) When pressure is taken off their resources, i.e. more food and nesting sites becoming available to them.
- (iii) When their habitat is reduced, mainly due to land clearance.
- (iv) Because old trees which provide nesting holes and take hundreds of years to grow are removed when land is cleared for agricultural use or new housing.
- (v) Disease, distance from nesting sites to available food, climate change, lack of water, fire may damage the environment, illegal poaching of fledglings or eggs.
- (vi) The weather varies from year to year changing the abundance of food and water in the area.

8.

- (i) The number of births per thousand of a population over a given time, e.g. number of births/1000/year.
- (ii) The number of deaths per thousand of a population over a given time, e.g. number of deaths/1000/year.
- (iii) The number of organisms per thousand entering a population over a given time, e.g. number of arrivals/1000/year.
- (iv) The number of organisms per thousand leaving a population over a given time, e.g. number of departures/1000/year.

9.

- (i) Food availability, ambient temperature, average age of the females in a population, time of year.
- (ii) Average age of population, disease, food and water availability, weather conditions.

10.

- (i)  $(b + i)$  is greater than  $(d + e)$ , ( $r$  is +ve)
- (ii)  $(d + e)$  is greater than  $(b + i)$ , ( $r$  is -ve)
- (iii)  $(b + i) = (d + e)$ , ( $r = 0$ )

11.

(i) Given:

Total births = 50, therefore

$$b = \frac{50}{10000} \times \frac{1000}{1} = 5/1000/\text{year}$$

Total deaths = 100, therefore

$$d = \frac{100}{10000} \times \frac{1000}{1} = 10/1000/\text{year}$$

Total emigrants = 10, therefore  $e = 1/1000/\text{year}$

Total immigrants = 5, therefore  $i = 0.5/1000/\text{year}$

$$\begin{aligned} \text{Therefore } r &= (b + i) - (d + e) = (5 + 0.5) - (10 + 1) \\ &= (5.5 - 11)/1000/\text{year} \\ &= -5.5/1000/\text{year} \end{aligned}$$

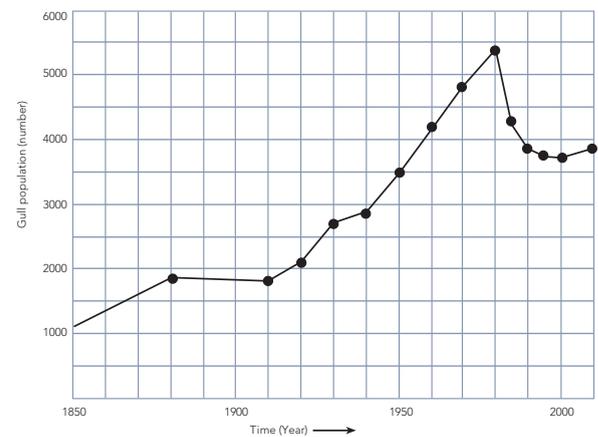
- (ii) If  $r = -5.5/1000/\text{year}$   
 $= -5.5 \times 10/10000/\text{year}$   
 $= -55/10000/\text{year}$

Population at end of year 10,000 – 55 = 9945.

- 12. Since these animals are unable to emigrate or immigrate, changes must be due to changes in either/both the birth rate and death rate. Factors which may affect birth rates include the health and numbers of reproducing organisms – determined by availability of birds eggs and small mammals on which they feed. Factors which may affect death rates include the density of birds of prey and parasites. Climate will also affect the population both directly and indirectly.

13. (i)

GRAPH: POP OF SILVER GULLS IN PERTH AREA OVER THE PAST 150 YEARS



(ii) 1950 – 1960.

(iii) 1880 and 1980.

- (iv) Increase in available food, reduction in disease, favourable weather, decline in predators.
- (v) Reduced food, increase in disease, poor weather conditions, increase in predators.

14.

- (i) Ospreys are large predatory birds which are high order consumers. They feed exclusively on fish. Their total biomass in the food web will be much less than that of lower order consumers in the environment and because they are large there will be few of them.
- (ii) These birds are smaller and lower order consumers. Therefore their numbers are greater than that of other birds. Silver gulls are also scavengers – they eat a wide variety of food and therefore they have greater resources available to them. Terns also eat a variety of small fish, crustaceans and plants.

## 2.3 Ecosystem Change

### Terminology

- (i) adaptation – a trait which enables an organism to survive and reproduce better in its environment.
- (ii) climax community – a community that has reached its final stage in ecological succession. It is stable while the environment remains relatively unchanged, e.g. a rainforest.
- (iii) ecological succession – the progression of communities that occur on an area of land or water over time or space.

- (iv) keystone species – a species that relative to its small population has a disproportionately large effect on its environment.
  - (v) pioneer organisms – organisms that are the first to colonise a disturbed or cleared area of land or water.
  - (vi) primary succession – succession which begins on a newly created substrate, e.g. a lava flow, exposed igneous rock.
  - (vii) secondary succession – succession that occurs when an existing community is disturbed.
  - (viii) spatial succession – the change in species structure that occurs from one point in an environment to another point.
  - (ix) temporal succession – the change in species structure or communities that occurs in an area over time.
- (iv) The prevailing temperature, humidity and wind speed.  
The amount of leaf litter and dead wood on the ground (the fuel load).  
The moisture in the leaf litter and the soil.  
The type of vegetation (eucalypts have oil in their leaves which is highly combustible).
  - (v) (a) Microorganisms that are below the surface may be protected from the heat by the soil. Soil is a good heat insulator. If the soil is moist this will increase their chances of survival.  
(b) Many insects fly and may therefore be able to escape the flames. Larval stages may be affected however many larval stages occur in water and soil.  
(c) Lizards and snakes that burrow can escape the heat easily.  
(d) Flightless birds (e.g. Emu), eggs and nests will be affected directly by the fire. Most birds will fly to another area to take refuge.  
(e) Mammals that burrow, live in hollows or can move quickly to another area are likely to find refuge from the direct effects of fire.  
(f) Trees that are very tall and that shed their lower branches may not be affected by less intense regular fire as their canopy is out of reach of the flames.

## Review Questions

1.
  - (i) Some undigested seeds which the bird ingests are eliminated with its faeces.
  - (ii) Many plant seeds are believed to be scattered through the forest in the faeces of the cassowary. The plants' dispersal is dependent on this large flightless bird. The continuing health of these plant populations and the ecosystem as a whole may depend on this bird.
2.
  - (i) Frequent bushfires will gradually eliminate plants that are not fire tolerant and encourage the growth and reproduction of those that are fire tolerant and those that depend on fire to flower, germinate or remove parasites and pests. These differences may cause a change in an ecosystem's species structure, so that only the plants that are fire tolerant remain and the biodiversity is reduced.
  - (ii) Some native plants have seeds which only germinate if they are subjected to heat and smoke, e.g. Feather flowers (*Verticordia* species).  
Heat is required to crack the outer coat of some species seeds, e.g. *Acacia* (wattle) species.  
Some plants have woody fruit that only release their seeds when heated strongly, e.g. *Hakea* species.  
Many eucalypts have a large lignotuber, a swelling at the top of the root system, which sends out shoots if a fire destroys the main stem of the tree.  
Eucalypts may also have epicormic buds which normally lie dormant but if fire damage occurs to the branches of the tree they germinate after the fire.  
Thick bark can also insulate the stem's living cells from the heat, e.g. *Marri*.
  - (iii) Where the fire causes the seeds' outer coats (testa) to crack, when it rains water can then enter and begin the germination process.
3.
  - (i) High intensity fire in a *Eucalyptus* forest may destroy a high proportion of older trees including habitat trees (those that provide shelter for native animals and birds) and young sapling. But this type of forest has evolved under the pressures of fire; the plants present in this forest are likely to be fire tolerant and often dependent on fire for their reproduction. The forest will recover quickly and benefit from it.
  - (ii) Rainforests are populated by a great diversity of plants and animals, many of which are not fire tolerant. Intense fires are not common in rainforests. Therefore many plant species and the animals that depend on them may be adversely affected and even disappear becoming extinct in the area. If fires were to become frequent in a rainforest it species structure would change in favour of fire tolerant plants and animals and its biodiversity would be reduced.

4. *The succession that follows a fire is called secondary succession as fire is a disturbance to an existing community and the subsequent progression of plants and animals is dependent on the species in that original community.*
5.
  - (i) *Large areas of land have been cleared of peppermints and eucalypts for housing and agriculture. This has caused habitat destruction and fragmentation. Introduced cats and foxes have added to the possum's list of predators.*
  - (ii) *The removal of trees that provide shelter and food and the increased pressure from additional predators have reduced the carrying capacity of this area for these possums.*
6.
  - (i) *Population estimates using techniques like the capture-recapture method could be used over many years. Where the population appears to plateau and remain fairly constant over a number of years then this can be assumed to be the carrying capacity.*
  - (ii) *These areas provide more food (wheat) for this bird species and in drier areas the watering troughs provide water. The changes are both biotic and abiotic.*
  - (iii) *An intense fire will remove a large amount of the fuel load consisting of a large amount of dead wood on which the termites feed. The numbat will therefore have less food and its population may fall. Numbats also shelter from predators in the hollows of fallen trees which could be destroyed. If the area destroyed by fire is a remnant vegetation stand the numbat may disappear permanently from the area.*
  - (iv) *The carrying capacity for the introduced herbivores will be less than expected because their death rate (due to poisoning) will be higher than expected.*
7.
  - (i) *Primary succession. The succession has taken place on bare rock and has not resulted from the disturbance of an existing community*
  - (ii) *The pioneer organisms include lichens, algae, bacteria and mosses.*
  - (iii) *The pioneer organisms change the granite through the substances they produce and the acids released as they decompose. These attack some minerals in the granite causing pores and cracks.*
  - (iv) (a) *Abiotic factors that may change the granite over time include sudden changes in temperature, water freezing and expanding in the pores and cracks in the rock and carbon dioxide in rain water forms a weak acid that may react with some minerals in the granite.*
    - (b) *A sudden change in temperature creates stresses within the rock (as occurs if a cold glass is placed in hot water) – these cause the rock to crack and crumble.*  
*When water freezes it expands. Where water has seeped into crevices in the granite and cooled to freezing in winter the expansion of the ice will further damage the rock.*  
*The weak acid formed when CO<sub>2</sub> dissolves in rain water will react with some minerals in the rock and cause further weathering.*
- (v) *The biodiversity on the granite outcrop would be at its greatest when the rock has been sufficiently weathered to form a deep soil and a climax community, at the end of the succession, had established itself where the rock once protruded from the earth.*
- (vi) *Temporal succession is illustrated in tracing the changes on the rock from the top diagram through to the lower diagram. These changes illustrate what might happen over many hundreds or even thousands of years.*  
*Spatial succession can be seen in each of the diagrams as the species change in moving from a central point on the rock along any radius outwards into the surrounding bush.*
8.
  - (i) *A line transect taken from the "strand line" at approximately right angles to the beach can be taken as far as practical inland (e.g. 100 m). Plant species touching the line or within 1 m of the line could be recorded or quadrats chosen at fixed intervals along the line could be used to record plant (and animal) species.*
  - (ii) *Spatial succession. Observations of succession are made along the length of a line (at one particular time only).*
  - (iii) *The plant zones exist because different plants have different requirements, different tolerances to abiotic factors like salt spray, wind carrying abrasive sand and shifting sand. Very few species can live as close to the "strand line" as Plant species 1 in the diagram as the conditions are most hostile there.*
  - (iv) *The abiotic factors that make this a hostile environment for most plants include high day time temperatures, strong winds, high salt levels in the air and in the soil, porous soil with a poor water holding capacity, sand burial, unstable soil, soil that lacks humus and soil with low levels of mineral nutrients (likely to be alkaline due to the presence of animal shells and its limestone content).*
  - (v) *The special adaptations possessed by the plants growing closest to the ocean include:*
    - *a light colour to reflect the heat*
    - *hair-like processes from the leaves to reflect heat*
    - *succulent leaves to store water*
    - *salt secreting cells in the leaves*

- *extensive root systems to anchor the plant firmly and to maximize uptake of minerals from poor soil*
  - *seeds that float for dispersal*
  - *flat low structure to withstand wind*
  - *tough epidermal layers to withstand sand blasting*
  - *reduced stomata density and stomata only on the underside of leaves.*
- (vi) *The special adaptations plants growing in unstable sand dunes possess must enable the plant to withstand sand burial (and partial exposure at other times). They are likely to spread in the sand using underground stems which produce vertical shoots which grow upwards when they are buried.*
- (vii) *The greatest biodiversity of animal species is likely to be found in the stable dune system; on the sketch this is beyond 80 m. This is because the greatest diversity of plants is located here and for each plant there are likely to be many dependent animals.*

## 2.4 Human Activities and Conservation

### Terminology

- (i) *bioaccumulation – some substances taken in by organisms accumulate or build up in their tissues. These substances are not excreted. Their accumulation is called bioaccumulation.*
- (ii) *biodegradable – describes a substance that is capable of being broken down by bacteria or other decomposers.*
- (iii) *biomagnification – substances which bioaccumulate may be passed up the food chain to higher order consumers because higher order consumers eat many lower order consumers, the percentage by weight of these substances increases in the higher order consumers.*
- (iv) *deforestation – the removal of most of the trees in a forest or woodland area.*
- (v) *desertification – the change in an ecosystem which results in a loss of plants and topsoil leaving the area desert-like and unsuitable for agriculture.*
- (vi) *eutrophication – the process in which levels of nutrients increases in lakes and rivers.*
- (vii) *ex situ conservation – conservation of a species carried out by removing some of its population from its natural area and breeding this group in a habitat which is not threatened, e.g. captive breeding programs at the Perth Zoo.*
- (viii) *extinct – a species which has not been sighted alive for fifty years or more.*
- (ix) *habitat fragmentation – when the normal range or distribution of an organism is divided by barriers which prevent the movement of individuals and gene flow over its normal distribution.*
- (x) *in situ conservation – conservation of a species of plant or animal in its natural environment.*
- (xi) *invasive species – an introduced species which does not naturally occur in an area and which causes environmental damage to that area.*
- (xii) *reafforestation – to replant trees where they have been cleared.*
- (xiii) *salinity – a measure of the salt concentration.*
- (xiv) *threatened species – an organism’s conservation status. It is a measure of its risk of extinction. Threatened species can be divided into three categories of risk. These are in ascending order – Vulnerable (VU), Endangered (EN) and Critically Endangered (CR).*
- (xv) *urbanisation – the movement of people from small towns and villages into cities.*

### Review Questions

1. (See next page).
2.
  - (i) *In urban areas, home gardeners often use lawn fertilisers containing nitrogen and phosphorous. If too much fertiliser is used, rain often washes this into rivers, creeks, lakes and swamps in the locality of their neighbourhood. This causes eutrophication in those water bodies.*
  - (ii) *In agricultural areas, excess fertiliser and sometimes animal wastes are washed into rivers and creeks causing eutrophication and then algal blooms during the warmer months of the year.*
3. *Overgrazing generally involves the introduction of sheep or cattle at levels above the carrying capacity of the area. This is most likely to happen in areas which are semi-arid, marginal for pastoral practices. During the summer when green feed is scarce, the animals are likely to eat all the small plants that are available and leave the land denuded of plants which normally hold the soil in place. When wind blows strongly, much of the topsoil is blown away leaving the land even less fertile and more desert-like.*
4. *Human sewage is likely to contain micro organisms which are carriers of human diseases, e.g. cholera, typhoid. If sewage pollutes drinking water, it is likely to introduce these diseases to the population using it.*
5.
  - (i) (a) *rabbits: “out compete” native herbivores, e.g. bandicoots, bilbies and wallabies, leaving insufficient food. Also they ringbark trees causing desertification and erosion in semi-arid areas.*  
 (b) *foxes: prey on native mammals, lambs, birds and reptiles. May carry the disease rabies if introduced to Australia. Compete with native cats (e.g. chudich) for food.*

1.

ENVIRONMENTAL PROBLEM	HUMAN ACTIVITIES THAT CAUSE PROBLEM	BIOLOGICAL CONSEQUENCES
(i) eutrophication	The excessive use of fertilisers and poor sewerage disposal.	Increased nutrient levels in water bodies that promote algal blooms and the subsequent loss of aquatic animals and plants.
(ii) dryland salinity	Clearing too many deep rooted trees in semi-arid areas. Following the removal of trees, water table rises – particularly in winter, bringing salt that is in the soil to the surface.	Loss of arable land area suitable for crop growth and pasture also creeks and rivers may become saline. The changes to both soil and water reduce biodiversity in areas that are affected – only salt tolerant plants and animals can survive in them.
(iii) habitat fragmentation	Excessive clearing of bush land for pasture, crops or urban sprawl.	Small isolated populations of animals and plants are created which lack genetic diversity and are therefore vulnerable to disease.
(iv) exotic plant pests	Some garden plants escape into natural ecosystems due to human carelessness; other plant pests are introduced due to inept, inadequate quarantine restrictions.	Exotic plants may “out compete” agricultural crops and/or native plants, reducing productivity and biodiversity.
(v) feral animals	Many animals have been allowed to escape into the wild or have been released deliberately. Feral animals include cats, foxes , rabbits, goats, camels, donkeys, horses and pigs.	Often the feral animals “out compete” native animals for food and sheltering spaces (rabbits, cane toad). They may predate on native animal (cats, foxes, cane toads). They may become so numerous that they damage natural ecosystems by overgrazing (camels, horses, donkeys, goats) and eroding water courses (pigs).
(vi) desertification	Overgrazing in semi-arid areas and the human need for wood fuel.	Reduction in the area of land useful for grazing.
(vii) deforestation	Clearing of forest for timber, agriculture or fuel.	Loss of biodiversity, native animals and plants.
(viii) overharvesting natural resources	Overexploitation may involve clearing too much vegetation, overstocking, overgrazing, the collection of too much plant material for burning ( in developing countries), overhunting of animals on land and overfishing.	Habitat destruction, erosion, loss of soil nutrients, increased dryland salinity, reduction in the populations of native plants and animals to the point of extinction, loss of biodiversity.
(ix) biomagnification	When certain pesticides and heavy metals which bioaccumulate are used indiscriminately and in large quantities over a long period of time.	The tissue concentration of pesticides and heavy metals, etc increases up the food chain so that it is highest in highest order consumers. This may affect the health of higher order consumers leading to declining populations and often a threat of extinction.
(x) ozone depletion	Increased levels of chlorofluoro-carbons (CFC's) in the upper atmosphere. These gases have been used in refrigeration, air conditioning and in other industrial processes.	More UV radiation reaches the earth's surface – increasing levels of skin cancer (in humans and pigs) and reducing the capacity of plants to photosynthesise.
(xi) climate change	Increased levels of carbon dioxide and methane in the atmosphere due to burning fossil fuels and to ruminant animals.	Increase in the world's average temperature, climate disturbance, rising sea levels, loss of arable land, loss of biodiversity.

- (c) **cats:** similar to the fox, feral cats kill birds, small mammals and may carry infectious diseases.
- (d) **pigs:** destroy plants, particularly along rivers causing increased erosion and removing habitats which are essential for breeding native wildlife.
- (e) **camels:** may damage trees. During periods of draught they may congregate around waterholes which are necessary for native animals' survival too. This reduces the populations of those animals with which they compete.
- (f) **goats:** overgraze native vegetation causing soil erosion. "Out compete" native herbivores and domestic animals. Transfer diseases to sheep.
- (ii) (a) The cane toad has poison glands which make its skin toxic to predators. In Australia it has no natural predators, therefore its population and distribution increase unchecked.
- (b) Cane toads reduce the biodiversity in areas that it invades. It "out competes" and predate on many native species and causes a decline in the numbers of its predators.
- 6.
- (i) Deforestation causes the water table to rise, especially during the wetter months of the year. The water dissolves salt which has accumulated in the soil, over thousands of years, and brings it up to or near to the soil surface.
- (ii) (a) Before clearing, in the natural ecosystem during summer the level of water underground is likely to retreat. This is because water is drawn from the water table by the deep rooted plants and transferred into the atmosphere. Little rain means that the water is not replaced (or recharged).
- (b) Winter rains cause the recharging of the water table and a rise in the water table, however transpiration by the deep rooted plants continues and restricts this rise in most areas.
- (c) After clearing, the water table remains relatively high even in the following summer, as less deep rooted plants are present to use the water and lower the water table.
- (d) During the winter, the water table rises unchecked, as less deep rooted plants are present to keep the water table well below the surface. In some places, especially low lying areas, lakes may appear. These are usually saline as the rising water dissolves crystals of salt that have leached into the soil over thousands of years. A tiny amount of salt is present in the rain that falls during the winter. The salt comes from the ocean and is carried by the N.W. winds in Western Australia that accompany the rain during winter.
- (e) When the saline lakes begin to evaporate during summer, their salinity increases. If the water disappears altogether, a layer of salt is left on the surface of the soil.
7. Some toxic substances, like mercury compounds, accumulate in the bodies of plants and animals which humans, as higher order consumers, eat. They are absorbed by plants which in turn may be eaten by herbivores and passed up the food chain to humans.
8. *E. coli* (*Escherichia coli*) is a bacterium which lives in the gut of humans (and many other mammals). It benefits the mammals by providing vitamin K. It is present in faeces and it is used as an indicator of faecal contamination and therefore the possible presence of diseases (caused by pathogenic micro organisms) associated with sewage in water bodies.
9. Yes, harvesting natural resources can be ecologically sustainable provided the resource is not over exploited.
- This can be seen in natural forests where a limited number of trees are removed each year for timber. Several new plants can be planted to replace each tree taken and these can be carefully monitored to ensure their survival to maturity. This is part of the practise of silviculture.
- Fish stocks can be maintained by both limiting numbers removed and restrictions on the size of the fish taken. This ensures that a viable breeding population remains from year to year.
- 10.
- (i) Climate change that occurs naturally ; rising temperatures as an ice age ends or declining rainfall as it begins.
- (ii) The increased percentages of carbon dioxide and methane in the atmosphere act like a blanket to trap heat energy in the lower atmosphere. More of this heat would previously have been dissipated into space.
- (iii) The problem may be reduced by limiting the amount of carbon dioxide and methane released into the atmosphere. This will require burning less fossil fuels (and relying more heavily on renewable sources of energy – solar, geothermal, tidal, hydroelectric and nuclear). It may also be reduced by reforestation and changing from diets that are heavily reliant on ruminant animals like cattle and sheep.
11. Natural ecosystems
- provide a wealth of genetic information which has not yet been studied. The value of this is not known but is likely to be significant. There are likely to be animals and plants which could be of great benefit to man;

- *biodiversity should be retained for the safety of future generations and for people to enjoy;*
  - *plants provide a large proportion of the Earth's atmospheric oxygen and remove carbon dioxide - helping to maintain other life on Earth;*
  - *provide a sustainable source of food and other resources for human populations.*
- 12.
- (i) *Human activities (including enhanced global warming and consequent climate disturbance) which destroy natural environments.*
  - (ii) *The rate of extinctions is increasing with increasing human populations and greater energy demands.*
- 13.
- (i) *Genetic strategies involve the use of molecular analysis to determine varieties of species which have evolved in particular environments. This enables a close match between an environment and suitable genotypes for restoration of disturbed areas. The recognition of different genotypes within an area can be used to make sure that when plants are reintroduced into the area, the appropriate biodiversity can be restored. Genetic studies can also reveal the extent of pollination between fragmented populations.*
  - (ii) *Environmental strategies involve more macroscopic elements of conservation. They may involve the use of biological control, e.g. the cactoblastis moth to control the prickly pear or culling feral pigs in the Perth Hills and the South-West. (Feral pigs spread dieback and also destroy natural habitats of frogs and fish).*
  - (iii) *Managerial strategies involve the use of government regulation to control human activities which interfere with natural ecosystems. The requirement for licences to catch specific fish enables the monitoring of the effect of fishing on populations of fish which are vulnerable and enables fish populations to recover the effects of over-exploitation which may have occurred in the past.*
14. *Climate change appears to be causing the climate in the south west of W.A. to become hotter and drier. This will reduce the area over which Jarrah and Karri forests (as well as other ecosystems which depend on higher rainfall) can persist.*  
*The selection of plant species and varieties which can tolerate these changed conditions may be necessary in order to prevent areas becoming desert-like.*  
*The removal of some species to other wetter areas may be necessary in order to preserve them.*
15. *See next page.*
16. *Geraldton wax is a native but it does not occur naturally in the Perth region. It grows so well in Kings Park and at Wireless Hill Park that it has become a pest species in those areas. It spreads extensively by seed and outcompetes the plants that grow naturally in these areas – this reduces biodiversity in the parks (and elsewhere).*
- 17.
- (i) *“Roundup® Ready” means that this very effective poison can be used on the canola crop without affecting the canola plants to any great extent. This enables widespread use of Roundup® to control weeds on those farms using the genetically modified canola, because it will not kill the canola.*
  - (ii) *The increased use of an effective herbicide may result in too much herbicide being used. Weed species may rapidly develop a widespread tolerance to it, as plants are selected for their ability to tolerate Roundup®. Roundup® may become ineffective against the weeds and therefore ‘Roundup® Ready’ canola may be of little value as well.*
- 18.
- (i) *The use of licences enables the governing bodies to collect revenue, which in turn can be used to police the reasonable exploitation of the resource (fish). Licences therefore may protect the fish species. The fines and removal of licences from those people who abuse the privilege to catch some of these species, also contributes to their conservation.*
  - (ii) *The charge is a ‘user pays’ system and it enables the conservation to be self-funded to some extent.*
- 19.
- (i) (a) *Natural fragmentation may occur due to climate change (e.g. the S.W. and S.E. of Australia were not always separated by a desert – when the continent was further south, millions of years ago, the movement of flora and fauna and the spread of genes – would have been more frequent as forests would have been continuous from one side of the continent to the other.*  
*Natural catastrophes and changes in the flow of rivers may fragment a large population.*  
 (b) *Artificial fragmentation occurs most frequently when land is cleared for cultivation. This may break up populations of natural plants and animals into numerous isolated ‘island’ colonies. This has been the case in W.A. where much of the south west has been cleared for wheat and sheep farming in the past and only small pockets of remnant bush remain.*
  - (ii) *Usually when artificial fragmentation occurs, it is rapid. The total area of habitat is reduced, the habitants are isolated such that interbreeding and gene flow is reduced, the amount of interface between different environments is increased while the amounts of interior habitats are decreased within the fragmented habitat.*

STRATEGY	EXPLANATION	EXAMPLE
Seed Banks	A laboratory in which plant seeds are first semi-dried and then kept in freezers or in liquid nitrogen.	The Science Directorate at Kings Park has a collection of over 2,500 seeds taken from W.A. habitats, many of the seeds have been collected from plants that are threatened.
Captive Breeding Programs	Animals are removed from their natural habitats and bred (ex situ) to produce young in protected habitats (e.g. zoos). When the species numbers and genetic diversity increase and a suitable environment becomes available, the organisms may be carefully reintroduced to their natural habitat.	At the Perth Zoo in South Perth, Chudiches, Numbats, Shark Bay Dibblers and Western Swamp Tortoises have all been bred successfully in captivity. Some have been returned to restored habitats.
DNA Profiling	Also called DNA finger-printing – involves the analysis of small segments of an organism's DNA. This is an aid to recognising the particular group or variety to which a particular organism belongs. Subtle differences between members of the same species make them better suited to particular habitats because of their phylogeny.	To restore disturbed and degraded environments (e.g. mine sites) it is important that the variety of plants and animals returned to restore the area have the original genotype – as they will be adapted best to the specific area.
New Strain Development	This involves improving the genetic makeup of a plant or animal species by genetic modification. In conservation this may help to avoid extinctions where changes to an environment are too rapid for the organism to evolve naturally. G.M. crops may also curb the need to clear more land as they may be suited to soils which are not tolerated by existing plants.	Genetically modified canola has been trialled and is now grown on many farms in W.A.
Biological Control	The introduction of an organism (predator, parasite, disease microorganism – pathogen) to control a pest species.	In Australia the rabbit has been controlled first by a virus which causes myxomatosis and now by a second virus which causes the calicivirus disease.
Reafforestation	When cleared areas of land which were previously woodland or forest have the same (or similar) native tree species replanted over the area.	Mine sites in the Darling Scarp which have been cleared for bauxite mining, have vegetation replanted over them when the mineral has been removed.
Introduced Species	Introduced species fall into two broad categories. The first consists of cultivated crops and livestock and domesticated animals. The second consists of invasive pest species and other exotic species that are not apparently harmful. Conservation generally requires the limitation of this second category.	The cane toad which is spreading from east to west across the top of Australia is presently moving into W.A. Attempts to prevent it from doing so appear to be failing – more support for those who are trying is needed.
Pest Control	The management of introduced pests that are adversely affecting natural environments.	There appears to be over 1 million camels in outback Australia. There are frequent "culls" which reduce their numbers.
National Parks	Many areas of land have been set aside in Australia for recreation and conservation. Agriculture is not permitted in these areas and they are a State Government responsibility.	In Australia, National Parks cover over 7% of the total area. They are generally wilderness areas which have a rich biodiversity.
Protected Zones	These are areas of special significance, often a 'no take' policy is enforced, which means that nothing natural can be removed from them without government permission. They are areas where natural populations can flourish and provide a source of stock in some places for neighbouring or similar ecosystems.	At Rottnest in the Marine Reserve and at Ningaloo there are 'Sanctuary Zones' – in which all the natural components are protected – people can 'look, but not touch'.
Licences	The government issues special licences to those of the public who wish to hunt or fish in particular areas, sometimes only at specific times. This enables the authorities to monitor catches and protect populations of those species involved.	Marron, Abalone, Rock lobster and several fresh water fish are protected in this way in W.A.
Open Seasons	These are limited times during the year (which can be adjusted by the authorities at short notice) in which some fish species (including shellfish) can be taken in certain areas.	Abalone could only be collected between 7 a.m and 8 a.m. on Sundays from 2nd November to 7th December (2008) in an area between the Busselton Jetty and the Greenough River Mouth.

Populations which are isolated have less genetic biodiversity and are therefore more vulnerable to change. Therefore extinctions are more likely.

Natural fragmentation is likely to occur much more slowly. Animals and plants have longer to adapt to change and therefore they are not as vulnerable to extinction.

## 2.5 Predicting Ecosystem Change

### Terminology

- (i) *data* – a collection of observations of variables that is either quantitative or qualitative
- (ii) *extrapolation* – to estimate by extending the known data. Often this involves extending a graph beyond the data that has been plotted to estimate a value that falls outside the known range.
- (iii) *macroinvertebrate* – an invertebrate that can be seen with the unaided eye.
- (iv) *model* – a scientific concept in which a process is represented by a diagram or a physical structure in order to develop a better understanding of that process.
- (v) *prediction* – is an educated guess as to what might happen in the future (usually based on a hypothesis).
- (vi) *random* – a process of selecting in which each item has an equal chance of selection. The process is therefore unbiased.
- (vii) *reliability* – a measure of the accuracy of data which is improved by an increase in the sample size that is used.
- (viii) *sample* – a small part of something (e.g. a population) intended to show what the whole thing is like.

### Review Questions

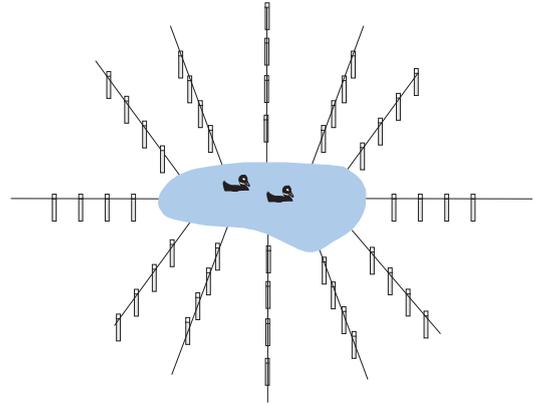
1.
  - (i) An ecosystem with a rich species biodiversity is generally more ‘healthy’. In an ecosystem with many species the food web will be more complex. The removal or reduction of one species is not likely to seriously affect other species because alternative food or shelter may be found. However, when there is little biodiversity the removal of one species can radically affect other populations as there are few alternatives for food or shelter.
  - (ii) The biodiversity of an ecosystem can be changed by change in the abiotic factors e.g. rising temperatures, reduced water availability, an increase in U.V. radiation. It can also be changed by the removal/introduction of feral organisms.
  - (iii) An ecosystem may be very ‘fragile’ if a number of its species is threatened with extinction and become rare. Small changes to this type of ecosystem may significantly reduce its biodiversity.
2. Ecosystems are more likely to continue and remain ‘healthy’, i.e. they are sustainable, if

they have a higher level of biodiversity and the species are abundant.

3.

(i)

- One way to estimate biodiversity and species abundance would be to run transects from the lake up to for example 100 metres in length radiating from a point in the middle of the lake. The position of each transect must be chosen at random around the lake and starting from the water’s edge.



- Each transect could be, for example, one metre wide. The plant species names and numbers could be recorded in each square metre along each transect.
  - The density of each species in the area could be estimated from this data.
- (ii) A development of this kind could:
- a) change the amount of water flowing into the lake.
  - b) raise or lower the water table in the area and therefore affect the depth of the lake.
  - c) affect the water quality due to wastes leaking into the lake therefore
  - d) affect the populations of invertebrates and the vertebrates which feed on them in and around the water.
  - e) change the temperature of the water.
  - f) introduce invasive plant species.
  - g) introduce domestic cats and dogs that may interfere with the native animals and birds, reducing their numbers.
- (iii)
- Using suitable traps, capture as many of the native mammals as possible ( $n_1$ ).
  - Tag these mammals using a coloured ear-clip or similar.
  - Release them.
  - One week later, capture as many of the mammals as possible again (using the same method of trapping) ( $n_2$ ).
  - In the second sample, count the number that were tagged, ( $m$ ).
  - Use this data to estimate the population of this mammal ( $N$ ).

The formula required is shown below.

$$N = \frac{n_1 \times n_2}{m}$$

(iv) The reliability of the estimate could be improved by

- conducting the estimate several times.
- increasing the sample sizes  $n_1$  and  $n_2$

(v) Several methods of collecting macro-invertebrates can be used. A long handled net with a D shaped frame can be drawn along the bed of the lake at random points and depths. The samples collected can be emptied into a white tray for identification and recording. In streams where water is moving into the lake, disturbing the muddy bed upstream with nets placed downstream in a useful way to sample.

(vi) Migratory birds would need to be observed on the lake at times when they visit. This may be only for a few weeks of the year. Careful observation and recording of their numbers and activities on the lake would need to be made each year for several years. The types of food used and the bird's use of the area for courtship and nesting would need to be observed.

#### 4.

(i) The students would have randomly selected 5 quadrats each of  $4m^2$  from the area and marked on a grid in their notes where each plant species was growing in each quadrat.

(ii) The quadrats were randomly selected so that there was no bias in their results – they did not deliberately choose areas which had few plants in them or areas which were not representative of the whole area.

(iii) The students collected data to determine the density of various plant species in a particular area. They will have a better assessment of both the abundance and biodiversity of plants in that area when the results are analysed.

(iv) That there is an association between Jarrah and Marri trees or that grass trees only grow near other trees (or some such educated guess).

(v)

PLANT	QUADRANT NO.					TOTAL
	1	2	3	4	5	
Wattle	4	4	6	6	6	26
Hibbertia	14	8	2	6	0	30
Marri	1	0	0	2	0	3
Jarrah	1	1	0	0	0	2
Grasstree	0	0	2	0	4	6
Isopogan	0	2	4	2	6	14
Kangaroo Paw	6	1	0	0	1	8

(vi)

PLANT TYPE	DENSITY (No.plants/m <sup>2</sup> )
Wattle	26/20 = 1.3 (Total no. of plants divided by total area of quadrats used)
Hibertia	30/20 = 1.5
Marri	3/20 = 0.15
Jarrah	2/20 = 0.1
Grass tree	6/20 = 0.30
Isopogan	14/20 = 0.7
Kangaroo paw	8/20 = 0.4

(vii)

PLANT TYPE	DENSITY (No.plants/m <sup>2</sup> )
Wattle	43/20 = 2.15
Hibertia	0/20 = 0
Marri	2/20 = 0.1
Jarrah	2/20 = 0.1
Grass tree	7/20 = 0.35
Isoppogan	2/20 = 0.1
Kangaroo paw	0/20 = 0
Unknown sp. ( shown as 0)	6/20 = 0.3

(viii)

- The population density of most plant species has reduced.
- Two species have disappeared.
- Only wattles have increased significantly – almost doubling in density.
- A new unknown species has colonized the area.

(ix)

- With fewer plant species, there may be an expected decrease in animal biodiversity.
- The abundance of most animal species would reduce with plant density reduction.
- There may be an increase in those animals that depend on wattles for food or shelter

(x) The food web would be less complex as the biodiversity would be smaller.

(xi) The community would be less stable. This is because the biodiversity and the abundance of most plant species have been reduced. Disease or natural disasters are likely to have a greater impact on these populations.

(xii) Reliable predictions could be made by studying the succession that has occurred in similar areas after fire. With sufficient evidence from other fires, reliable predictions can be made.

(xiii) The reliability of the data and the predictions could be improved by carrying out more quadrat studies in the area of the fire and gathering more secondary data from other studies.

### 3. INQUIRY SKILLS AND HUMAN ENDEAVOUR 1

#### 3.1 Science Inquiry Skills 1

##### Terminology

- (i) *classification* – the grouping of organisms according to their similarities and differences.
- (ii) *dependent variable* – the variable in an experiment which responds to changes in the independent or manipulated variable. Sometimes referred to as the responding variable.
- (iii) *hypothesis* – an educated guess put forward to explain an observation. To be described as a hypothesis the proposition must be testable. When evidence accumulates to support the hypothesis it becomes classified as a theory.
- (iv) *independent variable* – a variable which is deliberately changed in an experiment in order to measure the possible effect on another variable (called the dependent variable). Sometimes the independent variable is called the “manipulated” variable
- (v) *procedure* – a series of steps taken in order to achieve a result.
- (vi) *quadrat* – an area of study. Quadrats are usually definite areas (e.g. 1 m<sub>2</sub>) selected at random in order to estimate the average density of a particular organism in a particular region.
- (vii) *radio tracking* – a transmitter attached to an animal sends out a signal in the form of radio waves. The signal can be detected by an appropriate recorder.
- (viii) *taxonomic key* – a method of identifying organisms by looking at similarities and differences between them. A dichotomous key is an example of a taxonomic key.
- (ix) *transect* – a sampling line taken across part of a environment in order to survey the plants and/or animals in the area.
- (x) *variable* – a factor in the environment or in an experiment which can change.

##### Review Questions

1.
  - (i) “That classical music promotes the growth of beans.”
  - (ii) It was controlled by using batch Y – batch Y was treated in every way the same as batch X but with one variable, the music, omitted from its environment. It could therefore be compared to X and any differences in growth could be attributed to the music.
  - (iii) Using many bean seeds helps to improve reliability. The results should be more typical of what to expect. It eliminates error which may be due to sick or abnormally slow growing beans.

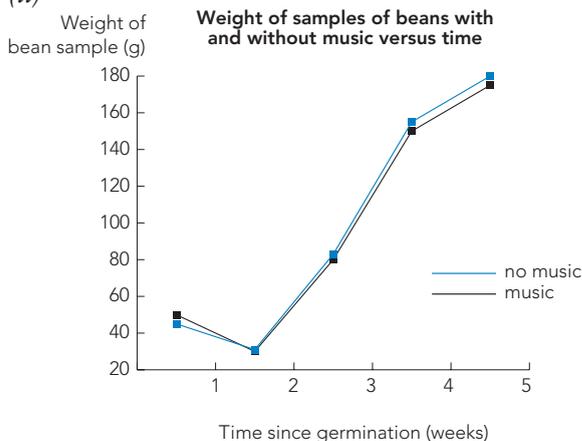
- (iv) a) *Independent variable*: presence or absence of classical music.
- b) *Dependent variable*: dry weight of bean seeds.
- c) *Soil type, soil temperature, bean type (variety), amount of water used, regularity of watering, amount of light received, wind (protection).*
- (v) a) A sample placed in a ‘slow’ oven (so that it is not burnt to a cinder). The water content of the plant gradually evaporates leaving just the organic matter. This can provide a good measure of plant growth.
- b) ‘Total weight’ (before heating) includes both the organic matter in the plant and also its water content. Water content may vary because of prevailing weather conditions and soil water content. A better measure of a plant’s accumulation of sugar, starch, protein, etc is its ‘dry weight’.
- (vi) Samples are chosen randomly to avoid bias. (It may be in the interests of the biologist’s back to carry only small plants back to the laboratory – but they might not reflect the normal growth.)
- (vii) Repetition is necessary to confirm results. A hypothesis cannot be accepted as true unless experiments based on that hypothesis consistently support it by providing similar results.

2.

- (i) Table: Dry Weight of Bean Seedling Samples with and without Music taken at weekly intervals from germination.

TIME SINCE GERMINATION (weeks)	WEIGHT OF BEAN SAMPLE (g)	
	Music	No Music
1	50	45
2	30	31
3	80	83
4	150	155
5	175	180

(ii)



- (iii) No. It does not because the plants show little difference in their growth weights. The growth rates follow a very similar pattern.

(iv) Repeat the experiment several times. Use different varieties of bean. Continue the experiment beyond 5 weeks. Measure the productivity of the beans by the weight of bean seeds they produce. Use even larger samples. Play different types of music. Vary the loudness. Use different soils.

(v) No. Unless other plant species were tested it would not be justified to generalise. Before a generalisation about the effect of music on plant growth can be made, many other plant species should be tested.

3.

(i) Sample size – increases the reliability of experiments, too small a sample may not be typical of the whole population.

(ii) Randomly selected samples – avoid bias.

(iii) Replicates – increases the reliability of results, if similar results are obtained our confidence in their reliability is improved.

(iv) Repeat Procedures – confirms (or otherwise) previous findings thus increasing reliability.

4. This is one example. You may choose any other suitable case study.

a) Louis Pasteur (1822 – 1895) recognised that often wine became sour while fermenting, whereas at other times the grapes fermented as required and produced drinkable wine. He recognised a problem.

b) The conditions in which the wines were crushed, bottled and cooked were examined. Other related food spoilings were assessed. Pasteur studied the micro-organisms found in both sour and good wine. He observed that the wines had different micro-organisms.

c) Pasteur proposed the hypothesis that the souring of the wine was caused by different types of micro-organisms from the types that produced good wine.

d) Pasteur developed techniques to exclude bacteria from the crushed wine. He developed a method of killing all the microbes in wine that had fermented correctly. Pasteur carried out controlled experiments, e.g. his ‘swan necked’ flask, designed to prevent microbes from entering wine in an experimental flask.

e) Pasteur examined the condition of wine that had microbe contamination with wine that had none. He collected data from wine treated by heating it for a few minutes at between 50° and 60° (pasteurisation).

f) Pasteur’s results supported his hypothesis that microbes of a particular type caused the souring. He also found that good wine could be preserved by pasteurisation.

5.

(i)

- Randomly select a number of quadrats (e.g. 20) of a suitable size (e.g. 100 m<sup>2</sup>)
- Count the number of Jarrah trees in each quadrat
- Calculate the average number of Jarrah trees in each quadrat (e.g. 0.01 per 100 m<sup>2</sup>)
- Convert this to a suitable unit (e.g. 1 per 10,000 m<sup>2</sup> = 1 per hectare).

(ii) Calculate population using the formula:

Total Population = density × total area.

Total area: = 0.5 km × 1.0 km

= 500 × 1000 m<sup>2</sup>

= 500,000 m<sup>2</sup>

= 50 hectares

Total Population = 1 × 50 = 50.

6.

(i)

- Capture a number of wallabies (as many as conveniently possible), (n<sup>1</sup>)
- Tag these animals (e.g. using a small inconspicuous clip on an ear).
- Release them back into the wild.
- Some time later (e.g. 3 weeks) capture another sample, (n<sup>2</sup>)
- Count the number tagged in this second sample (m).

$$(ii) N = \frac{55 \times 31}{6}$$

$$= \frac{55 \times 31}{6}$$

$$\approx 284$$

7.

(i) Small animals that walk or crawl along the ground, but cannot fly.

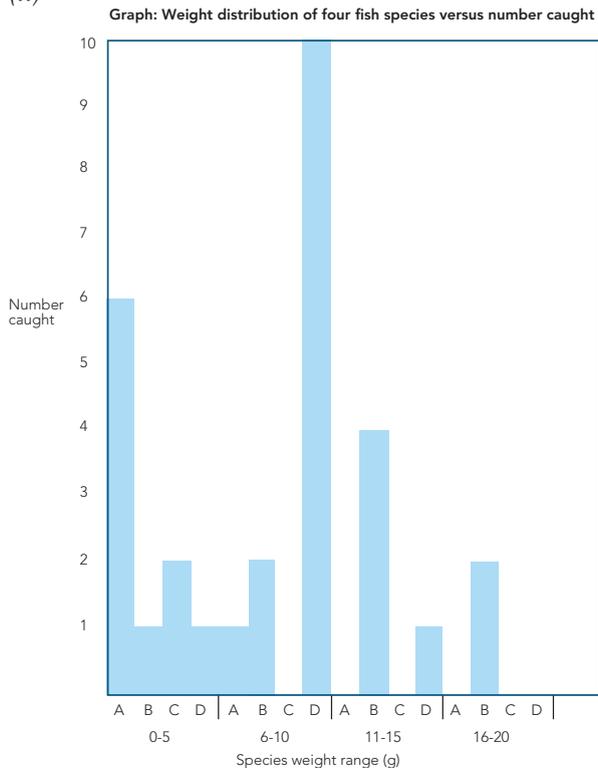
(ii) Animals left in ‘pit traps’ will die due to lack of food, water or warmth if left unattended.

8.

(i) Weight distribution of four species of fish caught

SPECIES	WEIGHT (g)			
	0-5	6-10	11-15	16-20
A	IIII I	I		
B	I	II	IIII	II
C	II			
D	I	IIII IIII	I	

(ii)



9.

(i) (a) The hypothesis should be a testable, educated guess, which explains an observation.

(b) It should be based on good scientific information, from other reliably tested hypotheses.

(ii) The method could be described as reliable if the results which were obtained could be reproduced by others using the same method, if the methods used reduced the source of errors to a minimum and properly tested the hypothesis, i.e. as accurately as possible establishes any link (or otherwise) between the two variables (the independent and dependent variables).

(iii) If the samples chosen for the experiment were not representative of the whole population, then the results are not reliable. This could occur because they were not randomly selected or the sample size may be too small (and therefore does not represent the population as a whole).

(iv) Error may result from carelessness or poor equipment. Carelessness may be reduced by repetition of readings from scientific instruments or by other individuals carrying out the experiment. Poor equipment may result in the degree of error in the measurements becoming so significant that the measurements are unreliable, e.g.  $5 \pm 1 \mu\text{m}$  – implies the reading could be anywhere between 4 and 6  $\mu\text{m}$  which in the context of other results might make the measurement meaningless.

(v) A very careful analysis of the data is necessary to establish whether the hypothesis

is supported or refuted. This should take in to account the degree of error involved in the data. How confident you are (which is statistically determined) of the correlation between the two variables (dependent and independent) will provide a guide as to whether the hypothesis is supported or not.

(vi) Shorter internet reports (e-publications) are likely to lack the data necessary for assessment. They can be easily published. The reader therefore needs to view them with critical awareness though they may be of both interest and value.

The internet also enables the production of much longer scientific reports with more detailed methodology, more data, graphical and animated results and longer discussions. However, they may also avoid 'peer review' that normally comes with the written articles in scientific journals.

(vii) Peer review, which involves scientists working in the same field evaluating an experiment or scientific study before it is published, tends to reduce the amount of unreliable and invalid information circulated by reputable scientific journals.

10.

(i) A control is a 'set up' in which all variables are the same as in the experiment, except the independent variable. This enables comparisons to be made between the control 'set up' and the experimental 'set up' to determine the effect any change to the independent variable has on the dependent variable.

(ii) To compare with the experiment in order to determine how the independent variable affects the dependent variable.

11. Family: Myrtaceae Choices: 1b, 5b, 8a.  
Family: Myoporaceae Choices: 1a, 2b, 3b.

12.

(i) The Effect of Caffeine on Human Heart Rate.

(ii) To test the hypothesis that caffeine in the diet increases human heart rate.

(iii)

- Area to seat 50 adults.
- At least 50 caffeine tablets and 50 placebo tablets.
- Stopwatches.
- Several people to help measure heart rates.

(iv)

- Select population sample (100) randomly.
- Divide sample into control (50) and experimental (50) group (randomly).
- Allow 15 minutes rest.
- Measure and record all resting heart rates.
- Administer appropriate tablets to each group.
- Measure and record all new heart rates.
- Calculate average values for each group.

(v)

SUBJECTS' STATUS	HEART RATE AVERAGE (beats/min)	
	Before	After
Caffeine (Experimental Group)	70	89
No caffeine (Control Group)	73	75

(vi) The results indicate that the caffeine tablet had a significant effect on the heart rate. It rose on average by 19 beats/minute compared with the control group whose average heart rate increased by only 2 beats/minute.

(vii) Douglas P and Luft R. 2007 Heart Rates, Macmillan, London.

Long, R.J. 1998. Caffeine and Its Effect on Blood Pressure, Penguin, Melbourne.

13.

(i) 100.

(ii) Chosen in an unbiased way. Not selected using any criterion.

(iii) Only healthy adults chosen or only adults below the age of 25 years but older than 18 years.

(iv) This group was to act as a comparison to determine whether or not the caffeine intake affected the heart rate.

(v) Number in each subgroup, each given a pill, time of heart rate measurement.

(vi) Caffeine intake.

(vii) Heart rate.

14.

(i) 50 in each group is reasonable. However a greater number (say 200) would be more appropriate to increase the reliability of the results.

(ii) Yes the biologist randomly selected all participants therefore avoiding any bias.

(iii) There was only one control group and one experimental group. The biologist would improve reliability with more than two groups.

(iv) The procedure was not repeated. Again, doing the experiment a number of times would also improve the reliability of the data.

15.

- Use a greater sample size.
- Repeat the experiment a number of times.
- Use a number of different caffeine tablets with varying concentrations of caffeine.
- Determine the tolerance to caffeine in the sample of people used.

## 3.2 Science as a Human Endeavour 1

### Terminology

(i) *biodiversity hotspot* – an area of the biosphere that has rich biodiversity and is threatened with destruction by human activity e.g. SW Australia

(ii) *ecosystem resilience* – the capacity of an ecosystem to withstand disturbance and to recover from change.

(iii) *fire regimes* – the frequency and intensity of the bushfires that have occurred in a particular area.

(iv) *genetic diversity* – refers to the variations within a species, which is due largely to the number of alleles within the population.

(v) *migration route satellite sensing* – this process involves the attachment of transmitters to a sample of a migratory species. Radio waves emitted from the animals' transmitters can be detected by satellite receivers which then relay messages down to receivers on the earth for analysis.

(vi) *single species conservation* – a single species is targeted for conservation. This approach may have positive effects on other associated species.

### Review Questions

1.

(i) Organisms are generally classified according to their structure, e.g. animals which have a backbone are placed in the Vertebrata (sub-phylum).

(ii) Recently some organisms have been reclassified on the basis of DNA evidence.

(iii) A clearer understanding of the evolution of the species is obtained and a need to conserve some species may become more apparent.

2. A conservation reserve is an area of natural significance which is set aside for preservation. These areas are important because they often contain populations of plants and animals that are threatened with extinction elsewhere.

3.

(i) Keystone species are believed to have a disproportionate importance in the ecosystems in which they exist. Their decline is likely to affect many other populations and therefore these species needs to be protected perhaps more than others.

(ii) Other factors may be leading to the ecosystem's decline, e.g. disease, salinity, climate change

(iii) Some ecologists believe that by targeting one species for conservation, conservationists are neglecting to secure other species and not considering the environment as a whole. They are neglecting to consider the biodiversity of the ecosystem in which the targeted species lives.

The panda is an example of this type of conservation – many other less attractive or iconic animal and plant species may be threatened in the same environment as the panda but they may be disappearing without being noticed. The underlying causes of

these extinctions are not being addressed by targeting just the panda for conservation. (v)

4.
  - (i) Biodiversity can be understood at three different levels.
    - genetic diversity – variety of genes within a species.
    - species diversity – the number and types of species.
    - ecosystem diversity – the variety of habitats and communities.
  - (ii) Australia's biodiversity is under threat for many reasons. These factors include climate change, changing fire regimes, over clearing of land for agriculture, introduction of feral animals and exotic plants, pollution, overstocking and urban sprawl.
  - (iii) The "precautionary principle" means that measures should be taken to avoid an accident if it is thought to be a possibility. This applies particularly to environmental catastrophes that may be almost impossible to reverse. Scientific understanding may be limited because insufficient time and money has yet to be allocated to a particular problem; the principle implies that an economic project or process which may affect an ecosystem should be delayed until the necessary research has been done.
5.
  - (i) Many ecosystems, in the oceans particularly, are shared and do not belong to one nation. Many ecosystems straddle national borders.
  - (ii) The tropical forests of the Amazon though largely in Brazil (over half) are also part of Peru, Colombia, Venezuela, Ecuador, Guyana, Bolivia, Suriname and French Guiana.
  - (iii) (a) Sites must be of outstanding universal value and meet at least one out of ten selection criteria. The criteria have been developed by the UNESCO. Four of the ten criteria relate directly to biological principles. For example one criterion states the area must "contain the most important and significant natural habitats for in situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation."  
 (b) The south west of WA is described as a "biodiversity hotspot" because it has great biodiversity and is threatened (by many factors including climate change).
  - (iv) Along the western coast from the Cape Naturalist to areas north of Broome and along the entire length of the eastern coast up to Cape York.



- (vi) The whales migrate from Antarctic waters to the northern waters of Australia in winter to mate and give birth to their young in warm water and they move south to the Antarctic in summer to feed on krill.
  - (vii) If the routes were interrupted their reproductive life cycle would be threatened and the animals would become endangered.
  - (viii) This interrupts the birds' life cycles and threatens their capacity to breed and survive. They migrate to escape the harsh winter conditions of another continent where there is little food for them in the northern winter and therefore without an alternative food supply they would become endangered.
6.
    - (i) Satellite sensing involves making images of the earth's surface from satellites to reveal the vegetation type and the degree of cover of large areas of land. When the procedure is conducted on a periodic basis this enables the monitoring of change to the vegetation. The degree to which particular species can be identified depends on their size, colour and the resolution of the instruments used.
    - (ii) Similar data can be obtained through time consuming surveys of the vegetation by sampling at ground level, e.g. using quadrats to collect data. This may be difficult in areas that are remote or difficult to access.
    - (iii) Satellite sensing enables large areas to be surveyed quickly, but it is expensive and less accurate in terms of species discrimination. Conversely, conventional means are less expensive and more accurate but they may be very difficult to conduct and very time consuming only allowing small areas to be assessed.

7.
  - (i) Before approving the research the ethics committee would need to be confident that the wellbeing of the animals was not threatened and that their treatment would be humane.
  - (ii) The size and shape of the animal species.
  - (iii) Glued on – dragon fly, bee  
Collar – possum, bandicoot  
Implant – fish, crocodile
  - (iv) Whether the animal flies and the size of the animal.  
If the animal flies (e.g. bird) then the weight of the transmitter would need to be reduced. If the animal was small the weight would have to be correspondingly small.
  - (v) This may alert the biologist that the transmitter had fallen off the animal or that the animal was dead.
  - (vi) An animal species which has a large territory over which it ranges (e.g. phascogale) may require a more sensitive receiver because it is likely to be a long way away from the animal and its transmitter on many occasions.

## 4. CELLS AS THE BASIS OF LIFE

### 4.1 Prokaryotic & Eukaryotic cells

#### Terminology

- (i) electron micrograph – a photograph taken with the aid of an electron microscope.
- (ii) exocytosis – the removal, by means of a vacuole, of wastes or secretions via a cell's membrane.
- (iii) metabolic waste – a chemical produced by the chemistry of the cells that is not required by the body and may become toxic if allowed to accumulate in the body, e.g. urea, CO<sub>2</sub>, lactic acid, uric acid, ammonia.
- (iv) nutrient – a substance which supplies living things with the raw materials for growth and/or energy.
- (vi) organelle – a small structure within the cytoplasm of a cell which carries out a particular function, e.g. mitochondrion.
- (vii) respiration – the chemical breakdown of organic matter, often glucose, in order to release energy, which takes place in cells.

#### Review Questions

1.
  - (i) Photosynthetic plant cells take carbon dioxide, water, light energy, mineral ions and when necessary oxygen from their surroundings.
  - (ii) Carbon dioxide, water and light energy are required for photosynthesis. Mineral ions are used as co-factors (assisting enzymes) and in the synthesis of many organic compounds using glucose as the starting compound.
  - (iii) The light energy absorbed by the plant cell is converted to chemical energy.

2.
  - (i) Animal cells take food (mainly organic matter), water and oxygen and some heat energy from their surroundings.
  - (ii) Food is used as a source of energy. It is also a source of the raw materials needed for growth, e.g. amino acids needed for protein synthesis. It also provides vitamins, some of which are co-enzymes (assisting enzymes).  
Water is used as a medium in which all the essential metabolic reactions take place. It is essential in the dilution of nitrogenous wastes. It may also be used to help cool the whole organism. Important in transporting materials.  
Oxygen – needed for aerobic respiration which provides the cell's energy.  
Heat may be used especially in an ectothermic animal to increase its cells' metabolic rate.

3.
  - (i) water + carbon dioxide → glucose + oxygen
  - (ii) Chlorophyll, light energy, enzymes, ADP and P must be present.
  - (iii) in chloroplasts.
  - (iv) Light – provides the energy to produce ATP, the energy in ATP is then used to synthesise glucose.  
Water – this is a raw material (its hydrogen is used in building the glucose and its oxygen released).  
Enzymes – photosynthesis, like respiration takes place in many stages with many intermediate compounds formed before the final products (glucose and oxygen). Each stage is controlled by a specific enzyme.  
Carbon dioxide – raw material, the carbon is used in the glucose and the other organic compounds formed from it.  
Chlorophyll – pigment which absorbs light energy and transfers it to the ATP.

4.
  - (i) Wastes cells produce are mainly products of respiration which include CO<sub>2</sub>, water, lactic acid, ethynol and methane. Used proteins that have degraded and excess amino acids are deaminated.
  - (ii) Wastes may leave the cell by diffusion as in the case of water and CO<sub>2</sub> or be eliminated through exocytosis e.g. waste proteins.
  - (iii) Wastes must be removed so that they do not interfere with the normal metabolism of the cell.

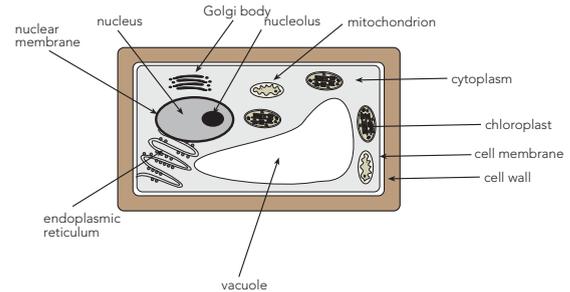
5.
  - (i)
    - (a) Nucleus.
    - (b) Cell wall.
    - (c) Plasma/cell membrane.
    - (d) Chloroplast.
    - (e) Nuclear membrane.
  - (ii)
    - (a) Chloroplasts.
    - (b) Root cells are generally below ground level in the soil. They do not photosynthesise. They either store nutrients or absorb water and minerals.

- (iii) (a) Nuclear membrane.  
 (b) Nucleus/nuclear plasm.  
 (c) Cell membrane.  
 (d) Cytoplasm.
- (iv) **Length:**  
 Length of the cell on page = 107 mm  
 Length of 5µm on page = 22 mm  
 $\therefore$  number of 5µm lengths =  $107 \div 22 = 4.9$   
 $\therefore$  actual cell length =  $4.9 \times 5\mu\text{m} = 24.5\mu\text{m}$
- Width:**  
 Width of the cell on page = 70 mm  
 Length of 5µm on page = 22 mm  
 $\therefore$  number of 5µm lengths =  $70 \div 22 = 3.2$   
 $\therefore$  actual cell length =  $3.2 \times 5\mu\text{m} = 16\mu\text{m}$ .
- (v)  
 a) Nuclei.  
 b) Length of white blood cell on page = 81 mm  
 Length of 5µm on page = 35 mm  
 $\therefore$  number of 5µm units in white blood cell's length =  $81 \div 35$   
 $\therefore$  actual cell length of white blood cell =  $81 \div 35 \times 5\mu\text{m} = 11.6\mu\text{m}$
6.  
 (i) Prokaryotic cells have no membrane bound organelles. The DNA consists of a single doughnut shaped molecule, which is not enclosed in a membrane. Eukaryotic cells have a membrane-bound nucleus and various other membrane bound organelles.  
 (ii) Prokaryotes include bacteria and cyanobacteria (blue-green algae). Eukaryotes include plants, animals, protists and fungi. Most organisms are eukaryotes.
7.  
 (i) A plant cell has a cellulose cell wall. An animal cell does not have a cell wall.  
 (ii) Plant cells often carry out photosynthesis. They are autotrophic. They have chloroplasts. Animal cells do not synthesise their own food but are heterotrophic. They do not have chloroplasts.  
 (iii) A plant cell has a large fluid filled vacuole. An animal cell does not.  
 (Most animal cells have centrioles, most plant cells do not).
8.  
 (i) The cell wall gives the plant cell its strength and rigidity. Animal cells are more flexible. A multicellular animal requires extracellular material, e.g. bone, for support.  
 (ii) Plant cells often carry out photosynthesis – they are autotrophic. Animal cells do not synthesis their own food but are heterotrophic.  
 (iii) The fluid filled vacuole in plants provides a reserve of water and minerals. It also provides support. Animals obtain water and minerals from other sources when these are required.
9. Both cell types have a cell membrane, DNA, cytoplasm, cytoskeleton and ribosomes. Prokaryotes have a cell wall, many

eukaryotes (plants and fungi) also have a cell wall though of a different composition.

10.  
 (i) Metabolism – the chemical processes which occur within the body of an organism. These include both anabolic and catabolic processes.  
 (ii) Photosynthesis – absorbs energy  
 Respiration – releases energy

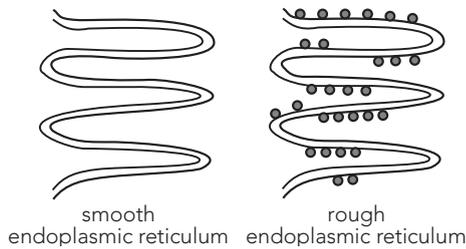
11.



12.

- (a) plasma membrane: selectively permeable – allows some things to enter or leave freely, actively transports when necessary, contains the fluid of cytoplasm.  
 (b) cell wall: provides plant cell with support and protection.  
 (c) nucleus: contains DNA which indirectly controls the activities of the other cell parts.  
 (d) vacuole: large plant vacuole stores water and some mineral ions.  
 (e) chloroplast: contains chlorophyll for photosynthesis, converts light energy to chemical energy.  
 (f) ribosome: site for protein synthesis.  
 (g) endoplasmic reticulum: membranous canal system for transport of substances within the cytoplasm, especially from nucleus to cell membrane.  
 (h) mitochondrion: site for aerobic stage of respiration.  
 (i) Golgi body: collecting and packaging centre for substances synthesised by cell.  
 (j) centriole: forms spindles in cell division (not found in higher plant cells).  
 (k) cilia: hair like structures which help propel many single celled organisms. Also found lining trachea in humans helping to remove dust by carrying mucus from lungs.  
 (l) flagellum: long thread-like organelle - moves to propel some cells (e.g. sperm and some protozoa and algae).
13. (c) nuclei.  
 (g) endoplasmic reticula.  
 (h) mitochondria.  
 (k) cilia.  
 (l) flagella.
14. Lysosomes are single membrane bounded bag-like organelles in the cytoplasm containing digestive enzymes. They are involved in intracellular digestion.

15.  
 (i) Some ER has ribosomes attached to the membrane giving it a rough appearance, smooth ER has no ribosomes attached.  
 (ii)



## 4.2 Cell Membranes

### Terminology

- (i) *concentration* – the amount of a solute in a given volume of solvent.  
 (ii) *concentration gradient* – the change in the concentration of a solute that may occur from one part of a solution to another part of that same solution.  
 (iii) *emulsify* – to physically break oil into smaller droplets, e.g. bile salts physically divide (digest) lipids into small droplets which can then be more quickly chemically digested by lipase because of the oil's increase in surface area to volume ratio.  
 (iv) *extracellular* – outside the cell. The fluid which surrounds a cell inside a multicellular organism is called extracellular fluid.  
 (v) *hydrophilic* – a molecule or part of a molecule which is attracted to water.  
 (vi) *hydrophobic* – a molecule or part of a molecule which is repelled by water.  
 (vii) *osmosis* – the movement of a solvent (usually water) by diffusion through a differentially permeable membrane.

### Review Questions

1.  
 (i) Lipids.      (ii) Proteins.  
 (iii) Alcohol breaks down cell membranes. This is because it dissolves lipids.  
 (iv) Detergent breaks down cell membranes. This is because it emulsifies lipids.
2.  
 (i) bilipid layer (with lipids showing both hydrophobic and hydrophilic regions).  
 (ii) protein (with a central hydrophilic region which allows ions and some molecules to pass through).  
 (iii) protein (with shaded hydrophobic and unshaded hydrophilic regions) – passes through entire membrane.  
 (iv) branching carbohydrate attached to protein (forming a glycoprotein).  
 (v) small protein not spanning entire membrane  
 (vi) branching carbohydrate attached to a lipid (forming a glycolipid).

The “fluid mosaic” model proposes that the cell membrane is made up of two layers of lipid. Proteins “float” in the lipids, some extend right across the membrane (and may form channels through which substances pass) and some proteins do not extend right through the membrane but float on either the external or internal surface of the membrane.

3.  
 (i) Active transport, pinocytosis, phagocytosis, exocytosis.  
 (ii) These are called “active” processes because they require energy provided by the cell.  
 (iii) Diffusion and osmosis.  
 (iv) These are passive because no energy needs to be supplied by the cell. The particles move because they have kinetic energy and therefore move down a concentration gradient.  
 (v) Pinocytosis and phagocytosis.
4.  
 (i) Both osmosis and diffusion are passive processes, i.e. they do not require an external source of energy. They involve the movement of substances from where they are more concentrated to where they are less concentrated.  
 (ii) Osmosis is a special case of diffusion. It is the diffusion of a solvent (in living things this solvent is water) through a selectively-permeable membrane (in living things this is a plasma membrane). Diffusion does not necessarily involve a solvent moving. It may be any solute or solvent and does not necessarily involve a selectively-permeable membrane.
5. (a) This shows the **glucose** concentration is **higher** on the outside than on the inside. Glucose molecules are too **large** to pass into the cell by normal **diffusion**.  
 (b) A glucose molecule fits on to a transport **molecule** like an enzyme fits its **substrate**.  
 (c) The transport protein changes **shape** so that the **glucose** molecule can move **through** the cell membrane.  
 (d) This process is called **facilitated** diffusion. Another glucose molecule can now fit onto the **transport** protein.
6.  
 (i) Cell A. The concentration gradient is greater for cell A, i.e. there is a higher concentration outside cell A and a low concentration inside cell A. Therefore the molecules will move rapidly into cell A.  
 (ii) The molecules will continue to be absorbed while there is a concentration gradient. If the cell is using up the molecules as they are absorbed, they will continue to enter the cell by diffusion until none remain in the extracellular fluid.

7.

CUBE	SURFACE AREA (cm <sup>2</sup> )	VOLUME (cm <sup>3</sup> )	S.A. : V (cm <sup>2</sup> / cm <sup>3</sup> )
1	6	1	6
2	24	8	3
3	54	27	2

- (i) Cube 1 (it has 6 cm<sup>2</sup>/cm<sup>3</sup>)  
Cube 3 (it has 2 cm<sup>2</sup>/cm<sup>3</sup>)
  - (ii) Provided the shape remains constant, the S.A. per unit volume becomes smaller as the cube increases in size.
  - (iii) As the cell increases in size, the rate of diffusion per cubic centimetre of its volume, would decrease. Its ability to absorb nutrients and eliminate wastes would become less rapid and therefore less efficient.
8. Molecules which are non-polar (i.e. have no positive or negatively charged ends) and fat soluble pass through the membrane easily because the cell membrane is largely phospholipid.

### 4.3 Biochemical Processes & Enzymes

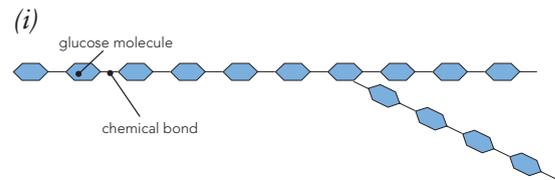
#### Terminology

- (i) biochemical process – a chemical process that occurs in a living cell.
- (ii) convolution – a fold in a membrane or tubule which increases its total surface area.
- (iii) inhibit – to limit the action of a process or function, e.g. to limit the production and release of a hormone from an endocrine gland.
- (iv) monomer – a molecule that can bond with similar molecules to form a long chained molecule or polymer, e.g. glucose molecules form starch.
- (v) pH – the level of acidity or alkalinity in a solution. This is dependant on the H<sup>+</sup> ion concentration. Acid solutions have a high H<sup>+</sup> ion concentration and a pH of less than 7. Alkaline solutions have a pH greater than 7. A neutral solution has a pH of 7.
- (vi) polymer – molecule made up of a long chain of monomers, e.g. glycogen is made up of a long chain of glucose molecules.
- (vii) reactant – a substance which is chemically changed during a chemical reaction.

#### Review Questions

1.
  - (i) Monosaccharides (simple sugars).
  - (ii) Fatty acids and glycerol.
  - (iii) Amino acids.

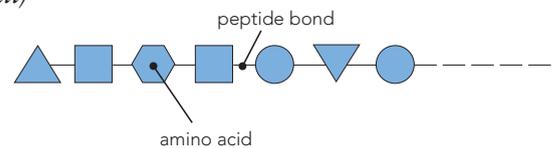
2.



(ii)



(iii)



3.

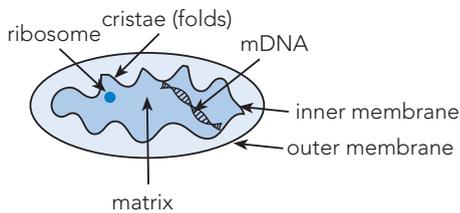
NUTRIENT	SOURCE	FUNCTION
Amino acids	animal and plant protein	structural proteins for growth and enzymes
Simple sugars	starch and other carbohydrates	source of energy
Fatty acids	fats and oils	structural lipids (e.g. cell membranes) and hormones. Food store

4.

- (i) The ER is a network of membranes which is continuous with the nuclear membrane that form channels within the cytoplasm of a eukaryotic cell. It is used to transport materials about the cell.
- (ii) Eukaryotic cells need to transport substances over a longer distance. They are up to 1000 times the diameter of a prokaryote. To do this efficiently the substances are confined to channels.  
Substances can move by diffusion within prokaryotic cells because these cells are so much smaller.
- (iii) The substances, e.g. proteins, can move into the channels of the reticulum and then move along the channels to their required destination in the cell.

(iv) Many enzymes are imbedded in membranes (e.g. on the cristae of mitochondria) which are central to the biochemical processes within cells.

(v)



(vi) The folds allow for the attachment and exposure of a greater density of enzymes that control aerobic respiration and the synthesis of ATP.

(vii) Having biochemical processes separated within the cell makes for greater efficiency. The concentration of the reactants is not altered by other unnecessary substances, products can be removed to promote further reaction, enzymes are more likely to combine with their substrate and the pH of the compartment can be maintained at an appropriate level. Being selectively permeable, membranes play a role in allowing only those substances that are required to enter or leave the organelle. Within the chloroplast which has an outer membrane itself, the light dependent stage and the light independent stage are separated by the thylakoid membranes.

5.

(i) Graph 1 indicates that a higher energy level must be reached for the reaction to occur, than in graph 2.

(ii)  $E_{A1} > E_{A2}$

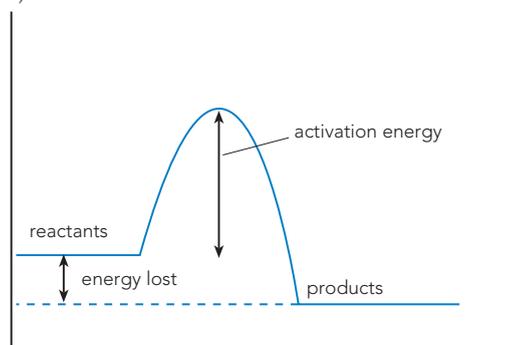
(iii) a) The substance 6 must be a more complex compound than both 1 and 2.

b) An anabolic reaction in which a more complex compound is synthesised.

(iv) The enzyme has lowered the activation energy, i.e. it has lowered the amount of energy needed to cause the reaction to occur.

(v) This requires less energy and therefore less stored food is used. Also the temperature required to cause the reaction to occur at an appropriate rate does not need to be as high.

(vi)



6.

(i) The energy required by every chemical reaction, which is needed by the molecules

before they will begin to react. The activation energy makes the molecules collide with enough force to interact. Every chemical reaction needs some energy to begin.

(ii) By an increase in temperature.

(iii) An increase in temperature may damage living cells by causing proteins to denature.

(iv) An enzyme will lower the activation energy which is needed by a chemical reaction.

7.

(i) Because they are not changed by the reaction and are reused in the cell's metabolism many times before they denature.

(ii) The 'active site' or 'catalytic site' is the place on the enzyme onto which the substrate fits.

(iii) Temperature alters the three dimensional shape of the enzyme molecule – it therefore alters the shape of the active site and affects the enzyme's efficiency (like a melting key). If the enzyme is heated too strongly, its shape is changed irreversibly – it is denatured. There is therefore an optimum temperature at which an enzyme functions best.

(iv) Enzymes are sensitive to pH and their activity is also affected by the concentration of both the reactants and the products.

8.

(i) 'Specificity' of enzymes means that each biochemical reaction is catalysed by a particular enzyme. The substrate only fits one particular (specific) enzyme.

(ii) Most chemical processes (e.g. photosynthesis, respiration, protein synthesis) occur in many stages. Each stage is controlled by a specific enzyme, thus there needs to be thousands of different enzymes to catalyse all these metabolic processes.

(iii) If an enzyme was missing, then it is very likely that the amount of the desired end products would be too small and the normal functioning of the cell would not occur.

9. Enzyme inhibitors are chemicals that either occupy the active site of an enzyme preventing its substrate from forming an enzyme-substrate complex (a competitive inhibitor) or change the shape of the enzyme (and its active site) so that it no longer fits the substrate (a non-competitive inhibitor).

10.

(i) As the concentration of the reactants increases the rate of the reaction increases until a limiting factor (e.g. concentration of an enzyme) begins to reduce the rate.

(ii) As the concentration of the product/s increase the rate of the reaction decreases. If the product/s is/are removed or changed chemically they will not slow the forward reaction.

11.

(i)

• Both agree that after the reaction has occurred, the enzyme is unchanged and can therefore be used again or recycled.

- Both agree that the reactant/s fit into the enzyme temporarily forming an enzyme-substrate complex.
- (ii) They are different in that while the first model proposes a fixed shape for the enzyme, the second model proposes that the enzyme has a flexible shape and therefore a flexible active site.
- (iii) a) 'Lock and Key' model.  
b) 'Induced Fit' model.

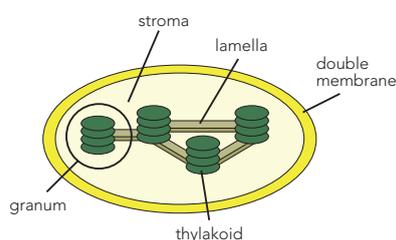
## 4.4 Photosynthesis & Cellular Respiration

### Terminology

- (i) adenosine triphosphate (ATP) – a compound made up of adenine, ribose (sugar) and three phosphate groups. The three phosphate groups are bonded in a row and energy is stored in the bond between the second and third phosphates. If this third bond is broken that energy is released for use by the cell.
- (ii) by-product – a chemical formed by a reaction or a process which is not the principal or main substance formed.
- (iii) anaerobic – a biological process which occurs in the absence of oxygen, e.g. fermentation.
- (iv) cytosol – the fluid part of the cytoplasm.
- (v) glycolysis – the anaerobic breakdown of glucose into pyruvate. It is the common metabolic pathway at the beginning of both aerobic and anaerobic respiration.
- (vi) granum – (plural: grana) part of a chloroplast which consists of a stack of thylacoids containing chlorophyll, where the light dependent stage of photosynthesis occurs.
- (vii) lamella – (plural: lamellae) flat membranes that contain chlorophyll and connect grana within the stroma of a chloroplast. Lamellae create a system in which all the thylacoids within a chloroplast are interconnected.
- (viii) limiting factor – a variable in an organism's environment which restricts its growth and reproduction.
- (ix) stroma – the fluid part of a chloroplast outside the thylacoids; where the light independent stage of photosynthesis occurs.
- (x) thylakoid – a membrane bounded sack which has chlorophyll and other photosynthetic pigments on its outer surface. The pigments absorb light energy which is used in the light dependent stage of photosynthesis that occurs in the inner part (the lumen) of the sack.

### Review Questions

1.



2.

(i)



(ii) There needs to be:

- (a) chlorophyll present
  - (b) a suitable temperature
  - (c) particular enzymes and
  - (d) sunlight.
- (iii) in chloroplasts.
- (iv) **Light** – provides the energy to produce ATP, the energy in ATP is then used to synthesise glucose.

**Water** – this is a raw material (its hydrogen is used in building the glucose and its oxygen is released).

**Enzymes** – photosynthesis, like respiration takes place in many stages with many intermediate compounds formed before the final products (glucose and oxygen). Each stage is controlled by a specific enzyme.

**Carbon dioxide** – raw material, the carbon is used in the glucose and the other organic compounds formed from it.

**Chlorophyll** – a green pigment which absorbs light energy and transfers it to the ATP.

**ADP and P** – used to make ATP.

3.

(i)  $C_6H_{12}O_6$

(ii) six (6)

(iii) six (6)

(iv) six (6)

(v) glucose (it has a total of 24 atoms and three different elements).

(vi) anabolic, as light energy is absorbed.

4.

(i) the light dependent stage and the light independent stage.

(ii) the light dependent stage produces ATP (and  $NADPH_2$ ).

(iii) oxygen.

(iv)  $CO_2$  and  $H_2O$  are used and simple sugars (e.g. glucose) are produced.

(v) ATP (it breaks down to ADP and P and releases energy).

5.

REACTIONS OF PHOTOSYNTHESIS	LIGHT DEPENDENT	LIGHT INDEPENDENT
Site at which it occurs	on thylakoid membranes (grana/lamellae)	stroma
Requirements	sunlight, water, ADP, P, NADP	chemical energy (ATP, NADPH), carbon dioxide
Products	oxygen, hydrogen, ATP, NADPH	glucose

- 6.
- (i)
- *light intensity, duration and quality.*
  - *concentration of CO<sub>2</sub> in the atmosphere.*
  - *amount of water available in the soil.*
  - *ambient temperature.*
  - *concentration of O<sub>2</sub> in the atmosphere.*
- (ii)
- *leaf surface area/leaf hairs/leaf cuticle thickness.*
  - *density of stomata.*
  - *density of chloroplasts/concentration of chlorophyll.*
  - *type of chlorophyll present.*
- 7.
- (i) *Respiration which requires oxygen.*
- (ii) *Glucose + oxygen → carbon dioxide + water + energy.*
- (iii) *Respiration which does not require oxygen.*
- (iv) a) *Animals: glucose → lactic acid + energy*  
 b) *Plants: glucose → alcohol + carbon dioxide + energy*
- 8.
- $$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{energy.}$$
- 9.
- (i) *pyruvate.*
- (ii) a) *lactic acid.*  
 b) *alcohol (ethanol) and carbon dioxide.*
- (iii) *two (2) molecules of ATP.*
- (iv) *in the cytoplasm of the cell.*
- (v) *36-38 molecules of ATP.*
- (vi) *It begins in the cytoplasm and is completed in a mitochondrion.*
- (vii) *glycolysis.*

10.

	<b>AEROBIC RESPIRATION</b>	<b>ANAEROBIC RESPIRATION</b>
Site	first in cytoplasm then in mitochondrion	in cytoplasm only
Requirements for oxygen	oxygen required	oxygen not required
Products in plants	carbon dioxide + water (+ energy)	carbon dioxide + alcohol (+ energy)
Products in animals	carbon dioxide + water (+ energy)	lactic acid (+ energy)
Products in bacteria	carbon dioxide + water (+ energy)	methane, hydrogen sulphide, metal ions or succinate (+ energy)
ATP produced from 1 glucose molecule	36 - 38 molecules of ATP	2 molecules of ATP

11. *Plants and animals share many enzymes in common. However those involved in the*

*later stages of anaerobic respiration are different and therefore the products formed are different.*

12. *The rate of respiration can be determined by:*

(i) *measuring the rate at which the products (CO<sub>2</sub>, H<sub>2</sub>O, lactic acid or alcohol) are formed.*

(ii) *measuring the rate at which the reactants are used up (glucose, oxygen) or*

(iii) *measuring the rate at which energy (in the form of heat) is released.*

13.

(i) *Cellular respiration may be limited by the availability of glucose and oxygen. It is influenced by the ambient temperature, as enzyme activity is sensitive to temperature. It may be affected by the rate at which the products are removed.*

(ii) *The concentration of mitochondria in a cell. The size of the cell. The proximity of the cell to its supply of oxygen and glucose.*

## 5. MULTICELLULAR ORGANISMS

### 5.1 Cells, Tissues, Organs and Systems

#### Terminology

(i) *cell – the basic “building block” of living things (except viruses). Consists of a membrane bounded protoplasm.*

(ii) *organ – a collection of tissues which together carry out one or more major functions in an organism, e.g. kidney, heart.*

(iii) *system – a group of organs which together carry out a major function (or functions) within the body, e.g. circulatory, respiratory.*

(iv) *tissue – a group of similar cells which together perform a particular function. Organs are composed of various tissues, e.g. muscle, nervous, connective.*

(v) *vascular tissue – special cells that make up the tubes which carry materials within the organism, e.g. the circulatory system in vertebrates is vascular tissue and the phloem and xylem vessels in plants are vascular tissue.*

#### Review Questions

1. *cell – tissue – organ – system*

2.

(i) *Cell differentiation: The development of specialised cells in multicellular organisms from unspecialised cells in the early stages of the organism's growth.*

(ii) *Cell specialisation: Mature cells usually become specialised; their shape and contents change so that they only carry out a narrow range of functions, e.g. red blood cells can only carry oxygen and carbon dioxide and because of their shape, a biconcave disc, they can bend so that they can pass through the narrowest of capillaries.*

3.
  - (i) *These tissues have different functions.*
  - (ii) *Tissue that lines the trachea or windpipe produces mucus and is ciliated. It helps remove dust and bacterial spores from the respiratory system. Tissue that lines the small intestine is secretory and absorptive. It produces digestive enzymes and absorbs digested food.*
4. *See next page.*
5.
  - (i) *circulatory.*
  - (ii) *respiratory.*
  - (iii) *nervous.*
  - (iv) *excretory (urinary).*
  - (v) *digestive.*
  - (vi) *female reproductive.*
6. *See next page.*

## 5.2 Respiratory Systems

### Terminology

- (i) *alveolus – a microscopic air sac in lungs.*
- (ii) *gas exchange – the absorption of oxygen accompanied by the excretion of carbon dioxide that takes place across a respiratory surface in animals. In photosynthetic plants, during photosynthesis carbon dioxide is absorbed and oxygen released to the environment.*
- (iii) *oxygenated – blood which has absorbed oxygen from the lungs and is carrying it as oxyhaemoglobin in the red blood cells.*
- (iv) *respiratory system – a system through which oxygen is obtained and carbon dioxide lost in an animal, e.g. gills, lungs, trachea (insects), skin (amphibians).*
- (v) *spiracle – pore into the body, branching until they form finer tubes for the delivery of oxygen to the interior cells of insects.*
- (vi) *tracheal system – a network of tubes, found in insects, which delivers oxygen and removes carbon dioxide from the body cells. It has body openings called spiracles which lead into trachea which branch into smaller tubes called tracheoles. The tracheoles are fluid filled near their tips. Oxygen dissolves in this fluid and passes directly by diffusion to the cells.*

### Review Questions

1. (i) *Oxygen* (ii) *Carbon dioxide*
2. (i) *Adult amphibians, cnidaria.*  
(ii) *Insects, arachnids.*  
(iii) *Mammals, birds, reptiles.*  
(iv) *Fish, crustacea, juvenile amphibians.*
3.
  - (i) *Because the amount of dissolved oxygen in water is much less than the amount of oxygen present in the air (20%).*
  - (ii) *The oxygen concentration in the water must exceed the oxygen concentration in the plasma of fish gills.*

- (iii) *Insects have holes (spiracles) which lead into tubes (tracheas). The oxygen diffuses through these from the outside atmosphere and carbon dioxide leaves by diffusion in the opposite direction. Birds have air sacs which are inflated and deflated by the muscles of the rib cage. The air sacs force air through very fine tubes where the gas exchange takes place.*
- (iv) *This is to enable the oxygen to dissolve first before diffusing into the blood plasma.*
- (v) *Fish either move through the water with their mouths open so that the oxygen in the water flowing over the gills diffuses into the blood, or fill their mouth cavity with water, close their mouths then by lifting the floor of the mouth cavity force water over the gills and out through the gill slits.*
4.
  - (i) *Microscopically small sacs called alveoli create a huge total surface area (S.A.) when they are all added together (in humans the S.A. is 60 – 80 m<sup>2</sup>).*
  - (ii) *The juvenile stage (e.g. tadpoles) has external gills which are moved through the water. Gills have numerous filaments which are highly vasculated. The adult stage (e.g. frog) uses lungs, mouth, pharynx and most importantly moist skin.*
  - (iii) *Fish gills are highly convoluted structures with a very high surface area. Blood flows, in capillaries in filaments, which make up the gills, in the opposite direction to the water which flows over them. This also assists the efficiency of the gas exchange.*
5.
  - (i) *A large S.A.: Vol (ratio) enables the oxygen to diffuse to the centre of the cell quickly and the carbon dioxide to diffuse from the cell rapidly. Because of its small size it therefore does not need a respiratory system.*
  - (ii) *As it grows (if its shape does not change) its S.A.: Vol becomes smaller. The efficiency of its gaseous exchange would decrease. If its size were to reach the volume of a human, metabolic processes would become so slow that it would probably die.*

## 5.3 Digestive Systems

### Terminology

- (i) *alimentary canal – a tube beginning at the mouth and terminating at the anus. Also called gastro-intestinal tract or digestive tract.*
- (ii) *carnivore – an animal that mainly eats other animals.*
- (iii) *cnidaria – a phylum which is radially symmetrical with stinging tentacles. Members have a single opening for food to enter and wastes to leave. This is the gastrovascular cavity which also serves as a respiratory surface. Examples include jellyfish and sea anenomes.*

4.

ORGAN SYSTEM	MAIN ORGANS	MAIN FUNCTION/S
(i) circulatory	heart, arteries, veins, arterioles, venules, capillaries	transports nutrients and wastes, distributes heat, carries hormones and supports the role of the immune system
(ii) respiratory	lungs, nose, nasal cavity, pharynx, trachea, bronchi, bronchioles	delivers oxygen to and removes carbon dioxide from the circulatory system.
(iii) digestive	mouth, oesophagus, stomach, small and large intestine, rectum and anus	breaks down large organic molecules into molecules small enough to be absorbed through its lining.
(iv) muscular	cardiac, smooth and striated muscle	moves bones and other substances e.g. blood and the contents of the digestive system.
(v) skeletal	bones	protects soft tissue, anchors muscle, site for blood cell synthesis, stores fat, supports body
(vi) excretory	kidneys, ureters, bladder, urethra	removes metabolic waste from the body and regulates water balance in the blood
(vii) lymphatic system	lymph vessels, lymph nodes	drains excess tissue fluid returning it to the circulatory system, provides immunity to disease and absorbs the products of fat digestion

6.

TISSUE	NAME	CELL SPECIALIZATION
A	palisade mesophyll	These cells are columnar in shape and have the highest density of chloroplasts. They absorb most of the light that falls on the leaf and therefore carry a high proportion of its photosynthesis.
B	spongy mesophyll	These cells are asymmetrical in shape and have large gaps around them. The gaps form intercellular spaces which allow gases (CO <sub>2</sub> , O <sub>2</sub> and water vapour) to flow easily around them. They also contain chloroplasts (fewer than the palisade) and photosynthesise.
C	epidermis (lower)	A single layer of transparent cells held together tightly, the cells often have an outside coating of wax to reduce water loss from the leaf. They have few if any chloroplasts and their main function is to protect and strengthen the leaf. Guard cells and hair cells which appear in the epidermis are specialized epidermal cells.
D	vascular	This is made up of xylem (dead cells), phloem and their supporting cells. The xylem is a straw-like structure with the dead cells arranged end to end and the walls that separate them have degenerated. Water and minerals are drawn up the xylem from the roots to the leaves. The phloem is made up of are live cells which lack a nucleus, a companion cell is attached to each phloem cell which does contain a nucleus. Phloem transports sugar (sucrose) from the leaves to the stem and roots for storage and retranslocates this when needed to growing areas around the plant.

(iv) *detrivore* – an animal that feeds on organic waste, e.g. earthworm.

(v) *herbivore* – a plant eating animal.

(vi) *insectivore* – an animal that eats insects, e.g. numbat.

(vii) *omnivore* – an animal which eats both plant and animal food.

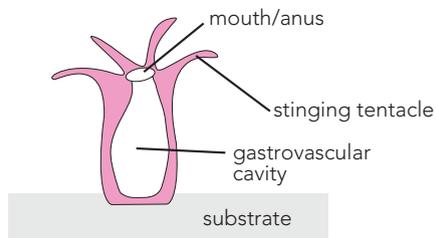
(viii) *parasite* – an organism which lives in or on another living thing (its host) to the detriment of the host organism.

(ix) *rectum* – the last section of the digestive tract between the colon and the anus.

(x) *ruminant* – a mammal herbivore which has a specialized stomach where the plant matter is fermented before being digested. Ruminants regurgitate food from the stomach and further chew it so that it can be more completely digested, e.g. cattle, sheep, goats.

## Review Questions

- Mechanical digestion is the physical breakdown of food into small particles which assists the chemical digestion by increasing the surface area available to the enzymes, e.g. bile emulsifies lipids. Chemical digestion is the breakdown of larger molecules into smaller molecules in the digestive system.
  - So that the molecules (which are smaller) can be absorbed.
- Cnidaria and platyhelminthes (flatworms).
  - Cnidaria



- This has a single opening through which the food enters and the wastes leave. It is simpler and found in less complex animals. Higher animals have a tube with two openings – a mouth through which food enters and an anus through which waste leaves.
- Carnivores (because meat is high in proteins).
    - Herbivores (because plants are high in carbohydrates).
  - Carbohydrates.
    - Lipids (fats). Lipids have a higher amount of energy than carbohydrates per gram and there is more available in meat.
  - The carnivore's food(meat) does not need to be as chemically digested as the herbivore's (plant material).
    - Microflora help to digest the cellulose and lignin in the plant food so that nutrients are available to the herbivore. The herbivore lacks all the enzymes to break down these compounds into molecules small enough to absorb.
    - Ruminants – cows, sheep, goats, camels.  
Non-ruminants – kangaroos, horses, pigs, possums.
    - Ruminants usually regurgitate their food to further physically digest it. The food is fermented in the first chamber of the stomach – a number of different microorganisms contributing to its chemical digestion before it is passed into the true stomach. Protein digestion occurs in the true stomach as normal. The ingested food then moves into the small intestine where further digestion and absorption occurs. In the caecum a chamber at the beginning of the large intestine bacteria break down cellulose.

- Non-ruminants do not regurgitate the ingested food and do not have a microflora that is located before the stomach. Normal digestion occurs in the stomach and small intestine. Similarly absorption occurs largely in the small intestine. The caecum is large and again bacteria in this chamber breaks down cellulose.
- The ruminant's digestive system is more efficient. The faeces of the non-ruminant still contain a high proportion of undigested nutrients (which the animal in many species reconsume).
  - Their caecum serves a similar function.
- The non-ruminant has a stomach that is a single compartment, the ruminant generally has a four chambered stomach.
    - The main difference is that they have a reduced caecum. In both animals the caecum plays little or no role in digestion. In humans it is a vestigial organ called the appendix.
  - monosaccharides, e.g. glucose.
    - fatty acids and glycerol.
    - amino acids.
  - a) incisor b) canine c) premolars d) molars
    - Mechanical digestion/physical digestion.
    - Physical digestion involves breaking the food into smaller pieces. The food is not chemically changed.  
Chemical digestion breaks large molecules into smaller molecules so that they can be absorbed through cell membranes more easily.
    - Physical digestion breaks food particles into smaller pieces so that it is easier to swallow and its surface area to volume ratio is increased. The increased surface area to volume ratio increases the efficiency and the rate of chemical digestion, as it exposes more of the chemically undigested food to the enzymes which break it down.
    - The numbers on the top line refer to adult teeth on one half of the upper jaw (maxilla): 2 incisors, 1 canine, 2 premolars and 3 molars. The numbers on the lower line refer to teeth on one half of the lower jaw (mandible): 2 incisors, 1 canine, 2 premolars and 3 molars.
    - Sheep's teeth – one half of the upper jaw - 0 incisors, 0 canines 3 premolars, 3 molars  
one half of lower jaw – 3 incisors, 1 canine, 3 premolars, 3 molars
    - Grass is cut effectively between the tough pad of the upper jaw and the lower incisors.
    - The long line of teeth, premolars and molars, are able to move laterally grinding the grass between them.
    - Cat's teeth – one half of the upper jaw – 3 incisors, 1 canine, 3 premolars, 1 molar.  
one half of lower jaw – 3 incisors, 1 canine, 2 premolars, 3 molars.

The cat has long canines which restrict lateral movement of the jaws and grinding but the cats diet does not require mastication.

- (x) The carnassial teeth consist of last upper premolar and first lower molar teeth. Found in carnivores, they are sharp teeth which come together like scissors. The last upper premolar slides over the outside of the first lower molar so that meat can be sliced into smaller parts. No grinding is necessary.
9. (i) mouth  
(ii) tongue  
(iii) liver  
(iv) gall bladder  
(v) small intestine  
(vi) ascending colon  
(vii) caecum  
(viii) appendix  
(ix) rectum  
(x) descending colon  
(xi) transverse colon  
(xii) pancreas  
(xiii) stomach  
(xiv) duodenum  
(xv) oesophagus  
(xvi) epiglottis  
(xvii) pharynx
10. (i) Mouth (amylase), stomach (pepsin), small intestine (mainly from duodenum and jejunum, amylases, proteases, lipases).  
(ii) Small intestine (mainly in ileum), large intestine (vitamins and water).  
(iii) Oesophagus, stomach, small intestine, large intestine.  
(iv) Lower colon (sigmoid), rectum and anal sphincter.
11. (i) The stomach, small intestine and large intestine have a supply of blood, but the small intestine is most richly supplied with blood as it contains a higher density of capillaries and absorbs most of the nutrients. These nutrients are transported in the hepatic portal vein to the liver for processing.  
(ii) Each villus has a lacteal which is part of the lymphatic system. The products of fat digestion, i.e. fatty acids and glycerol are absorbed into the lacteals and transported via the lymphatic system to the subclavian veins.
12. (i) (a) absorptive and secretory cells.  
(b) lacteal.  
(c) intestinal gland.  
(ii) In the small intestine from the duodenum to the last portion of the ileum.  
(iii) They are about 1 mm long and being small and numerous increase the total surface area for the absorption of digested nutrients.

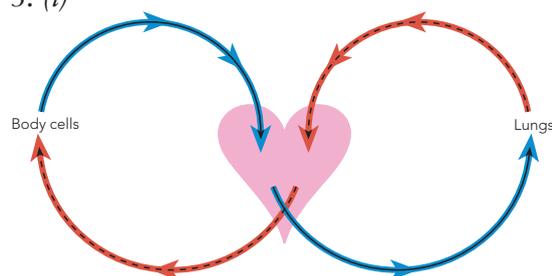
## 5.4 Circulatory Systems

### Terminology

- (i) arteriole – a small artery.  
(ii) artery – a blood vessel that carries blood away from the heart.  
(iii) capillary – a very thin-walled blood vessel which connects arteries to veins.  
(iv) circulatory system – collection of cells and organs which move substances around the internal environment of an organism, e.g. vascular system in plants, circulatory system in mammals, tracheal system in insects.  
(v) deoxygenated – having lost oxygen. In mammals, blood that is deoxygenated usually carries carbon dioxide in the form of bicarbonate ions, attached to haemoglobin in red blood cells and dissolved in the plasma.  
(vi) dorsal – on the upper side of the body  
(vii) lymphatic system – system of tubes or vessels which drain excess fluid from tissue beds and carries it back into the circulatory system.  
(viii) multicellular – many celled organism.  
(ix) vein – a blood vessel which carries blood towards the heart.  
(x) venule – a small vein which connects blood capillaries to a vein.

### Review Questions

- It moves oxygen from the respiratory surface to the body tissues and removes carbon dioxide from the body tissues to the respiratory surface. It also transports nutrients, hormones and wastes around the body where necessary.
- The mammal's circulatory system is closed. This means that the blood cells, large molecules and much of the plasma remain in the system and do not come into direct contact with other body tissue. The insect circulatory system is open. This means that the blood is forced out at the end of a blood vessel at the head end and flows back towards the posterior end of the animal. It flows through large spaces in the body. In so doing it bathes the tissues and organs before returning to the heart through ostia (holes in its tubular heart). In most insects oxygen is delivered directly to the muscles through their tracheal system (via spiracles, trachea and tracheoles). In the mammal, the blood is oxygenated as it flows through the lungs.
- (i)



- (ii)
- (a) *Heart: Pumps oxygenated blood to body cells and deoxygenated blood to lungs, receives deoxygenated blood from body cells and oxygenated blood from lungs.*
- (b) *Arteries: Carry blood away from the heart to other body tissues.*
- (c) *Veins: Carry blood to the heart from other body tissues.*
- (d) *Capillaries: Fine vessels which allow the exchange of nutrients, wastes and gases between blood and body cells and between the blood and respiratory surfaces.*
- 4.
- (i) *Oxygen and nutrients (like glucose).*
- (ii) *Carbon dioxide and other wastes (like urea).*
- 5.
- (i) *Lymph.*
- (ii) *Because more fluid leaves at the arterial end (X) than re-enters at the venous end (Y), the tissue would swell up with the excess fluid.*
- 6.
- (i) *Arteries, capillaries and veins.*
- (ii) *Mammals are generally larger organisms which cannot rely on the slower movement of fluids through the body cavity to deliver nutrients and remove wastes.*
- (iii) *A structural adaptation.*

## 5.5 Excretion

### Terminology

- (i) *ammonia – a gas ( $\text{NH}_3$ ) which dissolves readily in water. It is a metabolic waste that is toxic to cells and if not immediately excreted, must be converted to urea or uric acid that are less toxic compounds.*
- (ii) *aquatic (environment) – a water environment, marine or fresh water.*
- (iii) *deamination – the breakdown of excess amino acids in the liver. This involves the removal of the amino group of atoms ( $\text{NH}_2$ ) from the amino acid. Ammonia ( $\text{NH}_3$ ) is formed. This is excreted by many aquatic animals, which have no ‘water problem’. It is converted to urea ( $\text{CO}(\text{NH}_2)_2$ ), by mammals and adult amphibians and uric acid ( $\text{C}_5\text{H}_4\text{N}_4\text{O}_3$ ) by birds and most reptiles for excretion.*
- (iv) *excretion – the removal of metabolic wastes. These include carbon dioxide, urea, and uric acid.*
- (v) *isotonic – when two solutions have the same concentration of dissolved solutes they are said to be isotonic.*
- (vi) *osmoregulation – the maintenance of suitable concentrations of water and dissolved salts in an organism’s body cells. This is achieved in a variety of ways depending on the organism’s environment. Osmoregulation may involve contractile vacuoles, kidneys, impermeable body coverings, special gill cells which secrete*

- salts, the production of dry wastes (e.g. uric acid) and various behavioural adaptation including burrowing and nocturnal activity.*
- (vii) *terrestrial – living on land.*
- (viii) *toxicity – a measure of how poisonous a substance is to an organism.*
- (ix) *urea – an organic compound, formula  $\text{CO}(\text{NH}_2)_2$ , which is a waste product of the breakdown of excess amino acids in mammals. This nitrogenous metabolic waste is toxic and is excreted by the kidneys. It is soluble in water.*
- (x) *uric acid – a nitrogenous waste formed in birds, many reptiles and invertebrates from the breakdown of excess amino acids. It is sparingly soluble in water (formula  $\text{C}_5\text{H}_4\text{N}_4\text{O}_3$ ) and non-toxic.*

### Review Questions

- 1.
- (i) *The liver breaks down excess amino acids, converting them, first to ammonia, then to urea and carbohydrates. This process is called deamination.*
- (ii) *The urea is excreted. The carbohydrates may be used as a source of energy.*
- 2.
- (i) *Animals which eat other animals, i.e. carnivorous, e.g. eagle, dingo, numbat.*
- (ii) *Animals with a high protein intake produce larger amounts of nitrogenous wastes, e.g. ammonia, urea, uric acid.*
- (iii) *The energy may be obtained from the carbohydrate produced in the deamination of excess proteins.*
- 3.
- (i) *Ammonia – lost dissolved in water.*
- (ii) *Ammonia being very toxic must be greatly diluted with water to make it less poisonous when excreted. Terrestrial animals need to conserve water. Therefore, losing nitrogen waste in this form would be too expensive in terms of water loss.*
- 4.
- (i) *Uric acid.*
- (ii) *It is less toxic than urea and ammonia. It is also much less soluble than urea. Because of these properties it may be lost with little water. Birds save weight in excreting uric acid as they are required to carry less water than would be needed if urea was to be excreted.*
- 5.
- (i) (a) *Fish (also tadpoles)*  
(b) *Mammals (also adult frogs and aquatic reptiles)*  
(c) *Birds, reptiles*
- (ii) *Ammonia requires the least energy. Uric acid requires the most. Uric acid ( $\text{C}_5\text{H}_4\text{N}_4\text{O}_3$ ) is a more complex compound than ammonia ( $\text{NH}_3$ ). Therefore its synthesis (uricogenesis) requires the most energy and ammonia requires the least amount of energy.*

## 5.6 Transport in Vascular Plants

### Terminology

- (i) *adhesion* – the attraction that particles of different kinds have for each other, e.g. water molecules are attracted to glass molecules by adhesive forces.
- (ii) *cohesion* – the attraction that particles of the same kind have for each other, e.g. water molecules are attracted to other water molecules by cohesive forces.
- (iii) *flaccid* – condition of cells when they lose water and become soft and limp.
- (iv) *stoma* – (plural *stomata*) an opening or pore for gas exchange in the epidermis of a leaf or stem which is created by two guard cells.
- (v) *translocation* – the movement of sugar and other materials from the leaves to other parts of the plant (roots or stem) via the phloem vessels.
- (vi) *root pressure* – pressure that pushes water a small distance up the xylem from the lower end near the roots. Minerals are actively transported into the xylem from the root cells. Their presence there causes water to move by osmosis into the xylem this creates the root pressure.
- (vii) *turgid* – refers to a cell which is filled with water. Plant cells become turgid when surrounded by distilled water but do not lyse (burst) because their cell wall prevents this from occurring.

### Review Questions

1.
  - (i) Oxygen and carbon dioxide (a large amount of water vapour may also leave the leaf via the stomata depending on the weather and whether the stomata are open)
  - (ii) Normally oxygen is produced when a plant is photosynthesising and a large proportion of it is released via the stomata. This may begin in the early morning and continue until late afternoon depending on the weather. Carbon dioxide in the atmosphere is taken up increasingly via stomata as the rate of photosynthesis increases and slowly diminishes as the light begins to fade.
  - (iii) In summer it will be at its greatest provided the plant has plentiful water available. In mid-winter it will be at a minimum when day length is short and light intensity low.
2. A Waxy cuticle: helps to reduce rate of water loss. If a plant loses too much water its cells die.
  - B Upper epidermal tissue: secrete waxy cuticle, are transparent allowing light to reach palisade cells, provide protective covering and enclose other leaf cells. Contains few stomata.

C Palisade mesophyll cell layer: tightly packed column shaped cells which have an increased number of chloroplasts. Most of the leaf's photosynthesis takes place here.

D Spongy mesophyll cell layer: cells which because of their asymmetrical shapes, form large air spaces in the lower section of the leaf. The spaces allow gases to readily diffuse to and from the palisade layer. Spongy mesophyll cells also have some chlorophyll and therefore photosynthesise.

E Lower epidermal tissue: typically contain a greater number of stomata to allow gaseous exchange between the atmosphere and the intercellular spaces of the spongy mesophyll.

F Guard cells: two sausage shaped cells which control the size of the stoma. Control aperture of stoma and therefore rate of water loss from plant.

3.
  - (i) The plant may begin to wilt. If herbaceous, it may bend over as its leaves and stem lose their turgidity.
  - (ii) The stomata close (as the guard cells also wilt) and evaporation from the leaves is greatly reduced.
  - (iii) As the stomata are closed little atmospheric carbon dioxide can enter the leaves, thus photosynthesis may slow then cease.
  - (iv) As the plant is unable to carry out photosynthesis, its growth rate will be reduced. This accounts for the slow growth of many plants which live in arid conditions.
4.
  - (i) Root hair cells are plant cells which have an extension of the protoplasm which gives them the appearance of having hair. They are located in an area just behind the growing tip of a root.
  - (ii) The extension (or 'hair') gives the root hair cell a large SA:Vol. This increases the rate at which the cell can absorb minerals and water.
5. It moves water and minerals from the roots to the leaves (in xylem tissue) and organic substances (mainly sucrose) from the leaves to the roots and from the roots to other parts of the plant (in phloem tissue).
6.
  - (i) Vascular bundle.
  - (ii) Organic compounds, mostly sucrose and some amino acids.
  - (iii) Water and mineral ions.
7.
  - (i) a) through the root hair cells (by osmosis).  
b) through the root hair cells (by diffusion and active transport)  
c) through the open stomata in the leaves (and stems)
  - (ii) Water and carbon dioxide are used for photosynthesis in the leaves. Water is also

a medium for all the metabolic processes in the cells. Minerals are used in the synthesis of other compounds from the glucose produced in photosynthesis.

8.
  - (i) The glucose (a monosaccharide) is changed to sucrose (a disaccharide) in the leaves. The sucrose is then moved from the leaves to the stem and roots in the phloem vessels where it is often changed to starch and stored.
  - (ii) They are transported from the roots to the leaves in the xylem vessels. The water with these minerals is drawn up the xylem vessels in the transpiration stream.
9.
  - (i) The cells lose their turgidity, they become flaccid. As a result, the plant wilts and if the cells continue to dehydrate, eventually the cells (and the plant) will die.
  - (ii) The cells become turgid; this is not normally a problem as this helps the plant remain rigid, with its leaves well presented towards the sunlight.

## 6. INQUIRY SKILLS AND HUMAN ENDEAVOUR 2

### 6.1 Science Inquiry Skills 2

#### Terminology

- (i) control – an experiment that can be used as a comparison to test the effect of one variable upon another.
- (ii) field of view – This is the circular area that is observed when looking into the ocular of a microscope.
- (iii) magnification – the extent to which an object is enlarged by a microscope. It is expressed as the ratio of the image size to the actual size. When using a light microscope it is calculated by multiplying the magnifying power of the objective by the magnifying power of the ocular.
- (iv) random – a process of selecting in which each item has an equal chance of selection. The process is therefore unbiased.
- (v) sample – a small part of a population intended to show what the whole (of a population) is like.
- (vi) reliable data – means that the data are consistent; they are very similar each time the procedure or experiment is done.
- (vii) resolution – the capacity of a microscope to separate two objects which are very close together and produce an image of them as separate objects.
- (viii) risk assessment – to determine before conducting a new experiment the dangers involved in order to plan to minimize them for the safety of all involved.

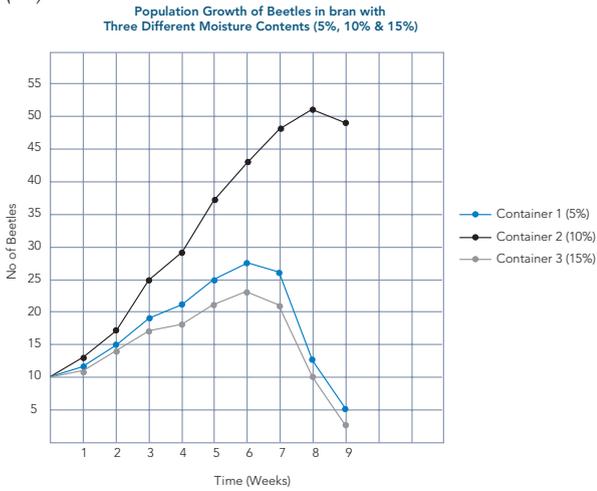
- (ix) virtual dissection – a dissection that is not of the real animal or plant. May be conducted on a lifelike model, using computer images or watching videos.

#### Review Questions

1.
  - (i) H: That smoking tobacco is the main cause of oral cancer in human populations
  - (ii) P: If a person smokes tobacco, then he/she is likely to develop oral cancer.
2.
  - (i) If cattle and sheep are replaced by kangaroos and emus on Australian farms, then less damage will be caused to the agricultural environment.
  - (ii) If the temperature of the sea continues to rise, then coral on reefs in Australia will die.
  - (iii) If the hook worm infestation can be treated in some way, then the number of sea lion pups surviving will increase.
3. (i) P (ii) H (iii) H (iv) P (v) H
4.
  - (i) If mealworm colonies are kept at a moisture content higher than 10% and lower than 10% then the rate of population growth in these colonies will be slower than at 10%.
  - (ii) Independent variable: The moisture content of bran. Dependent variable: The rate of population growth.
  - (iii) a) Manipulated variable / experimental variable.  
b) Responding variable.
  - (iv) In 1 and 3 the rate of population growth would be less than in 2.
  - (v) The rate of population growth in 2 is the same or less and in 1 and 3.
  - (vi) a) Use a greater range of moisture contents, e.g. 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15%.  
b) Repeat the experiment to obtain more data.
  - (vii) Total counts may not be possible – there may be too many larval/beetles. Random samples of bran need to be taken, each of the same mass and the number of mealworms in each sample (adults, pupa, and larva) counted.
  - (viii) One way to show the data is shown below.

TIME (weeks)	NO. OF BEETLES COUNTED		
	Container 1	Container 2	Container 3
1	12	13	12
2	15	17	13
3	19	25	17
4	21	29	18
5	23	37	21
6	27	43	23
7	26	48	21
8	13	51	10
9	5	47	3

(ix)

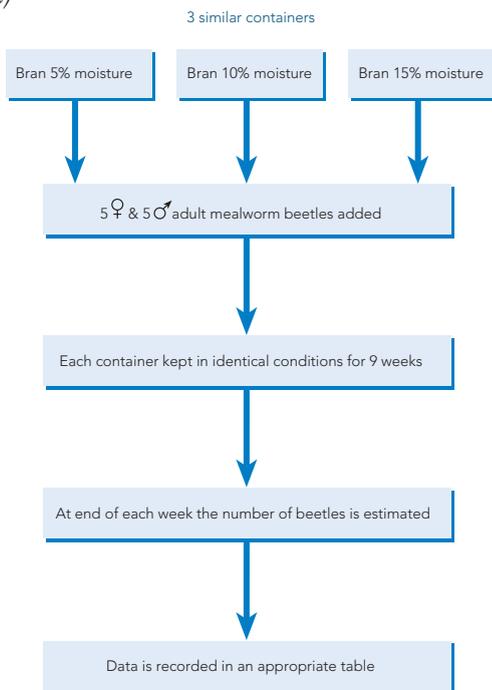


(x) Yes: The rate of population growth is highest in container 2 (10% moisture) than the others (5% and 15%).

(xi) Food may be running out or wastes are accumulating and reducing beetles' health.

(xii) Add more bran to the colonies either before conducting a similar experiment or towards the end of the experiment. Compare the growth rates with those already obtained. If testing second hypothesis, remove waste on a regular basis and compare growth rates.

(xiii)



5.

(i) Use of embryos for scientific research.

(ii)

- many sick/dying people need the results of this research immediately.
- discoveries could be made that enhance the quality of all human life.
- only human embryo cells indicate directly how human cells grow and repair.

(iii)

- every embryo cell represents a human life which begins at fertilisation – these lives are extinguished.

• researchers should be spending money on other scientific investigation more to do with saving young lives.

• adult human stem cells are a satisfactory substitute for embryonic stem cells.

6.

(i) That if there are dangers involved in doing the experiment that they are identified and measures are put in place to minimize the risk to those conducting the experiment and to others that are nearby.

(ii) This is necessary for the health and wellbeing of all concerned.

7. Primary data is data you collect yourself. Secondary data is data you obtain from the work of others.

8.

(i) Collect data from the population; compare the incidence of lung cancer in a group chosen at random which does not smoke with the incidence of lung cancer in a similar group which does smoke.

(ii) A significantly greater percentage of people who smoke develop lung cancer than those who do not smoke.

(iii) The percentage of people who develop lung cancer in the group who do not smoke is the same or significantly greater than in the group of people who do smoke.

9. (A) Ocular (lens through which magnified image is viewed).

(B) Coarse adjustment (for large movements of body tube in rough focusing)

(C) Fine adjustment (for final focusing).

(D) Arm (used for carrying microscope).

(E) Clip (holds slide in place).

(F) Inclination joint (for tilting body tube).

(G) Base (provides stable support).

(H) Mirror (reflects light through aperture in wheel diaphragm).

(I) Wheel diaphragm (controls the amount of light passing through object).

(J) Stage (supports slide).

(K) High power objective (increases magnification).

(L) Low power objective (lesser magnification).

(M) Revolving nosepiece (moves objectives to change magnification).

(N) Body tube (allows light to pass up to ocular).

10.

• Remove a very thin layer of epidermal cells from the outside of the onion.

• Add a drop of water to the slide.

• Place a small section of this tissue on a glass microscope slide.

• Add a drop of water to this tissue.

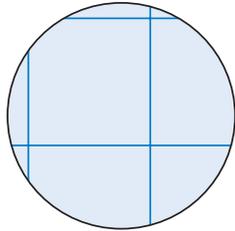
• Place the cover slip carefully over the tissue.

• Using a dropper add two or three drops of iodine solution to the edge of the cover slip.

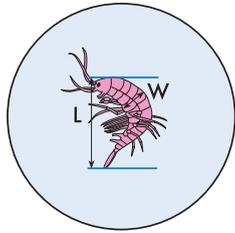
- Draw this through the onion tissue by placing absorbent paper on the opposite edge of the cover slip.

11.

- (i)  $40\times$  (ii) a) 4.5      b) 4500  
(iii)

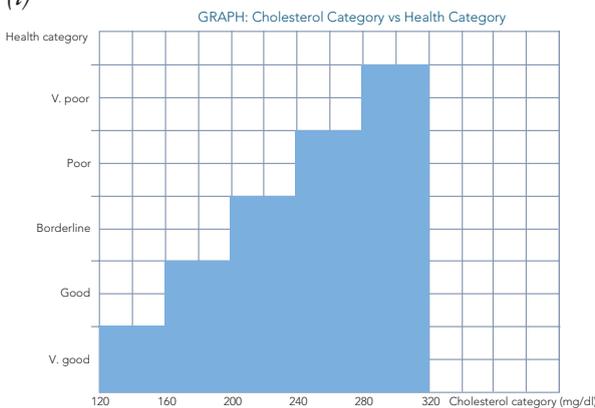


- (iv) (a) 1.8      (b) 1800  
(v) (a) length 0.8 mm or  $800\mu\text{m}$   
(b) width 0.16 mm or  $160\mu\text{m}$



12.

(i)



- (ii) The lower the cholesterol category or the less cholesterol a person has in his/her blood the healthier they are likely to be.  
(iii) The incidence of cardiovascular disease in each of these cholesterol ranges has been determined by research in the population. By measuring a person's blood cholesterol level his or her risk of cardiovascular disease can be determined and therefore their health category.

13. (a) Title: Describes very briefly, the nature of the research.

(b) Aim: Describes why the experiment is to be conducted – may include a hypothesis to be tested.

(c) Materials: Details what equipment and resources are needed to carry out the investigation.

(d) Procedure: Lists the steps needed to conduct the investigation. Details of controls used are also given.

(e) Results: Clearly presents the data collected using tables and/or graphs to display findings.

(f) Conclusion: Provides analysis of the results, including an assessment of whether or not the hypothesis is supported.

(g) References: This lists resource materials that may have been used/quoted in the text of the report.

## 6.2 Science as a Human Endeavour 2

### Terminology

- (i) electron – the small (it is  $1/1836$  the size of a proton) negatively charged particle in an atom  
(ii) ethanol – an organic chemical, colourless liquid (ethyl alcohol,  $\text{C}_2\text{H}_5\text{OH}$ ). Produced in fermentation.  
(iii) fermentation – anaerobic respiration of sugary fruit juice in yeast cells which produces alcohol and carbon dioxide.  
(iv) fluorescence – the emission of light from a substance that has absorbed light or has been excited by another form of radiation.  
(v) fluorophore – a fluorescent chemical.  
(vi) microorganism – an organism that can only be seen with a microscope because it is so small, e.g. bacteria, viruses.  
(vii) model – a scientific idea in which a process is represented by a diagram or a physical structure in order to develop a better understanding of the process and test predictions based on the idea, e.g. the fluid mosaic 'model' of the cell membrane.

### Review Questions

1.

(i) The light microscope.

(ii) The cell membrane appears as a single line.

2.

(i) Electron microscope.

(ii) It provides a greater magnification and resolution.

(iii) The bilipid layer.

(iv) The light microscope can achieve a magnification of up to  $2000\times$  and it can resolve objects that are as close as one micrometer  $10^{-6}\text{m}$  apart.

The electron microscope (transmission) can magnify up to  $10,000,000\times$  and has a resolution up to  $50 \times 10^{-12}\text{m}$ .

(v) The light microscope uses light and the magnification and resolution that is possible is determined by the wave length of light. This is much greater than the wave length of a beam of electrons.

Because the wave length of the electron beam is much shorter than that of light a greater magnification and resolution can be achieved.

(vi) The advantages of light microscopes include they are smaller, portable and less expensive.

*They can be used to observe living things while they are still alive. Slides require less preparation. The disadvantages include they have less magnification and less resolution.*

*The advantages of the e.m.'s are that they provide huge magnifications and resolutions which potentially, as technology improves, visualize an atom.*

*The disadvantages of the e.m. is the cost, the size and the necessity to prepare specimens so that water vapour cannot escape into the vacuum of the chamber, i.e. they cannot be alive.*

3. *Transmission electron microscopes direct the electron beam through the specimen. Scanning electron microscopes reflect the electron beam from the surface of the specimen – producing a three dimensional image.*

4. (i) *Fluorescent molecules (or fluorophores) are special molecules which emit light when light of a particular wavelength illuminates them. The light used in a light microscope can be selected to cause this fluorescence.*

*Fluorophores can be bound to a particular molecule, e.g. a protein or a nucleic acid. Their presence can be used to determine where a particular molecule of interest is in a cell using a suitable light microscope with its appropriate light source.*

(ii) *Fluorophores can be attached to DNA fragments so that their position on the gel can be seen or photographed.*

*Fluorophores can be attached to stains so that various chemical compounds can be located in cell organelles.*

5. (i) *Biofuels are fuels made from living things or their wastes.*

(ii) *Some biofuels are produced by microorganisms. Plants are grown e.g. sugar cane, the sugar is then fermented using*

*microorganisms to produce ethanol. The ethanol is used as a fuel.*

(iii) *In this process the sun's energy is captured by the plant in photosynthesis. The sugar produced is then anaerobically respired by microorganisms to produce the fuel.*

6. (i) *Microorganisms are used to break down human waste in sewage treatment plants. They are also used in landfill sites to break down organic waste anaerobically producing methane which can be used as a fuel source.*

(ii) *Without the use of microorganisms in waste disposal to produce fuel the waste would accumulate in the environment and remain unused. Microorganisms enable the recycling of matter.*

7. (i) *Fungi, bacteria and yeasts*  
(ii) *Particular fungi and bacteria are used to produce certain cheeses and chocolates. Bacteria is used to produce yogurt and vinegar. Yeasts are used for bread, beer and wine.*

8. (i) **Replacement** – *requires other methods of conducting research without the use of animals if this can achieve similar results or the animal chosen should be replaced with another that is less aware or intelligent where appropriate.*

(ii) **Reduction** – *the number of animals used should be minimized without compromising the reliability of the results.*

(iii) **Refinement** – *every animal used for research should not suffer unduly. Any pain or anxiety must be kept to an absolute minimum. This applies to those higher animals that have complex nervous systems and sensory receptors.*



# SOLUTIONS TO TRIAL TESTS

## TT 1: BIODIVERSITY & CLASSIFICATION

### Section 1

- 1. *c*
- 2. *b*
- 3. *d*
- 4. *c*
- 5. *d*
- 6. *a*
- 7. *d*
- 8. *b*
- 9. *b*
- 10. *c*
- 11. *c*
- 12. *b*
- 13. *b*
- 14. *d*
- 15. *a*
- 16. *a*
- 17. *c*
- 18. *b*
- 19. *b*
- 20. *d*

### Section 2

1. (i) *Hibbertia longiflora* and *Hibbertia scandens*.  
(ii) Both of these plants belong to the same genus, whereas the other plants do not.
2. (i) The scientist may have to communicate with other scientists, some of whom would not use English names. The scientific names are universal.  
The nurseryman may use local common names as his clients are most likely familiar with them.  
(ii) Using two words, the genus and species, is simpler and less time consuming to write. We can easily determine the other levels of classification if given these two.  
(iii) The genus name is written first with a capital letter. The species follows with a lower case. If typed the two words are generally typed in italics, e.g. *Homo sapiens*. (They should be underlined if hand written)  
(iv) The second name of the species indicates the particular group to which the organism belongs. It is not a man-made category.

3. (i)

Phylum	Chordata	Chordata	Chordata	Chordata
Class	Aves	Aves	Aves	Aves
Order	Falconiformes	Coraciiformes	Coraciiformes	Pelecaniformes
Family	Falconidae	Alcedinidae	Alcedinidae	Pelecanidae
Genus	Falco	Alcyone	Alcyone	Pelecanus
Species	peregrinus	azurea	pusilla	conspicillatus

- (ii) *Alcyone azurea* and *Alcyone pusilla*
- (iii)
  - Presence of feathers
  - Four chambered heart
  - Forelimbs adapted for flight (wings)
  - Lay hard shelled eggs.
- (iv) The size of the adults, the colours of the feathers, the reproductive behaviour.
4. This is one of several solutions to this question.
  - 1.(a) Flowers with five petals 2
  - 1.(b) Flowers with numerous petals 4
  - 2.(a) Flowers with separate petals (unattached)  
*Chamaelaucium uncinatum*
  - 2.(b) Flowers with joined petals 3
  - 3.(a) Flowers with rounded petals  
*Rhododendron lochae*
  - 3.(b) Flowers with pointed petals  
*Claytrix tetragona*
  - 4.(a) Flowers with nine stamens  
*Eriostemon verrucosus*
  - 4.(b) Flowers with more than nine stamens  
*Disphyma australe*
5. (i) *Phylidonyris novaehollandiae* – New Holland honeyeater.  
(ii) 1 (a), 2 (a), 3(b), 4 (a)
6. (i) (b)  
(ii) Two organisms that belong to the same genus must also belong to the same family. Therefore the organisms in (b) are likely to have more in common.
7. (i) If they reproduce viable (fertile) offspring in their natural environment they are considered to belong to the same species.  
(ii) Bacteria do not normally reproduce sexually, they undergo binary fission (asexual). Chemical tests are needed therefore e.g. their reaction to stains and DNA analysis.
8. (i) This means using two words, the genus and species, to name the organism.  
(ii) It is used to make communication simple and to standardise the procedure which makes communication more efficient.
9. A species is group of organisms which are interbreeding in their natural environment and producing viable offspring or a group of organisms that are structurally and functionally very similar. They have similar DNA.

- 10.
- (i) *Their flowers should have a very similar structure, similar stamens, styles, ovules, colour, petals arrangement and proportions.*
  - (ii) *Their populations may have evolved to suit a particular environment or the environment may be affecting their phenotype, e.g. restricting growth.*
- 11.
- (i) *They observe and measure structural (and sometimes behavioural features) then compare these with previously researched recorded organisms. Comparisons reveal whether or not the organism has been identified.*
  - (ii) *No, it does not change the ecosystem's biodiversity, but it does increase understanding of it.*
- 12.
- (i)
    - *The tree shows the evolutionary history of a few related species.*
    - *It shows when certain species evolved through adaptive radiation and which species is believed to be a common ancestor.*
    - *It shows when species have become extinct and which persist to the present.*
  - (ii) *Species D.*
  - (iii) *By comparisons of its anatomical, physiological, molecular and genetic features with those of all other organisms possible.*
  - (iv) *Species B, C.*
  - (v) *Species A.*
  - (vi) *Two populations of the same species have become separated and gradually diverged (speciated) into two separate species from that one species.*
  - (vii) *Species E.*

### Section 3

- (i)
  - (a) *Genes diversity:*
    - *This is the total number of alleles that are present in the gene pool of each species for each genetically determined trait.*
    - *In the human gene pool for the one trait blood grouping in the ABO system there are three alleles I<sup>A</sup>, I<sup>B</sup> and i.*
  - (b) *Species diversity:*
    - *This is the total number of different species in a community or ecosystem.*
    - *In a natural ecosystem this includes all the animal, plant and microorganism species.*
  - (c) *Ecosystems diversity:*
    - *This is the range of different ecosystems in a large area.*
    - *It may include rainforests, coral reefs, sand dunes, woodlands and desert areas.*

- (ii) *Biodiversity is dependent on:*
  - *proximity to the equator,*
  - *climate,*
  - *topography,*
  - *type of soil,*
  - *amount of disturbance and human interference.*
  - *generally tropical conditions enhance biodiversity as the sunlight and water availability for plant growth are high.*
  - *where soil is rich and the area is protected from extremes more plant species flourish.*
- (iii)
  - (a)
    - *Genetic diversity can be determined through observation of the range of phenotypes in a population and*
    - *through biochemical tests of proteins and genes.*
  - (b)
    - *Species diversity – involves making observations and collecting data in the field.*
    - *It requires carefully determining whether populations are the same or different species through DNA and other biochemical tests.*
  - (c)
    - *Ecosystems diversity – observation in the field, analysis of data collected and*
    - *comparison with similar ecosystems in the biosphere.*
  - (iv)
    - *Reliable information about biodiversity can be used to determine the health of an ecosystem;*
    - *it can be used as a bench mark to determine whether an ecosystem is changing improving or declining.*
    - *The biodiversity needs to be maintained so that the environment is resilient to change. This means that where degradation occurs the environment can recover.*
    - *The abundance of species and their biodiversity is essential for environmental sustainability.*

## TT 2: ECOSYSTEMS

### Section 1

- |       |       |
|-------|-------|
| 1. a  | 11. b |
| 2. c  | 12. b |
| 3. c  | 13. e |
| 4. d  | 14. d |
| 5. a  | 15. c |
| 6. b  | 16. a |
| 7. a  | 17. b |
| 8. d  | 18. d |
| 9. a  | 19. d |
| 10. b | 20. a |

## Section 2

1.
  - (i) Each plant is made up of several parts: for a flowering plant these include the roots, stems, leaves and flowers. Different animals feed on different parts of the plant. Therefore there are more animal species than plant species. Wherever there are more plant species there will be many more animal species.
  - (ii) Animals may feed on many plants. Animals may use the plants as shelter or to make nests. Plants may rely on animals for pollination. Some plants may obtain nutrients from animals, e.g. insectivorous plants.
  - (iii) a) This refers to competition between the different species, e.g. for food, space.  
b) This refers to competition between members of the same species. Competition within the species, e.g. for mates, food, shelter.
  - (iv) a) Each involves a relationship between two different species.  
b) Symbiosis.  
c) Neither species is harmed in mutualism and commensalism whereas in parasitism the host species is disadvantaged.
2.
  - (i) Plant plankton.
  - (ii) Fungi and bacteria.
  - (iii) Mussels, animal plankton, small fish.
  - (iv) Arrows show the direction in which chemical energy is transferred.
  - (v) Bacteria and fungi break down the dead remains of all the organisms, returning the minerals to the community for reuse by plants.
  - (vi) Starfish eat mussels. Therefore, if the mussels disappear the starfish population will decline. If mussels were their only food, they too would disappear.
  - (vii) Plant plankton may increase. More food would then be available to animal plankton and small fish which may, in turn, increase in numbers.
3. Soil water content, soil temperature, soil particle size, soil aeration, soil pH, soil salinity.
4. Plant food, plant shelter, predators, competitors, parasites, mates, offspring.
5.
  - (i) Temperature, light, dissolved gases, viscosity, pH, salinity, water currents.
  - (ii) **Humidity:** measure of the water vapour concentration in the air.  
**Soil type:** only affects land plants and those emergent plants that live close to the river or land banks.  
**Wind:** movement of air currents.  
**Buoyancy:** feature of the fish, not its environment.
6.
  - (i) **Insect species:** Some insects, e.g. locusts, may eat the seedling, limiting its growth/killing the plant.
  - (ii) **Large herbivores:** These may either eat or trample the seedling.
  - (iii) **Similar seedlings:** These compete for light, soil, nutrients and soil water. If close to the seedling, only the strongest will survive.
  - (iv) **Larger nearby plants:** These have roots which may extend all around the seedling and therefore compete for water and nutrients. But they may also protect the seedling from wind and harsh sunlight.
  - (v) **Soil microorganisms:** These help break down organic matter and provide nutrients for the seedling. However, some microorganisms may be parasitic.
  - (vi) **Air borne fungal species:** Like bacteria, fungi may help improve the soil nutrients, but some may be parasitic and damage the seedling.
7.
  - (i) Host.
  - (ii) Competitor.
  - (iii) Food (the word 'prey' is normally reserved for animals).
8.
  - (i) This is a symbiotic relationship called mutualism. Both organisms benefit by the association.
  - (ii) Collaborators.
9.
  - (i) **Humidity:** Plants give off water in transpiration. This goes into the atmosphere and increases the humidity of the atmosphere around them.
  - (ii) **Temperature:** Plants respire releasing energy in the form of heat. This generally raises the temperature of the air around them. However, they shade the ground during the day. Therefore they tend to reduce the extremes of temperature found in the open.
  - (iii) **Rainfall:** Forests increase the atmospheric water and therefore increase the rainfall generally.
  - (iv) **Wind speed:** Trees slow the wind down. They form a barrier or wind break reducing erosion and evaporation from the soil.
  - (v) **Animal diversity:** For each plant species there are likely to be many species of insect/bird feeding on it or using it for shelter. Plant diversity determines the animal diversity. For several species of plant there is likely to be many more animal species.

10.

ORGANISM	ONE FUNCTION WITHIN THE ECOSYSTEM	TWO EXAMPLES
Producer	Absorbs light energy from the sun and converts much of this into chemical energy in photosynthesis. Provides the food for primary consumers	Trees, grasses
Primary consumer	Feeds on producers, provides food for secondary consumers	Kangaroos, sheep
Secondary consumer	Feeds on primary consumers and provides food for higher order consumers	Eagles, dingoes
Omnivore	Feeds on both producers and consumers	Brush tailed possum, pigs
Parasite	Lives on (ectoparasite) or in (endoparasite) another organism. May feed on its host's tissue or derive nutrients from the ingesta in the host's digestive tract.	Tape worm, lice
Detritivore	Feeds on detritus, the dead remains of other organisms and their faeces	Earthworms, slaters
Decomposer	Breaks the organic matter – the dead remains and wastes of animals and plants – down into simple molecules that are returned to the soil or water for reuse by other plants and animals	Fungi, bacteria

### Section 3

- (i) (a) *Component species: (max 5 marks)*
- *Forests typically have great biodiversity because of the great range of different habitats that the ecosystem provides.*
  - *On the ground there is leaf litter which provides a moist layer of organic matter for detritivores and decomposers, ants and spiders reside at this level.*
  - *There may be sundew (insectivorous plants), mosses and lichens on and around exposed rocks.*
  - *At the next level, grasses and small shrubs, small birds and small herbivorous mammals and invertebrates and their predators.*
  - *Large herbivores like kangaroos and insectivores like numbats feed at this level too.*
  - *In the next horizontal zone, saplings up to 2 metres, grass trees and tall shrubs are found.*

- *Many birds, possums, bats and invertebrates – moths, butterflies, dragonflies and spiders are found here too.*

(b) *Species interactions: (max 5 marks)*

- *Examples of the full range of interactions are represented in the forest.*
- *Predator – prey in the dragonfly feeding on other flying insects.*
- *Collaboration in the ant colonies.*
- *Mutualism between alga and fungus in the lichen.*
- *Commensalism in the vines which climb from the ground and are supported by large trees.*
- *Parasitism in the ticks which invest the skin of kangaroos.*
- *Producers in the plants that photosynthesise.*
- *Consumers in all the herbivores, omnivores, insectivores and carnivores.*
- *Decomposers in the bacteria and fungi.*

(c) *Abiotic factors: (max 5 marks)*

- *The soil is often rich because of organic matter decomposition.*
- *The air is calmer due to the protection of the trees.*
- *The atmosphere is more humid due to transpiration from the plants.*
- *The air has a richer supply of oxygen and lower levels of carbon dioxide.*
- *Temperatures are more stable, generally warmer at night and cooler during the day.*
- *The canopy created by the trees casts a shadow which reduces the light falling on the ground.*

(ii) (a) *range of habitats: (max 2 marks)*

- *Soil – contains roots and organic matter.*
- *Leaf litter – layers of moist decomposing organic matter.*
- *Exposed rocks and soil – cracks and crevices protect insects and lizards.*
- *Dead trees on ground – form shelter for centipedes, cockroaches and snakes.*
- *Bark of trees – hundreds of insect species live amongst the fibres.*
- *Hollow tree trunks home for possums, bats, phasgogales, parrots and bees.*
- *Grass trees – shelter ring tail possums and may insect species.*
- *Flowers and fruit – ants, bees and small honey possums are found feeding on these.*
- *Leaves – herbivorous insects and carnivorous spiders live among the leaves.*

(b) *Changes – abiotic factors during year (max 3 marks)*

- *The extremes of temperature and light intensity that occur through the year are not as great in the forest as they are in open woodland and cleared areas outside the forest.*
- *The forest will not be as cold in winter as in the open areas. In summer it will not be as hot.*

- In summer, the soil moisture is retained in the forest more than outside as less direct radiation from the sun impacts on the ground.
- Rainfall over the forest is likely to be greater as the forest creates its own humid atmosphere and clouds.
- Winter storms that may batter exposed areas have a reduced affect as the trees create their own windbreak.
- In spring the biodiversity of plants will become evident when the flowers appear but the conditions in the forest will still be mild and moist.

## TT 3: ENERGY AND MATTER

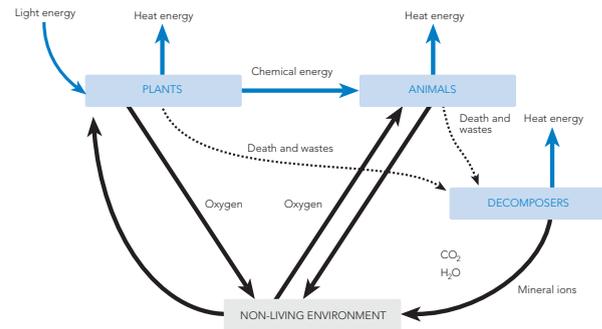
### Section 1

- c
- b
- c
- b
- c
- d
- a
- a
- c
- b
- b
- d
- d
- c
- b
- a
- a
- a
- d

### Section 2

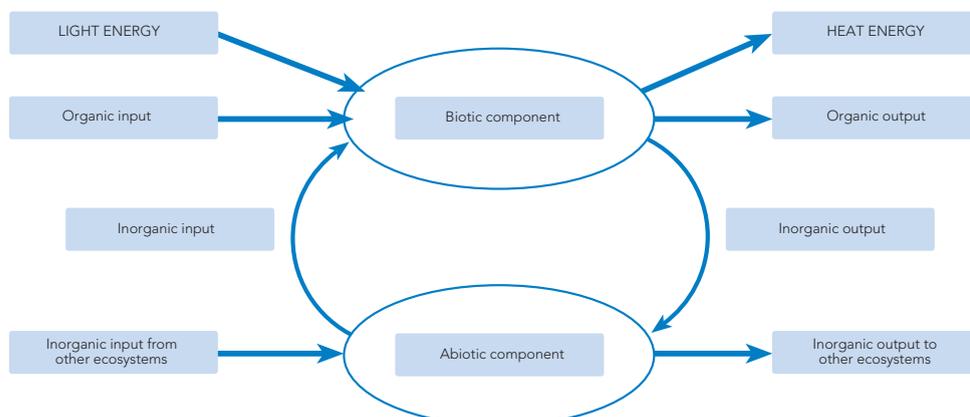
- Nitrates.
  - They have nitrogen fixing bacteria which live in nodules in their roots.
  - Ammonia ( $\text{NH}_3$ ).
  - absorption (in roots)
    - death
    - excretion
    - decomposition
    - nitrification
    - nitrification
    - denitrification
    - feeding (ingestion)

- 0.1 energy units
  - 0.03 energy units
  - Example (ii) - it is a food web (although the feeding relationships in a community are likely to be more complex than this!).
  - No. There are probably other animals which eat sawfly larvae and others that eat ants. The lizards are likely to get far less energy than 0.03 energy units.
- See diagram at the bottom of this page.
  - 'inorganic input' and 'inorganic output'.
  - 'organic input' and 'inorganic input from other ecosystems'.
  - the 'organic output' goes to other ecosystems.
  - the light energy comes from the sun.
  - the heat energy is dissipated into the atmosphere then lost in space.
- Ecosystem: the living and non-living parts of an environment together with the cycling of matter between them.
  - A stable ecosystem does not change greatly from one year to the next. There is a constant recycling of matter and an uninterrupted flow of energy through the system.
  -



- Heat is lost at every trophic level and is dissipated into space.
- Energy is not recycled, it flows through.
- Decomposers obtain their energy as chemical energy in the form of organic matter which they break down.

3. (i)



- (vii) Producers take up carbon dioxide, water, minerals and light energy.
- (viii) Animals and plants return carbon dioxide, water and minerals and heat to the non-living environment.
- (ix) Decomposers return nutrients to the soil (or water).

[12 marks]

- 5.
- (i) (a) one tank may have had more added nutrient.
  - (b) one tank because of its position may receive more sunlight and heat, thus increasing the average temperature in the tank.
  - (c) the fish in each tank could be genetically different, one population therefore growing more rapidly than the other.

- (ii)
  - increase nutrients
  - provide more oxygen to each
  - quicker removal of waste

(iii) Tank A

$$\begin{aligned}
 & 350 \text{ kg}/30000 \text{ L/year} \\
 & = 350000 \text{ g}/30000 \text{ L/year} \\
 & = \frac{350000 \text{ g/L/week}}{52 \times 30000} \\
 & = 0.22 \text{ g/L/week}
 \end{aligned}$$

Tank B

$$\begin{aligned}
 & 250 \text{ kg}/30000 \text{ L/year} \\
 & = \frac{250000 \text{ g/L/week}}{52 \times 30000} \\
 & = 0.16 \text{ g/L/week}
 \end{aligned}$$

[9 marks]

- 6.
- (i) A tropical rainforest is generally warmer and has a greater amount of light and water available for photosynthesis than does a temperate evergreen forest where the growth is more dependent on seasons.
  - (ii)
 

Tropical rainforest	2200	g/m <sup>2</sup> /yr
Desert scrub	90	g/m <sup>2</sup> /yr
Difference	2110	g/m <sup>2</sup> /yr
  - (iii) The biomass of the first order consumers in the rainforest is likely to be of the order of 24 times that of the biomass of first order consumers in the desert – as there is approximately 24 times the chemical energy available to them.

$$\frac{2200}{90} \approx 24$$

- (iv) Carbon dioxide absorption is directly related to the rate of photosynthesis. Therefore CO<sub>2</sub>

is likely to be absorbed at an average rate 24 times higher in the tropical rain forest than that of the desert scrub.

- (v) The density of the organisms is much greater in the tropical rain forests. Consequently they have a much greater carrying capacity for the animals which live in them.

- (vi)
  - a number of quadrats selected at random (e.g. one metre<sup>2</sup>).
  - organic matter in each quadrat collected, dried and weighed – average dry weight (g/m<sup>2</sup>).
  - procedure repeated at the same time in one year.
  - calculate the net change in weight (g/m<sup>2</sup>/yr).

### Section 3

How biotic environment removes carbon from the atmosphere:

- Carbon is absorbed as CO<sub>2</sub> by photosynthetic plants.
- CO<sub>2</sub> enters the plant through open stomata and moves into mesophyll cells by diffusion.
- In photosynthesis carbon dioxide (CO<sub>2</sub>) combines with water to form glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>) and oxygen.
- The overall balanced chemical equation is:  
6CO<sub>2</sub> + 6H<sub>2</sub>O + light energy → C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> + 6O<sub>2</sub>
- This process occurs in the chloroplasts of plants and requires chlorophyll and many enzymes.
- Light provides the energy for this anabolic chemical reaction.
- The carbon in carbon dioxide is incorporated in the glucose.

How carbon is used within the biotic environment:

- The glucose that is formed in photosynthesis may be used by the plant in respiration.
- The overall balanced chemical equation is:  
C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> + 6O<sub>2</sub> → 6CO<sub>2</sub> + 6H<sub>2</sub>O + energy.
- This provides energy for cell division, protein synthesis, active transport, cytoplasmic streaming and many other processes.
- Much of the glucose is converted to sucrose and moved in the phloem to be stored in the plant's roots and stem as starch.
- When needed elsewhere in the plant it is moved into phloem and retranslocated.
- Glucose is the starting chemical for all the other biochemicals that plants make, e.g. amino acids, fatty acids, vitamins, hormones.
- Animals feed on plants or other animals that have eaten plants.
- The carbon in all these organic compounds therefore finds its way from the plants to the animals through the food web.
- It is found in the proteins, carbohydrates, fats, vitamins and hormones in animals, derived from plants either directly or indirectly.

How carbon is returned to the atmosphere:

- When animals and plants die their remains (and their wastes) are broken down by decomposers.
- Fungi generally begin the process and bacteria complete the decomposition.
- Decomposition releases CO<sub>2</sub> back into the atmosphere.
- Both plants and animals also respire during their life time and this also releases CO<sub>2</sub> continuously into the atmosphere (or water).
- Some plants are burnt before they decay – combustion also releases CO<sub>2</sub> into the atmosphere
- Plant matter that is buried and forms coal may be burnt millions of years later releasing CO<sub>2</sub>.
- Animals that are covered in sediment may also form a fuel – oil, which if burnt also releases CO<sub>2</sub>.

is likely to be small. Therefore the density of the birds will be greater.

2. Too many sheep or cattle per acre will cause vegetation to become denuded, i.e. the area will be stripped of plants and exposed to the effects of wind and water erosion. The farm is likely to suffer a leaching of its soil nutrients and gully erosion. Rising water tables, because of a lack of trees, will bring salt to the surface and result in loss of soil fertility due to its salinity.
3.
  - (i) Surrounding bush ecosystems are continuously being cleared for further housing/industrial development. If they are not destroyed in this way – often they are used as repositories for waste. Also destruction of vegetation by various motorised transport, dune buggies, off-road four wheel drive vehicles, and motor bikes causes erosion and general degradation of bush ecosystems.
  - (ii) Swan/Canning Rivers – the level of use by the urban population increases as the population rises. There is a potential for further pollution if the septic tanks are not replaced by deep sewage in suburbs which flank the rivers. Much of the damage to these rivers is caused by fertiliser run off and rising salt levels in their tributaries.
  - (iii) Marine ecosystems – pollution by industry and human effluent will further degrade the marine ecosystems, e.g. Cockburn Sound, unless steps are taken to reduce the waste load put upon them.

## TT 4: POPULATIONS

### Section 1

- |       |       |
|-------|-------|
| 1. b  | 11. b |
| 2. d  | 12. b |
| 3. b  | 13. d |
| 4. a  | 14. a |
| 5. b  | 15. a |
| 6. a  | 16. b |
| 7. a  | 17. b |
| 8. b  | 18. a |
| 9. d  | 19. c |
| 10. c | 20. b |

### Section 2

1.
  - (i) Competition between animals of the same species may affect their ability to reproduce (i.e. their 'b' rate) and/or affect their chances of survival (i.e. their 'd' rate). If there is strong competition for limited resources, a decrease in their birth rate and increase in their death rate will cause their population to decline.
  - (ii) Competition is density-dependent. When the density is great competition for resources is likely to be great.
  - (iii) Density-dependent. Reduced availability of resources will increase competition between the birds.
  - (iv) a) Birds will defend an area sufficiently large to support reproduction. The size of this area is likely to depend on its carrying capacity. If the carrying capacity is low then there will be few if any birds in the area.  
b) If the area has a high carrying capacity (e.g. it has a large number of nesting sites, a plentiful supply of food and few predators) then the territorial area occupied by the birds

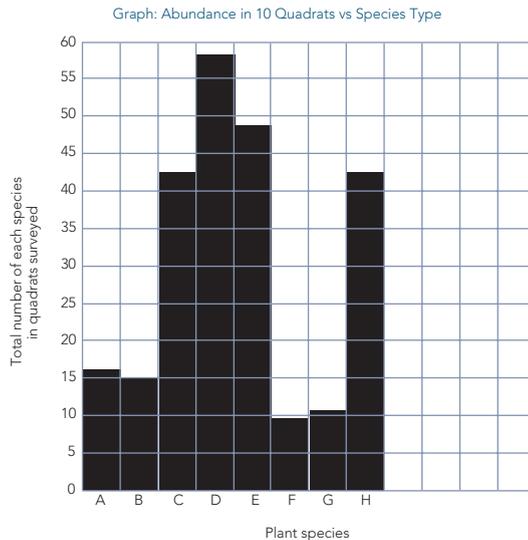
$$\begin{aligned}
 &4. \\
 &i) \text{ New Total Population} = \\
 &\quad \text{Original Population} + \text{Change} \\
 &= 5100 + ((B + I) - (D + E)) \\
 &= 5100 + ((615 + 500) - (205 + 600)) \\
 &= 5100 + (1115 - 805) \\
 &= 5100 + 310 \\
 &= 5410
 \end{aligned}$$

$$\begin{aligned}
 &ii) \text{ Density} = \frac{\text{Population}}{\text{Area}} \\
 &\frac{5100}{0.5 \text{ ha}} = \frac{5100}{5000 \text{ m}^2} = 1.02/\text{m}^2
 \end{aligned}$$

iii)

$$r = \frac{\text{Change in population}}{\text{Population at beginning of year}} \times \frac{1000}{1}$$
$$= \frac{310}{5100} \times 1000$$
$$= 60.4/1000/\text{yr}$$

5. a)



b) Density of E =  $\frac{\text{Total Number of E}}{\text{Area}}$

$$= \frac{48}{200 \text{ m}^2}$$
$$= 0.24 / \text{m}^2$$

6.

- (i) Between days 11 and 16. This is the time when the slope is at its greatest.
- (ii) At about day 33. This is the point at which the graph levels out – reaches a plateau.
- (iii) If in an enclosed space – it may have run out of space. It may have exhausted its food supply.
- (iv)  $r = 0$
- (v) Day 35 – 37. At this point the birth rate is smaller than the death rate (no emigration or immigration can occur in an enclosed experiment).

7.

- (i) It may require a particular soil type, soil moisture and / or temperature. Area X may not provide an essential factor.
- (ii) Dispersal to area Y being so far away and separated by desert may be highly unlikely.
- (iii) The area may experience lengthy droughts – many years of little or no rain. The rabbits cannot breed if there is insufficient green food.
- (iv) Rabbit plagues are likely to cause great destruction of plants growing in the area. This may be followed by serious erosion of areas that are exposed.

8.

(i) A declining birth rate (b) will result in a lessening of the number of young children in the population. The proportion of older people will therefore become greater. A declining death rate (d) results in more people reaching old age. Therefore this will also further increase the proportion of older people in the population.

(ii) People who immigrate, i.e. who enter the population, are more likely to be younger, including young families. The increase in young adults and young families who are likely to have children will lower the average age of the population over a number of years.

9.

(i) Niche means the role or function that a species has in an ecosystem. e.g. grasses contribute food to the community through photosynthesis. They also hold the soil and reduce erosion. They form a shelter for small animals and birds. They provide nesting sites for some birds, insects and spiders.

(ii)

(a) Tree – provides shade for animals, its fruit and leaves may be food for a variety of organisms. Its hollow trunk may be home to bats, possums, birds or bees.

(b) Kangaroos are primary consumers – they eat native grasses and leaves, they have few predators apart from man in this area. Their young may occasionally be taken by dogs but they are generally well protected in the pouch.

10.

(i) These two animals occupy a similar niche. They are both nocturnal carnivores that feed on large invertebrates, small mammals, lizards and birds. In the short term they compete with one another and limit each other's population to some extent.

(ii) The feral fox, however, appears to be a stronger competitor and according to the competitive exclusion principle eventually the fox will replace the chuditch (if people do not intervene by removing or reducing the feral fox).

11.

(i) The proportion of young people in one population may be higher than in another population whose population may consist of a high proportion of older people.

(ii) If the birth rate of one human population is greater for a number of years than another's, then it will have a higher proportion of children and young adults.

Another contributor to the higher proportion of younger people in a population may be immigration (into the population) of young adults.

- (iii) Plant populations may be different following a fire (or natural catastrophe) in one which has left the opportunity for secondary succession to occur. This population will be younger and faster growing than a similar ecosystem that has not been disturbed for many years.
- (iv) A younger population is likely to have a higher birth rate and a lower death rate. It will therefore have a natural growth rate ( $b - d$ ) which will be higher. An older population will have a lower birth rate and a higher death rate and will therefore have a lower growth rate.

(iii)

- a particular species requires particular resources to increase in numbers and establish itself in any environment.
- e.g. the ring-tailed possum requires certain species of native plants as food.
- e.g. the ring-tailed possum also requires a number of particular nesting sites – holes in old trees, or the crooks of old grass trees.
- the carrying capacity of an environment for a particular species depends on the limiting factor/s.
- e.g. if there are few old trees in one area of forest – it will support only a few ring-tailed possums / or none at all if the density is too small for successful reproduction.
- another forest area may have an abundance of old trees but few plant species which form part of their diet. Therefore the limiting factor is different but the effect is the same – few if any ring-tailed possums will exist in the area.
- in any area where there is an abundance of resources for a particular species and few predators, its carrying capacity will be higher.
- e.g. in an area where the numbers of trees suitable for nesting is high, the food is abundant and predators such as pythons, foxes and cats are few, the ring-tailed possum population will flourish.
- the territorial area necessary to support its young will be smaller and the density of the organism in the area will be greater.

## Section 3

1.(i)

- the growth of a population normally shows an 'S' curve.
- the slow growth rate at the beginning reflects a slow 'b' rate, as nesting sites are established, few mates, low population density reduce the number of births. The 'd' rate is likely to be high as the age structure is likely to be skewed toward older individuals.
- as the population becomes established, the 'b' rate begins to exceed the 'd' rate.
- the population is not restrained or limited by resources, predators, disease, etc.
- the value of 'r' increases during the exponential period, it does not remain constant.
- the population plateaus as one or more limiting factors begins to restrict the 'b' rate and/or increase the 'd' rate.
- the limiting factors in the plateau are density-dependent, e.g. spread of disease, restricted food, nesting sites, predator numbers.
- as the population plateaus,  $b = d$  i.e.  $r = 0$ .

(ii)

- density-independent factors which restrict population growth include: natural disasters, e.g. floods, cyclones, storms, drought.
- the population growth may be reduced by such events because the death rate increases. The birth rate may decrease but by a lesser amount, i.e.  $b - d$  becomes smaller, as 'd' exceeds 'b'.
- density-dependent factors which restrict population growth include: disease, lack of food, reduced space, increased predation, lack of water.
- communicable disease spreads more rapidly where organisms are close together.
- food, water, living space are likely to become limiting factors as density increases because competition becomes more fierce.
- as the population increases, the number of predators may increase at a similar rate. A high population density may make it easier for predators to capture prey in a given area.

## TT 5: ECOSYSTEM CHANGE

### Section 1

- |       |       |
|-------|-------|
| 1. d  | 11. c |
| 2. b  | 12. a |
| 3. a  | 13. a |
| 4. d  | 14. c |
| 5. d  | 15. d |
| 6. d  | 16. b |
| 7. b  | 17. b |
| 8. d  | 18. a |
| 9. a  | 19. c |
| 10. d | 20. c |

### Section 2

1.
  - (i) The disappearance of the insect will lead to the decline or even the disappearance of the particular orchid as the orchid will not be pollinated and will not reproduce.
  - (ii) Mutualism – both species benefit from their association
  - (iii) If the orchid was to disappear, the insect would lose its sole source of food at a particular time of the year. It may disappear or decline and therefore not pollinate the

- other plant species when they flower. These other plants will decline too.
- (iv) While it may be small in numbers and appear insignificant, its disappearance would have a disproportionate effect on the ecosystem
- 2.
- (i) Heat is necessary for the germination of wattle seeds.
- (ii)
- samples of seeds should be soaked in water at room temperature for the times shown in the table and germination rates measured to properly control variables (i.e. use a control).
  - repeat the experiment using different temperatures.
  - use more seeds in each sample.
  - use more time intervals in the water.
  - leave the seeds in hot water for longer than 240 secs.
  - allow the seeds more time to germinate.
- (iii)
- germination rates appear to increase with the time the seeds are left in hot water, no seeds germinated that were not heated.
  - heat appears necessary for wattle seed germination, i.e. the hypothesis is supported.
- (iv) From this experiment it can be inferred that fire could promote the germination of wattle seeds.
- (v) Heat promotes the germination of the wattles' seeds and may inhibit other seed germination depending on the intensity of the fire.
- (vi) Other plants, e.g. Banksias and Hakeas, may be stimulated by a mild intensity fire. Wattles require stronger heat to crack their seed coat (testa).
- 3.
- (i) Primary succession – succession which begins on a newly created substrate.
- (ii) Primary succession will occur on a newly exposed volcanic island. The rock may be weathered first by temperature change and water. The wind and birds may deposit seeds on the island and begin a procession of plant and animal communities.
- (iii) Secondary succession – succession that occurs when an existing community is disturbed.
- (iv) A flood may inundate an area of land around a river sweeping away much of the plant and animal life. The ecosystem will undergo a succession of communities that will be determined largely by the organisms that survived the flood.
- 4.
- (i) The fire may destroy the stem and leaves of the plant. However the lignotuber remains, protected by soil from the heat. When conditions return to normal, the plant will begin to grow shoots from the lignotuber.
- (ii) An intense fire will destroy plant species that are not tolerant to extreme heat. Only those that are adapted to the intensity will survive. This means that fire selects certain species. The area may have a reduced biodiversity and only contain fire resistant species (at least in the short term).
- 5.
- (i) Many insects lay their eggs in water and the larval stage is aquatic, so that in the event of fire they are protected. Adult insects often fly or burrow underground.
- (ii) Many reptiles burrow or live in hollows in and under trees and rocks.
- (iii) Most birds can fly away from the area. Large and small flightless birds are at risk.
- (iv) Some mammals may burrow or live in the hollows of large trees
- 6.
- (i) Lichens consist of an alga (or cyanobacterium) and a fungus living in a mutualistic relationship. The alga photosynthesises and provides food while the fungus appears to provide a suitable microhabitat for the lichen and may make some minerals available to the alga from the rock substrate. Lichens are able to colonise the rock because of these adaptations and their tolerance to the conditions.
- (ii) Bacteria and cyanobacteria. They do not require a soil substrate and some are able to derive their nutrients from the rock.
- (iii) Rapid temperature changes causes expansion and contraction that is not uniform or even, it creates stresses in the rock. This is likely to crack the rock on its surface.
- (iv)
- Water may seep into the rock. When it freezes the water expands and breaks up the rock.
  - Water may also contain some dissolved CO<sub>2</sub> which makes it slightly acidic. This may chemically weather the rock because some minerals react with the acid.
  - Water trapped in the rock crevices also provides the opportunity for plants to colonise the rock as they need the water.
- (v) Lichens are likely to be followed by mosses and small ferns, small annual angiosperms, grasses and small shrubs, larger shrubs and saplings, tall trees.
- (vi) Natural disturbance such as fire or floods. A fire is likely to destroy much of the plant and animal life on the rock especially in the mid life of the succession and a process of secondary succession may begin again.
- (vii) A climax community is a community that has reached its final stage in the ecological succession. It becomes stable and has great biodiversity while the environment remains relatively unchanged.

- (viii) As the granite outcrop appears to be in the Australian bush, the climax community is likely to be a eucalyptus forest or woodland with great biodiversity. The trees will provide shade and protection for a multitude of other plants and animals and the abiotic conditions will be far less harsh than on the granite outcrop.
- (ix) It illustrates a succession in time – probably thousands of years.
- (x) In conservation biology an understanding of the processes that occur as an environment recovers from disturbance, whether natural or caused by humans, is very important. This understanding may help humans restore ecosystems, regain their biodiversity and develop a resilience to change.

### Section 3

Carrying capacity:

- carrying capacity is defined as the population of a species which a particular area can support.
- this is determined by abiotic and biotic factors – these factors limit the carrying capacity
- if the soil in an environment is dry, plants that grow there are likely to be sparse and the population lower
- if plant populations are high – productivity is high – food webs are more complex and animal populations greater

Climate change involves a number of changes to abiotic factors. These may be different in different areas of the earth but in Australia are likely to include:

- a fall in the annual rainfall
- a rise in the average temperature
- stronger prevailing winds, changes in wind direction
- a greater range of daily temperatures
- more frequent storms and cyclones
- more frequent floods
- more frequent bush fires.

These changes in turn may result in changes to the biotic factors and the carrying capacity of the environment generally.

- less annual rainfall will, in most cases, result in less plant productivity (more rainfall more plant productivity).
- water is needed for photosynthesis.
- falling annual rainfall will reduce plant biodiversity as only plants that are adapted to dry conditions can survive – xerophytes.
- the disappearance of some plant species is likely to reduce the animal biodiversity even more, as each plant species may provide food and shelter for many animal species.
- plant productivity will affect animal populations – less plant productivity will

result in fewer animals as competition will increase for less available food.

- higher order consumer species at the top of the food pyramid are likely to be threatened as they rely on a large mass of lower order consumers (and plants) to support them.
- as available water decreases plants become more stressed (including larger trees) making them more susceptible to diseases, e.g. fungal and bacterial.
- as the water table falls in summer to lower depths than normal, in some areas, the tap roots of some trees may not find available water, increasing mortality rates of some plant species.
- a rise in the average mean temperature with longer, hotter and more frequent “heat waves” may cause an increase in the mortality rate of smaller trees and saplings in summer – less recruitment lowers the carrying capacity.
- stronger winds have a drying effect on plants – those that are adapted to these conditions close their stomata, plants that are not well adapted may wilt and die.
- this also reduces plant productivity as they are unable to photosynthesise without an intake of carbon dioxide.
- a drier climate with a reduction in frequent cloud cover often results in greater extremes of daily temperatures, i.e. colder nights and warmer days – lower temperatures may result in frost damage to those plants that are not adapted to temperatures below freezing.
- higher daytime temperatures cause greater water evaporation from the soil and less water is then available for plant productivity.
- more frequent storms and cyclones cause direct damage to plants and loss of animal life and indirectly cause flooding which may damage plants along waterways (although in some areas the flooding will be welcome as it is a natural part of life cycles).
- the rise in the average daily temperature and associated changes in stronger wind and less rainfall make some areas more prone to bushfires – these may become more frequent and more intense.
- this may reduce biodiversity – favouring those plants that are fire tolerant and the disturbance results in secondary succession occurring on a frequent basis – reducing the carrying capacity generally.

## TT 6: HUMAN ACTIVITIES, CONSERVATION & PREDICTING ECOSYSTEM CHANGE

### Section 1

- |              |              |
|--------------|--------------|
| 1. <i>d</i>  | 11. <i>a</i> |
| 2. <i>a</i>  | 12. <i>c</i> |
| 3. <i>d</i>  | 13. <i>a</i> |
| 4. <i>a</i>  | 14. <i>d</i> |
| 5. <i>b</i>  | 15. <i>d</i> |
| 6. <i>b</i>  | 16. <i>a</i> |
| 7. <i>c</i>  | 17. <i>b</i> |
| 8. <i>a</i>  | 18. <i>c</i> |
| 9. <i>a</i>  | 19. <i>a</i> |
| 10. <i>d</i> | 20. <i>a</i> |

### Section 2

1.

(i) carbon dioxide and methane

(ii) chlorofluorocarbons (CFC's)

(iii)

- burning fossil fuels/ruminant animals.
- clearing forests.

(iv)

- release of CFC's from old refrigerators and airconditioners.
- use of CFC's to produce spongy rubber.

(v)

- overgrazing in marginal farming areas (i.e. allowing too many sheep or cattle to populate areas of low rainfall).
- overclearing in marginal farming areas for crops (i.e. clearing too much land in low rainfall areas – these often quickly lose productivity and become arid wastelands).

[8 marks]

2.

(i) Numbat, Noisy scrub bird.

(ii) Numbat was once common throughout most of southern Australia especially in Wandoo open forest ecosystems. Its distribution is now confined to a small area of eucalyptus woodland in the S.W. of W.A.

Noisy Scrub Bird was once common along the south coast of W.A. The species is now reduced to a small area east of Albany called Two Peoples Bay.

(iii) Fox and cat.

(iv) The fox is dispersed over the entire country apart from the far north. The cat is dispersed over the entire continent.

[5 marks]

3.

(i) The water table rises closer to the surface of the soil.

(ii) Because the roots of the trees no longer draw water from the soil and pass it to the leaves, where it is then transpired into the atmosphere, the water table rises.

(iii) As the water moves up through the soil, it dissolves salt which has accumulated there and carries it to the surface. When the water evaporates salt is left behind, often forming a visible white film of salt over the surface of the land.

(iv) The water which flows into creeks and rivers has much of this dissolved salt in it. The water courses often become too salty for even stock to drink and naturally occurring animals and plants disappear from these rivers and are replaced by a few halophyte species.

(v)

- The rising salt levels may be reduced by replanting deep rooted trees and shrubs in cleared areas to lower the water table.
- Land should not be cleared before the effect on soil salinity is determined.
- Salt tolerant plants may be introduced in areas most severely affected to help lower the water table.

(vi) There would be a continuing loss of useful farming land. Much of rural Western Australia would become totally unproductive.

(vii) Urban dwellers may volunteer to help raise and plant tree seedlings on farming properties or be prepared to pay higher taxes to pay contractors to do this or pay more for food.

[9 marks]

4.

(i) Often pollutants from the waste leach into the ground water contaminating it.

(ii) Swamp communities disappear. There is a loss of birds, fish, lizards, snakes, small marsupials and invertebrates from the area.

(iii) Migratory birds lose important feeding areas. Birds entering Australia to feed or reproduce during the northern hemisphere's winter are unable to do so. Their numbers decline. Resident birds, those that live here all year, have their only habitat destroyed. Their numbers decline.

(iv)

- They provide alternative recreational areas.
- The biodiversity of the areas are maintained.
- The quality of ground water is maintained.
- Helps maintain bird populations in other parts of the world because migration is still possible.

[7 marks]

5.

(i)

• European rabbits were introduced into Australia by early settlers in the eighteenth and nineteenth century.

• They adapted well to the environment and spread over much of the continent except for the far north – wet tropics.

• Rabbits have become a pest in Australia causing loss of pasture, loss of native plant

- species, soil erosion and competition with native herbivores for food and burrows.
- A virus called Myxomatosis spread by fleas was introduced into the population (1950)
  - Large numbers of rabbits died from the disease.
  - But the population was not eliminated altogether.
- (ii) By the late 1950's the rabbit population had increased again, the survivors having a resistance to Myxomatosis. Other methods of control have had to be used with varying success (e.g. destroying burrows, hunting, calicivirus, poisons (1080))
- (iii)
- The prickly pear (a cactus) was introduced to Australia in the early 1800's.
  - Its seeds pass through the digestive tract of animals and birds so it was easily dispersed by them. The plant can also readily grow from its parts – vegetatively. It spread rapidly from New South Wales to Queensland.
  - It outcompeted other plants and reduced large areas of farm land to waste. The plant itself was of little economic value.
  - A small insect the cactoblastis moth was introduced successfully to Australia in the 1920's.
  - The moth lays its eggs on the plant and the larvae feeds on the plant – generally destroying it.
- (iv)
- The cactoblastis moth has successfully controlled the population of the prickly pear in Australia.
  - Large areas of land have been reclaimed for agriculture.
  - The two populations of moth and prickly pear are now much reduced.
- 6.
- (i) The use of chlorofluorocarbons (CFCs)
- as propellants in sprays.
  - in refrigeration and air conditioning.
  - to create small pockets of gas in sponge rubber mattresses.
- (ii) More UV is able to reach the Earth's surface because ozone normally absorbs a high proportion of UV. UV reduces the rate of photosynthesis and increases the rate of skin cancer in humans (and pigs).
- (iii) CFCs have been replaced by safer hydrocarbon gases in most instances and CFC disposal is closely controlled.
- (iv) Management.
- 7.
- (i) **Seed banks** are laboratories in which seeds are semi-dried and kept in freezers or in liquid nitrogen. The seeds can be used to rehabilitate disturbed areas, when other conditions are restored.
- (ii) **Captive breeding programs** – animals are removed from their natural habitats and bred (ex-situ) to produce young in protected habitats (e.g. zoos). When the species numbers and genetic diversity increase and a suitable environment becomes available, the organisms may be carefully reintroduced to their natural habitat.
- (iii) **Introduced species** fall into two broad categories. The first consists of cultivated crops and livestock and domesticated animals. The second consists of invasive pest species and other exotic species that are not apparently harmful. Conservation generally requires the limitation of this second category. This may involve the use of biological control, poisons and hunting.
- (iv) **Open seasons** are limited times during the year (which can be adjusted by the authorities at short notice) in which some fish species including shellfish and other animals (e.g. ducks) can be taken (hunted) in certain areas. This is intended to allow the species to recover from harvesting and reproduce sustainable populations.

### Section 3

- (i)
- Animals and plants often face extinction because their habitat is destroyed.
  - Animals may be overexploited for meat/skin.
  - Hunted because they are a pest to farmers.
  - Hunted by feral predators.
  - Plants may be eaten by stock – sheep or cattle.
  - Plants which are limited in number and abundance may be removed for development of housing or replaced by pasture or crops.
  - If all or some of these pressures are removed, the animal or plant has a greater chance of survival.
  - The restoration of their habitat or the protection of remaining habitats to enable the organism to reproduce may be required.
  - Animals and plants may need to be placed on a 'protected' list by governments limiting or entirely preventing their removal from the wild.
  - Feral predators may need to be removed by shooting or poisoning in the areas under threat.
  - A collection of seeds (in a 'seed bank') is often established to keep the genetic material for future reproduction.
  - 'Captive' breeding programs for both plants and animals are conducted to produce populations of the organisms in protected environments.
  - 'Corridors' may be created to allow the exchange of genes between isolated

populations caused by the fragmentation of the original population.

- Pet owners may be encouraged to sterilise cats and dogs, so that should they become feral, they will not breed and increase the pressure on native animals.
- Culling feral herbivores (goats, camels, donkeys) regularly, reducing the damaging effect they have on native plant populations.

[10 marks]

(ii)

(Students may choose from a number of different introduced plant species including blackberry, Broad leaf pepper tree, Bridal creeper, lantana, mimosa, salvinia, Arum lily, watsonia.)

(Two common names required. Essential to name two plants).

- blackberry.
- Bridal creeper.

Methods of control include:

- use of herbicides.
- mechanical removal.
- burning.
- grazing.
- prohibiting movement of seeds and plants
- legislation that requires all landholders to remove pest plant infestations.
- use of biological control, e.g. introduced fungus and leafhoppers to control Bridal creeper.

[6 marks]

(iii)

Conservation of biodiversity

- ensures ecosystems and environments remain stable – limits erosion and land degradation.
- biodiversity provides support for other plants and animals.
- some species have not been studied that may provide a source of food or medicine in the future.
- future generations have a right to enjoy the wide variety of life that present generations enjoy.
- natural ecosystems are needed for water catchment.
- natural ecosystems are needed as carbon sinks to absorb carbon dioxide from the atmosphere.
- natural ecosystems provide recreational opportunities.

[4 marks]

## TT 7: INQUIRY SKILLS & HUMAN ENDEAVOUR 1

### Section 1

- |       |       |
|-------|-------|
| 1. d  | 11. a |
| 2. a  | 12. a |
| 3. b  | 13. c |
| 4. c  | 14. b |
| 5. d  | 15. b |
| 6. d  | 16. a |
| 7. c  | 17. c |
| 8. b  | 18. a |
| 9. b  | 19. c |
| 10. d | 20. b |

### Section 2

1.

(i) Capture–recapture

(ii)

$$N = \frac{n^1 \times n^2}{m}$$

N = estimated population

$n^1$  = number tagged in first sample

$n^2$  = total captured in second sample

m = observed number tagged in second sample

(iii) 
$$N = \frac{50 \times 124}{17}$$

$$= 365$$

(iv)

- The snails that were tagged may have become easier prey for birds.
  - Some snails may have gone into aestivation because of warming weather.
  - Snail deaths may have exceeded snail recruitment.
2. a) **Observation:** Something which is seen, heard, smelt, felt, tasted or detected using an instrument.
- b) **Hypothesis:** An educated guess which provides a testable explanation for observations.
- c) **Prediction:** A forecast of what a future observation might be.
- d) **Data:** Observations (e.g. numerical measurements) obtained in an experiment used to arrive at a conclusion.
- e) **Random:** Without bias; usually used to describe the way in which samples are chosen.
- f) **Quadrat:** An area chosen to study; normally a square, the size of which is determined by the experiment.
- g) **Variable:** A factor which changes or can change, e.g. temperature.
- h) **Sample:** A small part taken from the whole which represents the whole.
- i) **Replicate:** To carry out a similar/copy of an experiment.

j) **Procedure:** The order in which an experiment is carried out – method used.

3.

(i)

- Randomly pick several hundred pea pods, e.g. 500.
  - Divide these randomly into two equal groups.
  - Place half, the experimental group, into a freezer and keep the other half, the control group, in a room at normal temperature, e.g. 20°C.
  - Leave both groups at their respective temperatures for one week.
  - Remove both samples and using an appropriate test, test each for the amount of Vitamin C.
  - Calculate the average Vitamin C concentration in both the control seeds and the experimental seeds.
  - Record all the results obtained.
  - Determine whether the results support or refute the hypothesis.
- (ii) Age of pea pods, the pea variety, soil in which peas are grown, the light pea plants receive, amount of water given to plants, time of treatment.
- (iii) a) Temperature at which peas are kept after picking.  
b) Concentration of Vitamin C in peas.
- (iv) a) The peas which were frozen should have a greater concentration of vitamin C than those which were kept at room temperature for several days.  
b) The peas which were frozen have less or the same concentration of vitamin C in them as those which were kept at room temperature for several days.
- (v) A larger sample, e.g. 1000 pea pods, or repeat procedures from which similar results were obtained.

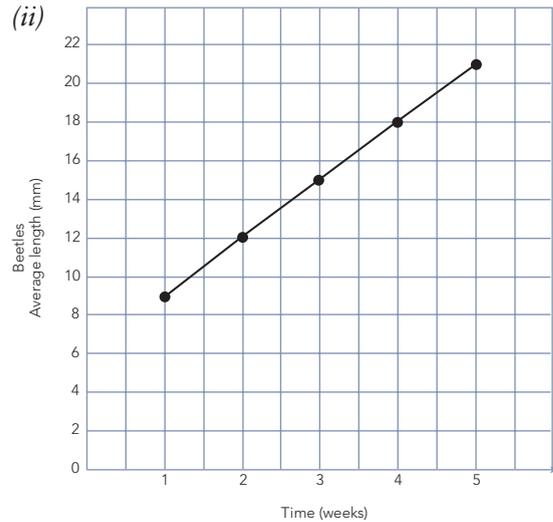
4.

(i)

TIME (weeks)	BEEPLES' AVERAGE LENGTH (mm)
1	9
2	12
3	15
4	18
5	21

Graph: Average Beetle's length vs time

(ii)



- (iii) Parallax error could occur – caused by looking at the graduations on the scale used at an angle less than 90°. Measurements must be standardised, i.e. taken from the same points on each insect.
- (iv) Greater care in looking at the specimen and the scale from directly above. Adopting an agreed measurement, e.g. from the apex of the head to the lowest part of the abdomen not the wings.
- (v) The number of beetles used to calculate the average size at each time interval. If the number is small then the reliability of the data is low.
- (vi) The longer the beetle the older it is. (This does not take into account moulting of the exoskeleton or ecdysis which takes place periodically in order to allow for growth).

5.

- (i) (Students may choose any new experiment or investigation – this is one example)  
Measurement of the water content of one kg of fresh plant matter.
- A container was weighed empty.
  - The plant matter was then added to the container.
  - The fresh plant matter plus container were weighed together.
  - The net weight of the fresh plant matter was calculated.
  - The plant matter and the container were then placed in an oven for 24 hours.
  - They were then removed and reweighed.
  - The dry weight and % of water were then calculated.
- (ii) In each part of the experiment any dangers needed to be assessed
- the container chosen had to be heat proof – so that it did not ignite or explode in the oven.
  - the temperature of the oven needed to be low so that the organic matter in the plants did not dry and ignite.

- care needed to be taken in removing the material from the oven using appropriate tongs to avoid skin burns.
  - the material had to be cooled on a heat proof mat in order to avoid damage to the laboratory bench before reweighing.
6. Answer (one of many possible answers)
- 1.a) Object with only straight sides or only smooth sides 2
  - 1.b) Object with straight sides and smooth sides 4
  - 2.a) Object with four sides or less 3
  - 2.b) Object with more than four sides
- yobul  
glunk  
slunk
- 3.a) Object with circular side only
  - 3.b) Object with square sides only
  - 4.a) Object with an inner circular shape
  - 4.b) Object with an outer circular shape
- sibble  
gromal
7. (i) *Climacteris picumnus* – Brown treecreeper  
(ii) 1 (a), 2 (a), 3(b), 4 (b)
- 8.
- (i)
- Place a peg in the sand at high water mark.
  - Run a cord or string at right angles to the beach into the stable dunes where the larger trees are growing.
  - Record its distance from the beach and the type of each plant that touches the string.
- (ii) If these plants germinate closer than 50 metres to the beach, they will not tolerate the higher salt concentration in that habitat.
- (iii)
- Measure the salt concentration in the soil at various intervals (e.g. 10 metres) from the high water mark.
  - Prepare 10 pots of soil with the salt concentration as found at the 10, 20, 30, 40, 50 and 60 metre intervals. (They should have decreasing salt concentrations as the distance increases).
  - Place the seeds/seedlings of plants taken from beyond the 50 metre mark in each pot.
  - Keep all other variables the same, i.e. light, water, disease, etc.
  - Monitor the growth of the plants in each pot for several months.
  - Record differences in their growth and survival rates.
- Note: The pot containing soil from 60 metres represents the control.

### Section 3

- (i)
- An area of the earth's biosphere that has great biodiversity.
  - It has many different species, many genes and ecosystems.
  - In the case of a "hotspot" that biodiversity is threatened by human activity.
- The SW is a large area of the state extending from Geraldton in the north to Esperance in the south east, with a large area of land to the west of a line joining these two places extending to the oceans.
  - This area has great biodiversity but has been heavily cleared of vegetation since colonisation for farming (largely wheat, sheep and cattle) and mining.
  - Clearing has resulted in soil salinity increasing in many areas and rising salt levels in rivers and creeks.
  - The natural vegetation that remains has been fragmented.
  - Many plant and animal populations have become isolated in small pockets.
  - These small isolated populations with low genetic diversity are at risk of local extinction.
  - The area has had a declining rainfall over many decades.
  - This has been due to climate change.
  - Reduced rainfall and rising temperatures have put greater pressure on already stressed natural populations of plants and animals.
- (ii)
- Keystone species are believed to have a disproportionate importance in the ecosystems in which they exist.
  - Their decline is likely to affect many other species.
  - Therefore if a keystone species is under threat, it needs to be protected perhaps more than others.
  - For example in W.A. Tiger sharks eat a range of sea animals – other fish, turtles and dugongs.
  - This helps keep the populations of these prey at reasonable numbers.
  - If the Tiger sharks were removed, turtles and dugongs may overgraze sea grasses.
  - Sea grasses are required by many species of fish to lay their eggs – overgrazing is likely to cause the decline of many fish species.
- (iii)
- Single-species conservation involves targeting a single species to save it from threat of extinction.
  - e.g. this may be an iconic species like the panda.
  - The species may or may not be a keystone species.
  - Those that argue that this approach is legitimate conservation argue that efforts to save a species in its habitat will have a positive effect on other species that live there too.
  - It is also an effective means to raise public awareness and to raise funds for conservation.
  - Opponents to this approach believe that directing a disproportionate amount of effort and money at one species risks neglecting other species.
  - The argument here is that the effort should be directed across the ecosystem and its biodiversity in a more general approach.
  - Promoting and supporting biodiversity is the key to conservation of ecosystems and single-species conservation appears to overlook this idea.

## TT 8: PROKARYOTIC & EUKARYOTIC CELLS

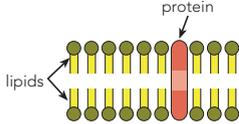
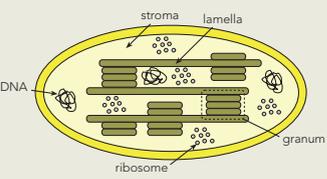
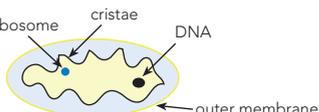
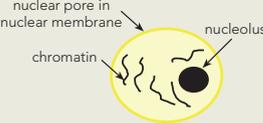
### Section 1

1. d
2. a
3. c
4. b
5. c
6. d
7. b
8. d
9. b
10. b
11. a
12. c
13. d
14. a
15. b
16. d
17. d
18. c
19. c
20. b

### Section 2

1.
  - (i) organic compounds are needed for:
    - (a) growth and repair, e.g. proteins.
    - (b) energy, e.g. carbohydrates and fats.
    - (c) as co-enzymes, e.g. vitamin B.
    - (d) as co-factors, e.g. vitamin C.
  - (ii) Oxygen: essential for aerobic respiration, heterotrophs (unlike autotrophs) cannot make oxygen but rely on oxygen from their surroundings.
  - (iii) Water: medium in which all the metabolic processes in cells occurs. The amount of water present determines the concentration of both reactants and products.
  - (iv) Mineral ions: required as co-factors in enzyme controlled reactions, e.g. calcium. Also as constituents in the synthesis of organic compounds, e.g. iron needed in haemoglobin. Minerals are needed in
2.
  - (i) Carbon dioxide: necessary reactant for photosynthesis. The carbon is used in the synthesis of all the organic compounds derived from the glucose produced.
  - (ii) Water: also necessary for photosynthesis. It is split such that the oxygen is released while the hydrogen ions produced take part in synthesising the glucose. Water is also a medium for all the metabolism which occurs in the cell's cytoplasm and nucleoplasm.
  - (iii) Light energy: required as a source of energy for the chemical bonds which must be formed in photosynthesis and the subsequent synthesis of other compounds. Light energy is converted into chemical energy.
  - (iv) Mineral ions: needed for the synthesis of many organic chemicals, e.g. chlorophyll contains magnesium, proteins contain nitrogen (from nitrates). Also used as co-factors e.g. calcium.
3. If metabolic wastes like carbon dioxide and urea are allowed to accumulate in the body fluids of an animal, they will become so concentrated that they are toxic and will therefore cause the animal to become sick or even die.
4. See table below.
5.
  - (i) Plant cell walls support the cell giving it strength and structure. The wall prevents the plant cell from lysing (bursting) if its intracellular hydrostatic pressure becomes high.

4.

ORGANELLE NAME	STRUCTURE	FUNCTIONS	DIAGRAM
plasma/cell membrane	Two layers of lipid with proteins floating in the layers.	Controls exchange between cell and its environment.	
chloroplast	Double membrane. Large plastid containing chlorophyll arranged on stacked sheets of membranes called lamellae.	Carries out photosynthesis producing sugar. May store starch.	
mitochondrion	Rod shaped organelle. Double membrane. Inner membrane folded forming cristae.	Site for aerobic respiration. Production of ATP.	
nucleus	Double membrane bound large organelle containing DNA and RNA. Membrane has large pores.	Controls other organelles by controlling protein synthesis (contains hereditary code).	

bone, e.g. calcium, phosphorus. For nerve impulses, e.g. sodium, potassium.

2.

(i) Carbon dioxide: necessary reactant for photosynthesis. The carbon is used in the synthesis of all the organic compounds derived from the glucose produced.

(ii) Water: also necessary for photosynthesis. It is split such that the oxygen is released while the hydrogen ions produced take part in synthesising the glucose. Water is also a medium for all the metabolism which occurs in the cell's cytoplasm and nucleoplasm.

(iii) Light energy: required as a source of energy for the chemical bonds which must be formed in photosynthesis and the subsequent synthesis of other compounds. Light energy is converted into chemical energy.

(iv) Mineral ions: needed for the synthesis of many organic chemicals, e.g. chlorophyll contains magnesium, proteins contain nitrogen (from nitrates). Also used as co-factors e.g. calcium.

3. If metabolic wastes like carbon dioxide and urea are allowed to accumulate in the body fluids of an animal, they will become so concentrated that they are toxic and will therefore cause the animal to become sick or even die.

4. See table below.

5.

(i) Plant cell walls support the cell giving it strength and structure. The wall prevents the plant cell from lysing (bursting) if its intracellular hydrostatic pressure becomes high.

Animals are either supported by an exoskeleton or an endoskeleton. Those animals that do not possess a skeleton are usually small or supported by their buoyancy in an aquatic environment. Animals require adaptations (like kidneys) to regulate the water content in and around cells so that their cells are not subjected to high intracellular hydrostatic pressures.

(ii) Animals do not need chlorophyll because they do not synthesise glucose. They do not photosynthesise. They rely on plants or other animals for their food.

6.

(i)

- Prokaryotes have no membrane bounded organelles, eukaryotes have several membrane bounded organelles, e.g. nucleus, mitochondrion, chloroplast, Golgi apparatus.
- Prokaryote cells are much smaller (less than 5 micrometres) than eukaryote cells (more than 10 micrometres).
- Prokaryote cells have a single donut-shaped chromosome, eukaryotes have chromosomes shaped like a double helix.
- All prokaryotes are single-celled, most eukaryotes are multi-cellular.

(ii) Both cell types

- respire.
- contain DNA.
- grow and reproduce.
- have a cytoskeleton (though the prokaryote's is less complex).

(iii) The mitochondrion and the chloroplast

(iv) The mitochondrion is similar to a heterotrophic bacterium. It contains its own DNA and is able to reproduce by fission similar to bacteria. The chloroplasts also have their own DNA and resemble cyanobacteria. Both photosynthesise. Chloroplasts also divide by fission as do cyanobacteria.

(v) This suggests that eukaryotes have evolved through the fusion of various cells. Some have incorporated bacteria like cells in their cytoplasm and become heterotrophic eukaryotes and others have incorporated both bacteria-like cells and cyanobacteria-like cells and become eukaryotic autotrophs.

7. The nucleus is essential for the repair of damaged parts of the cell because it controls protein synthesis. As the red blood cell has no nucleus it is unable to repair any damaged parts (including the cell membrane). Therefore it does not live long.

8.

(i) (a) 4 mm or 4000  $\mu\text{m}$  ( $\pm 0.1$  mm, i.e. answers in the region 3.9 - 4.1 mm accepted)

$$(b) 4 \times \frac{40}{100} = 1.6 \text{ mm or } 1600 \mu\text{m}$$

( $\pm 0.1$  mm)

(ii) (a)  $0.5 \times 1.6 \text{ mm} = 0.8 \text{ mm or } 800 \mu\text{m}$   
( $\pm 0.05$  mm)

$$(b) \frac{5}{32} \times 1.6 \text{ mm} = 0.25 \text{ mm or } 250 \mu\text{m}$$

( $\pm 0.05$  mm)

(iii) no. of cells =  $\frac{4000}{250} = 16 (\pm 1)$

9. (i) oxygen (produced during photosynthesis)  
(ii) bacteria move towards the oxygen  
(iii) they may have flagella to propel them through the water  
(iv) close to the surface where the oxygen concentration is greatest or near photosynthetic algae

10.

(i) The sum of the chemical processes which occur within the body of an organism. These include both anabolic and catabolic processes.

(ii) An anabolic reaction is a chemical reaction in which simpler molecules are used to synthesise more complex molecules.

(iii) Yes, a net input of energy is required. This is because the energy state of the products is at a higher level than that of the reactants in an anabolic reaction.

(iv) A catabolic reaction is a chemical reaction in which the products are less complex than the reactants. The reactants are broken down.

(v) No net energy is required. Energy is released as the energy level of the products is lower than that of the reactants.

### Section 3

(i)

- the plant cells have high concentration of water molecules around them.
- the plant cells have a lower concentration of water in their cytoplasm.
- water moves by diffusion through their plasma membrane (osmosis) into the cells.
- this movement increases the water pressure (hydrostatic pressure) inside the cells causing them to swell (and become turgid).

(ii)

- animal cells which are placed in distilled water have a high concentration of water molecules around them.
- the animal cells have a lower concentration of water molecules in their cytoplasm.
- water moves into the cells by osmosis.
- the hydrostatic pressure inside the cells increases and with no cell wall to prevent expansion the cells eventually burst (i.e. they lyse).

(iii)

- as the cell increases in volume, if its shape stays the same, its SA:Vol becomes smaller.

- with a smaller SA:Vol (ratio) the efficiency with which it can absorb nutrients and water and eliminate wastes decreases – the processes become too slow.
  - this reduces the cells' metabolic efficiency.
  - if it divides (e.g. by mitosis) the new cells are smaller and each has a larger SA:Vol (ratio). Each is therefore more efficient.
- (iv)
- substances which are in greater concentration in the external environment of the cell (e.g. in the intercellular fluid) than in the cytoplasm may move rapidly into the cytoplasm.
  - substances which are in lower concentration in the intercellular fluid will not move into the cytoplasm. They may in fact move out of the cell and into the intercellular fluid instead.
  - molecules which are too large, or insoluble in lipids or charged ions, may not be able to move through the selectively-permeable plasma membrane.
  - some proteins in the plasma membrane may form channels which allow some substances in and out of the cell.
  - sometimes proteins in the plasma membrane act as carrier molecules and transport certain molecules across the membrane (a process called "facilitated diffusion").
  - the plasma membrane is therefore selectively permeable.
- (v)
- root hair cells which absorb water and minerals from the soil have a long hair-like extension of their cytoplasm to increase their total surface area (S.A.)
  - the increased S.A. enables them to absorb minerals and water more rapidly than they could with a smaller S.A. They are therefore more efficient.

## TT 9: CELL MEMBRANES

### Section 1

- |       |       |
|-------|-------|
| 1. d  | 11. b |
| 2. c  | 12. a |
| 3. b  | 13. d |
| 4. b  | 14. c |
| 5. b  | 15. a |
| 6. c  | 16. d |
| 7. a  | 17. d |
| 8. a  | 18. d |
| 9. a  | 19. d |
| 10. b | 20. b |

### Section 2

- 1.
- (i) The calcium ions may be absorbed by active transport. Carrier molecules in the

membrane will 'push' calcium into the cell, a process which requires energy.

(ii) ATP (adenosine triphosphate)

(iii)  $ATP \rightarrow ADP + P + ENERGY$

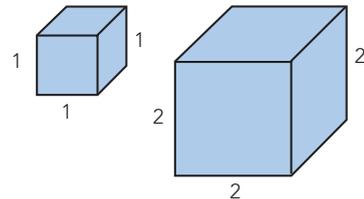
adenosine triphosphate  $\rightarrow$  adenosine diphosphate + inorganic phosphate + energy.

(iv) Protein synthesis, movement, cytoplasmic streaming, cell division.

2.

(i) The SA : Vol ratio becomes smaller (both the s.a. and vol increase, but the s.a. increases less than the volume).

(ii)



$$SA = 6 \text{ cm}^2$$

$$Vol = 1 \text{ cm}^3$$

$$SA : Vol = 6:1$$

$$SA = 24 \text{ cm}^2$$

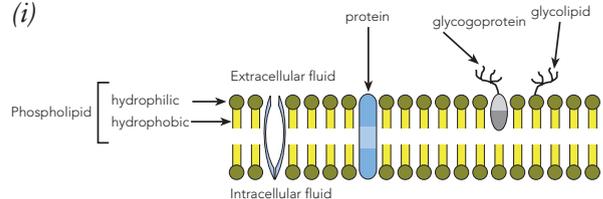
$$Vol = 8 \text{ cm}^3$$

$$SA : Vol = 24:8 = 3:1$$

(iii) As its size increases, the rate at which nutrients can diffuse into the centre of the cell decreases. Similarly the loss of wastes becomes less efficient. Therefore the cell's chances of survival decrease.

3.

(i)



(ii) It is called the fluid mosaic model of the cell membrane because:

- it is not fixed but capable of folding in or out as in endocytosis,
- it is a mosaic because it consists of several molecule types (proteins, phospholipids and carbohydrates) arranged asymmetrically in its structure and
- it is a model because it is designed to make a complex idea more easily explained.

(iii) (a) Fat soluble substance pass through the membrane easily by first dissolving in the bilipid layer.

(b) Non polar particles can fit between the lipid molecules because the gaps between them are large enough and they are not repelled or attracted to the lipid molecules.

(c) Water is a small enough molecule which is not strongly charged; it therefore passes between the lipid molecules.

(vi) Not all proteins are fat soluble, they are all large molecules (polymers).

4.

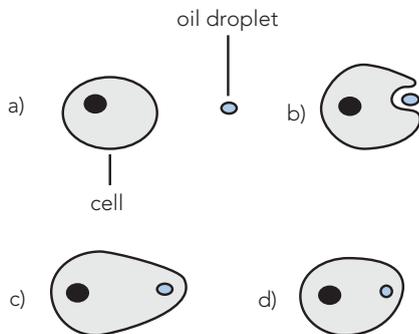
PASSIVE	ACTIVE
diffusion	active transport
facilitated diffusion	endocytosis(pinocytosis/ phagocytosis)
osmosis	exocytosis

5.

- They are moving from where they are more concentrated to where they are less concentrated.
- They are passing through a channel protein. This forms an unimpeded passage for them.
- Diffusion.
- The concentration of this substance will become equal on both sides of the membrane. The rate at which the particles enter will equal the rate at which they leave.
- If the substance is being used by the cell continuously, equilibrium will not be reached and the substance will continue to move into the cell until none remains in the extracellular fluid.
- The particles (ions) are moving against the concentration gradient – from where they are less concentrated to where they are more concentrated.
- Active transport.

6.

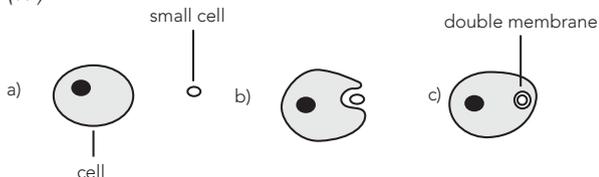
(i)



(ii) Pinocytosis.

(iii) The vacuole will have a single layered membrane (not double like a mitochondrion) which will be the same as the plasma membrane from which it was formed – a bilipid layer.

(iv)



The membrane would be a double membrane as shown – not unlike a mitochondrion. The outer membrane being part of the host cell's plasma membrane and the inner membrane being that of the captured cell.

7.

- the surface-area-to-volume ratio of the cell.
- concentration gradients.
- the physical and chemical nature of the materials being exchanged.

### Section 3

(i)

(a) passive transport and facilitated diffusion

- Substances tend to move through a plasma membrane from where they are concentrated to where they are less concentrated.
- This requires no input of energy (the kinetic energy of the particles is sufficient).
- Only small molecules or ions may pass between the lipid molecules of the membrane in this way.
- Facilitated diffusion occurs if the molecule is too large or carries a charge that prevents the movement.
- A carrier molecule (protein) is required to facilitate.
- Facilitated diffusion, as with normal diffusion, occurs down a concentration gradient.

(any 5 dot points)

(b) osmosis

- Osmosis – a special case of (passive) diffusion.
- Solvent molecule (water usually) moves from where it is most concentrated to where it is less concentrated.
- Through a semi-permeable membrane (in living things – the plasma membrane).

(c) Active transport

- Movement of substances through a plasma membrane against a concentration gradient, i.e. from where they are less concentrated to where they are more concentrated:
- energy is required.
- energy is supplied by ATP.

(d) Endocytosis

- Some molecules or particles are too big or unsuited to be drawn in by facilitated diffusion.
- Shape of membrane changes to engulf the particle either by:
  - phagocytosis – where a false 'foot' or pseudopod grows out in the direction of the particle to engulf it or,
  - pinocytosis – where an infold called an invagination forms and the particle (here usually a droplet of oil or liquid) is captured.
- endocytosis requires energy – it is an active process (you may use diagrams to illustrate these ideas – clearly labelled – and therefore you need not describe them in detail).

(e) Exocytosis

- Some secretions/wastes are too large to leave the cell by diffusion.
- They are packaged in a single membrane spherical bag or sac (called a vesicle) usually created by a Golgi body.

- The vesicle moves to the plasma membrane, bursts and its contents are pushed out through the membrane.
- (ii)
- Some mechanisms are described as active because they require an input of energy from an external source. That source is usually ATP.
  - Other mechanisms are described as passive because they do not require energy from an external source. The kinetic energy of the particles themselves is the source of energy which determines their movement.

## TT 10: BIOCHEMICAL PROCESSES & ENZYMES

### Section 1

- |       |       |
|-------|-------|
| 1. b  | 11. a |
| 2. a  | 12. b |
| 3. c  | 13. d |
| 4. a  | 14. c |
| 5. c  | 15. b |
| 6. d  | 16. b |
| 7. a  | 17. c |
| 8. c  | 18. b |
| 9. d  | 19. c |
| 10. d | 20. c |

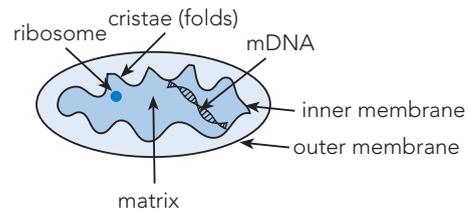
### Section 2

- Enzymes, transport proteins in cell membranes, form structures within the cells, some hormones are proteins.
  - Different proteins consist of different amino acids, a different order of amino acids in the amino acid chain and a different number of amino acids in the chain. as a result they have different tertiary or three dimensional structures.
- Each enzyme has a particular optimum pH. If its fluid surroundings are too alkaline or too acid the shape of the enzyme and its active site will change so that it becomes less suited to fit its substrate.
  - Similarly each enzyme has a particular optimum temperature. If its fluid surroundings are too cold or too hot the shape of the enzyme and its active site will change so that it becomes less suited to fit its substrate. Extreme temperature may denature the enzyme such that its shape is changed irreversibly.
  - Inhibitors are chemicals which slow or stop an enzyme from catalysing a reaction. They may be competitive inhibitors which occupy the active site to the exclusion of a substrate or non-competitive inhibitors which change the shape of the enzyme so that it no longer fits its substrate.

- Coenzymes organic compound (e.g. a vitamin) which assists enzymes by carrying chemical groups or atoms from one enzyme to another. Cofactors are metal ions (e.g.  $Zn^{++}$ ,  $Fe^{++}$ ) or vitamins which help bind an enzyme to its substrate or the cofactor may serve as the active site on the enzyme itself.
- Concentration of reactants – the greater the concentration of the reactants the greater the rate of forward reaction or the more rapidly products are formed. Other limiting factors will slow the reaction as the concentration of the reactants increases. Limiting factors may include the rate of product removal, the temperature or the availability of enzyme molecules.
- Concentration of products – as the concentration of the products increases this will decrease the forward reaction rate i.e. the rate at which the products are formed will slow. If products are removed from the organelle or cell in which they are being produced or if they are converted chemically to another substance, they will not inhibit the reaction rate.

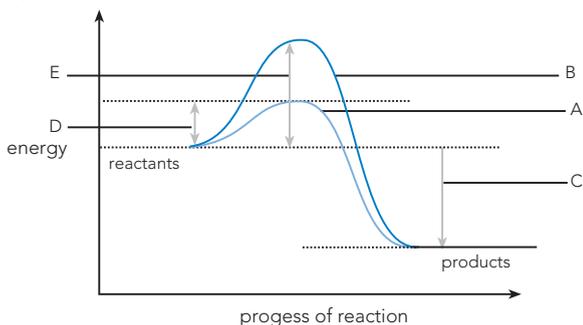
3.

(i)



- It is the site for aerobic respiration and the formation of ATP
  - The inner membrane is highly folded or convoluted (forming the cristae)
  - The folds create a greater surface area for the attachment of more enzymes which aid in the synthesis of ATP.
  - Having metabolic processes isolated makes them more efficient.
    - Other chemicals cannot inhibit the reactions and the substances reacting are not diluted.
    - The pH inside the organelle can be maintained more easily.
    - Products can be removed quickly so that the forward reaction is not inhibited.
- 4.
- Endoplasmic reticulum (ER) consists of network of membranes which forms channels within the cytoplasm of a cell. It is used to transport materials about the cell.
  - So that the proteins that are synthesised on them are able to be moved readily into the channels for transport to other parts of the cell.

5.  
(i)



- (ii) *Catabolic. The energy level of the products is lower than the energy level of the reactants. Energy is released.*
- (iii) *Enzymes are recycled continuously and last for many (thousands) reactions. Once the products are formed from the enzyme substrate complex, the enzyme can accept another substrate.*
- (iv) (a) *The number and type of amino acids in the chain.*  
 (b) *The attraction and repulsion in a two dimensional plane that amino acids in the chain have for one another – resulting in loops along its length.*  
 (c) *The three dimensional shape the enzyme created because of (a) and (b.) This results in part of the structure forming the shape of the active site.*

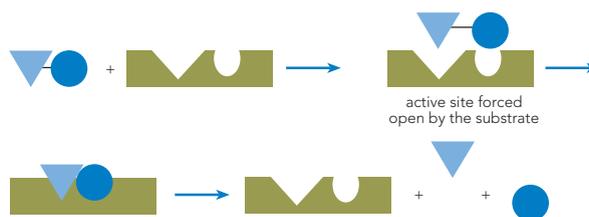
### Section 3

(i) **The 'Lock and Key' model**

- Every enzyme is a protein (with more than 100 amino acids).
- Each enzyme has a 'tertiary' – three dimensional shape determined by the total number of its amino acids and their arrangement in a long chain-like structure.
- Within this shape is an area called the 'active site' which is also a particular shape. This is called the 'key'.
- Into the active site the reactant/reactants (the 'lock') fit temporarily to form an 'enzyme substrate complex'.
- While held in the active site, the substrate is more likely to combine or dissociate (break apart).
- After doing so, the resulting product/products move out of the active site.
- The active site is then ready to accept more reactant/s and so the enzyme is recycled.

This can be illustrated as shown below:

••

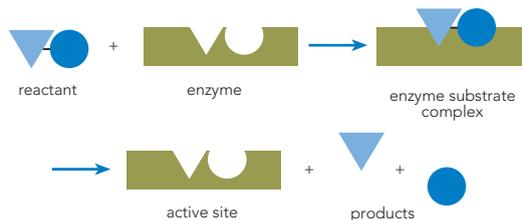


(Note: this is a catabolic reaction – the reverse of the diagram could be used to show an anabolic one.)

**The 'Induced Fit' model**

- Similar to the 'lock and key' model except the shape of the active site is modified as the enzyme slips into it to form the 'enzyme-substrate complex'.
- This is shown below:

••



[12 marks]

(ii)

- The shape of the active site is critical for its efficiency in accepting the reactant/s in both models.
- If the shape of the active site changes, then it will no longer catalyse the reaction as rapidly. It will cease to do so, if the shape changes significantly.
- Temperature may cause the (protein) enzyme to alter its shape, as molecules vibrate and move within the macromolecule.
- The pH of the surrounding fluid is determined by the presence of  $H^+$  and  $OH^-$  ions. These charged particles can attract different parts of the enzyme and distort its shape also.

[4 marks]

(iii)

- The activation energy is the energy which is necessary to begin the reaction.
- Heat may be supplied to provide this energy. (However excess heat is detrimental to enzyme action as it changes the shape of the enzyme)
- Enzymes have the effect of lowering the activation energy necessary for a reaction to proceed.
- Therefore enzyme controlled reactions proceed rapidly without the need for excessive heat input.
- They do not require as much energy.

[4 marks]

## TT 11: PHOTOSYNTHESIS & CELLULAR RESPIRATION

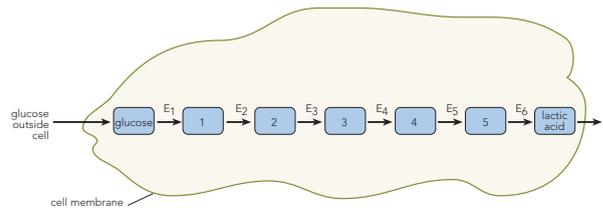
### Section 1

- |       |       |
|-------|-------|
| 1. d  | 11. b |
| 2. a  | 12. d |
| 3. a  | 13. d |
| 4. d  | 14. a |
| 5. c  | 15. d |
| 6. d  | 16. a |
| 7. a  | 17. c |
| 8. d  | 18. a |
| 9. c  | 19. b |
| 10. d | 20. c |

### Section 2

- Substance 5 would form but the final products of alcohol and carbon dioxide would not.
  - The accumulation of alcohol is likely to inhibit the action of the enzymes, resulting in less glucose being broken down.
  - Carbon dioxide dissolves to form a weak acid (carbonic acid). This will lower the pH of the cytoplasm and inhibit the enzyme activity. Less glucose will be respired.
  - The heat will denature the enzymes and the breakdown of glucose will slow down then cease.
  - Enzymes fit on to their substrates because they have an appropriate shape. Part of their three dimensional shape is called an 'active site' or 'catalytic site'. This is where the substrate locks on to the enzyme. Heat can change the overall shape of an enzyme, and when it is extreme heat, the change is permanent. The enzymes are 'denatured' and no longer fit with the substrate.
  - The breakdown releases energy. Much of this energy is stored as chemical energy in ATP which can be used where and when it is needed by the cell.
  - With oxygen, the glucose would be broken down completely to carbon dioxide and water. No alcohol would be formed, but more carbon dioxide and ATP.
  - The energy yield with oxygen (aerobic) will be up to 19 times as much as without oxygen. One molecule of glucose respired aerobically will produce up to thirty eight (38) molecules of ATP, whereas one molecule of glucose respired anaerobically will produce only two (2) ATP molecules.
  - Respiration.
    - Aerobic and anaerobic respiration.
  - Anaerobic respiration occurs in the cytoplasm.

(xi)



(Note: The enzymes involved would be different from those of the plant cell).

- The accumulation of lactic acid would lower the pH, inhibiting enzyme action in the cell.
- Not all the chemical energy released by the glucose which is broken down in respiration is transferred to the ATP molecules. As much as 50% is lost as heat.
    - Aerobic respiration, as aerobic respiration involves more energy transformations and produces more energy. Therefore more energy is lost.
    - Place the organism in water in a vacuum flask.
      - Provide sufficient nutrient for growth, a suitable temperature and some glucose.
      - Measure the temperature periodically over the following twenty four hours.
      - Test for the presence of glucose at the end of this period.
      - Repeat the experiment without the glucose.
  - Water + Carbon dioxide → Glucose + Oxygen
    - $H_2O + CO_2 \rightarrow C_6H_{12}O_6 + O_2$
    - The end products are at a higher energy level than the reactants. Glucose is a more complex molecule than both water and carbon dioxide. There is a net input of energy.
    - It provides the food which is the basis of food webs.
      - It releases oxygen into the atmosphere which is essential for aerobic respiration in animals.

(v)

FACTOR	WHY THIS AFFECTS THE RATE OF PHS
availability of CO <sub>2</sub>	As photosynthesis is a chemical reaction, the greater the concentration of CO <sub>2</sub> within limits, the faster the reaction will proceed
temperature	Many enzymes are involved in the second stage (light independent) of photosynthesis. These have an optimum temperature in most plants of around 20°C -25°C
light intensity	The higher the light intensity the greater the rate because the rate of the light dependent stage is increased until other factors cause the rate to plateau. At too high a light intensity chlorophyll may be damaged.

4.

(i) *Stage 1 – Light dependent stage; Chlorophyll absorbs light energy, ATP (and NADPH) are formed and water is split into hydrogen and oxygen.*

*Stage 2 – Light independent stage; ATP breaks down to ADP and P, releasing energy, energy used for anabolic reaction in which carbon dioxide combines with hydrogen to form glucose.*

(ii) *Stage 1 – Light dependent stage takes place on the thylakoid membranes.*

*Stage 2 – Light independent stage takes place outside the thylakoid membranes in the stroma.*

5. (i)

FACTOR	WHY THIS AFFECTS THE RATE OF RESPIRATION
available glucose	As respiration is a chemical reaction, the greater the concentration of the reactant, glucose, the faster the reaction will proceed
product removal e.g. CO <sub>2</sub>	The accumulation of a product will slow the reaction down especially as CO <sub>2</sub> dissolved in water forms an acidic solution.
pH	Many enzymes are involved in the both anaerobic respiration and aerobic respiration. The optimum pH for the enzymes is dependent on the particular organism. In humans it is generally very slightly alkaline. In yeasts it is acidic at around pH of 6.

(ii) *If the structure of the cell is such that it has a high surface area to volume ratio, it is able to absorb glucose (and oxygen) rapidly*

*and dispose of wastes rapidly. Therefore it has the potential to respire rapidly. The cell may have microvilli or be flat or elongated in shape to increase surface area rather than being spherical.*

### Section 3

(i) *Students may choose to answer this question in a table as below.*

	ANAEROBIC RESPIRATION	AEROBIC RESPIRATION
Where it occurs in cell	• Cytoplasm	• Mitochondria
Requirements	• Glucose • enzymes • suitable temp. & pH	• Glucose (pyruvate) • enzymes • suitable temp. & pH • oxygen
Circumstances	• in absence of oxygen	• in presence of oxygen
Products	• in plants – ethanol and carbon dioxide • in animals – lactic acid	• carbon dioxide and water

(ii)

- *Plants must colonise the cleared area before the animals because they are autotrophs.*
- *They use photosynthesis to make their own food.*
- $6\text{CO}_2 + 6\text{H}_2\text{O} + \text{light energy} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
- *The animals are heterotrophs.*
- *They rely on plants either directly or indirectly for their food.*
- *Animals cannot live in the area without plants.*
- *Herbivores are likely to move into the area following the plants then carnivores and omnivores.*

## TT 12: RESPIRATORY & DIGESTIVE SYSTEMS

### Section 1

- |              |              |
|--------------|--------------|
| 1. <i>d</i>  | 11. <i>d</i> |
| 2. <i>c</i>  | 12. <i>c</i> |
| 3. <i>b</i>  | 13. <i>a</i> |
| 4. <i>a</i>  | 14. <i>b</i> |
| 5. <i>c</i>  | 15. <i>a</i> |
| 6. <i>a</i>  | 16. <i>b</i> |
| 7. <i>d</i>  | 17. <i>c</i> |
| 8. <i>b</i>  | 18. <i>c</i> |
| 9. <i>a</i>  | 19. <i>d</i> |
| 10. <i>c</i> | 20. <i>d</i> |

## Section 2

1.
  - (i) *Adult amphibians (frogs, salamanders and newts), annelids (earthworms).*
  - (ii) *Fish, larval stage amphibians.*
  - (iii) *Reptiles, birds, mammals.*
  - (iv) *Insects.*
- 2.

	PROBLEM IN OBTAINING O <sub>2</sub>	ADAPTATIONS
(i) moist skin	exposed to a dry atmosphere the skin can dry out and the oxygen will not be able to first dissolve in the water before entering the blood in the capillaries below	some frogs may burrow in the soil, form a chamber and remain in a humid microhabitat for several months other frogs reside in damp places under rocks and fallen trees
(ii) gills	the oxygen in the water may be at a very low concentration especially if the water is warm	the enormous surface area of the gills helps reduce this problem some fish force a flow of water over their gills using muscles in their mouth blood flow in the gill capillaries is in the opposite direction to the flow of water over them
(iii) lungs	deep within the thoracic cavity, the lungs need to be aerated regularly to maintain a steep concentration gradient for gas exchange	the muscles of the ribs and diaphragm increase and decrease the volume of the lungs on a regular basis – forcing air in and out continuously
(iv) spiracles	water, dust or chemicals may enter the spiracles when they are open – blocking the supply of oxygen to the cells below	muscles around the openings can open them (muscles relax) or close them when required (muscles contract)

3.
  - (i) *Nitrogen, inert gases.*
  - (ii) *From 4.5% to 9.5%, an increase of 5% by volume of air exhaled (i.e. a 111% increase).*
  - (iii) *From 5% to 10%, an increase of 5% (i.e. a 100% increase).*
  - (iv) *More energy is required during exercise. The energy is provided by respiration. Respiration uses oxygen and produces carbon dioxide as waste.*
  - (v) *Breathing air that is relatively dry causes water to evaporate from the lungs, we therefore normally lose water when breathing.*
4.
  - (i) (a) *Carnivores: eat other animals.*  
 (b) *Herbivores: eat plants.*  
 (c) *Omnivores: eat both other animals and plants.*

- (d) *Detritivores: eat the dead remains of plants and animals (organic matter which is decomposing).*
- (ii) *Parasite.*
- (iii) *Saprophyte or detritivores (detritivore is the preferred name).*
5. (i) *Chemical digestion.*  
 (ii) *System.*  
 (iii) *Enzyme.*  
 (iv) *Hydrochloric.*  
 (v) *Lipase.*  
 (vi) *Amino acids.*  
 (vii) *Villi.*  
 (viii) *Peristalsis.*  
 (ix) *Molar.*  
 (x) *Gastrovascular cavity.*
6. (i)

LETTER LABEL	NAME OF PART	FUNCTION OF PART
a	liver	stores glycogen, breaks down excess amino acids and old red blood cells, produces bile, detoxifies poisons.
b	gall bladder	stores and concentrates bile, releases bile when required into duodenum
c	small intestine	digests and absorbs food
d	large intestine	stores wastes, reabsorbs water and absorbs some vitamins
e	rectum	stores faeces before elimination
f	stomach	digests protein – breaks them down to polypeptides

- (ii) (a) *It appears to have little function (although it could serve as a reservoir of microorganisms for the colon).*  
 (b) *Similarly it appears to have no function and not be present in many carnivores.*  
 (c) *It contains bacteria which aid in the breakdown of cellulose.*  
 (d) *As in (c) above, however much of the cellulose is broken down in the rumen, the first of four chambers of the “stomach”.*
7.
  - (i) *Greater concentration of oxygen in X than in Y causes oxygen to diffuse from X to Y. The greater concentration of carbon dioxide in Y than in X causes carbon dioxide to diffuse from Y to X.*
  - (ii) *Most oxygen (97%) attaches to haemoglobin in the erythrocytes and travels as oxyhaemoglobin, only 3% dissolves in the plasma.*
  - (iii) *So that oxygen can first dissolve in this fluid then move by diffusion into the plasma in the capillaries.*

- (iv)
- Each alveolus is thin (one cell thick).
  - There are many alveoli (large surface area).
  - Alveoli have a lining of moisture (for diffusion).
  - There is always a diffusion gradient while blood moves past in the capillaries.

8.

- (i) Because the food they eat is different. The food herbivores eat is much more difficult to digest because of the plants cell wall and because herbivores do not produce cellulase, an enzyme required to break down cellulose. Their digestive system contains microorganisms that do produce cellulase. Carnivores eat meat which requires less chemical digestion to prepare it for absorption.
- (ii) The ruminant has four chambers in its stomach with microorganisms that produce cellulase in the first chamber. They regurgitate their food and chew it again to better prepare it for chemical digestion. Non-ruminants have a proportionally larger caecum but their stomach is a single chamber (like omnivores and carnivores) and it serves to digest proteins (as does the fourth chamber of the ruminant stomach). They do not regurgitate food and chew the “cud”.
- (iii) The ruminant’s is the most efficient – a greater proportion of the food’s nutrients is absorbed in the ruminant’s digestive system. Non- ruminants often re-ingest their wastes in order to recover more nutrients.

### Section 3

#### (i) The mammalian lungs

- Gases concentration gradients must be maintained.
- Oxygen levels in the alveolus must be kept greater than in the blood of the capillaries around them.
- Alveoli must have a large S.A.
- Alveoli need to be moist.
- Alveoli need to be elastic.
- Alveoli must be protected physically.
- Alveoli must be kept free from pathogens.
- Alveoli must be kept free of dust etc.
- Alveoli need to be well supplied with deoxygenated blood.

[max 5 marks]

To achieve these:

- Alveoli must be microscopic and numerous.
- Alveoli need to be removed from air (deep in the thorax) - kept moist.
- Alveoli can stretch and return to original size.
- Ribs protect the lungs.
- White blood cells (macrophages) live on the inner surface of the alveoli – removing most pathogens that reach them.

- Cilia which line the lower nasal passage, trachea and bronchi trap dust and pathogens – waft it upwards.
- Cilia have a coating of mucus produced by the mucosa lining these areas to help trap foreign particles.
- Air is warmed in the nasal passage which increases the rate of diffusion in the alveoli.
- Air is also moistened in the upper respiratory tract which reduces evaporation from the surface of the alveoli.

[max 5 marks]

(ii)

- The **gastrovascular cavity** is a sac which has one opening that serves as both the mouth and anus.
  - Found only in simple animals – jellyfish, sea anemones, hydra and flat worms.
  - These animals live in the water or in moist habitats (some flatworms are parasitic).
  - They ingest food often small aquatic organisms.
  - The water facilitates ingestion.
  - Enzymes are secreted into the cavity so that digestion is extracellular.
  - The cavity allows for the ingestion of large food particles and small organisms.
- [max 5 marks]
- The **alimentary canal** is a tube with two openings, a mouth at the anterior end and an anus at the posterior end.
  - Found in most complex animals – vertebrates, invertebrates.
  - These animals live in a variety of habitats including on land.
  - The tube allows for the food to be processed in separate stages along its length.
  - Physical and chemical digestion are more thorough.
  - This enables the digestion to be more complete.
  - A greater proportion of the nutrients are extracted from the ingesta.
  - This allows the organism to grow more rapidly and larger.

[max 5 marks]

## TT 13: CIRCULATORY SYSTEMS & PLANT VASCULAR SYSTEMS

### Section 1

- |       |       |
|-------|-------|
| 1. c  | 11. d |
| 2. d  | 12. b |
| 3. a  | 13. d |
| 4. d  | 14. a |
| 5. b  | 15. d |
| 6. d  | 16. b |
| 7. c  | 17. c |
| 8. d  | 18. a |
| 9. b  | 19. b |
| 10. c | 20. b |

## Section 2

1.

(i) C (ii) A (iii) B

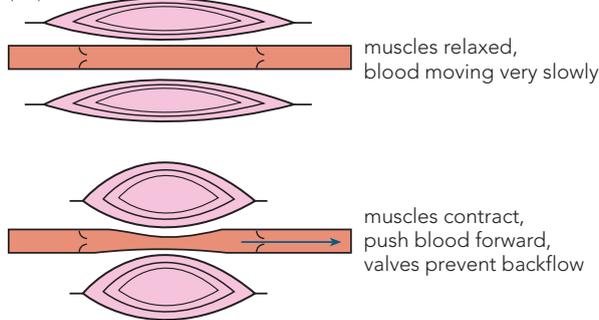
(iv) Artery – Must expand to allow for the extra pressure and then contract to keep the blood flowing.

Vein – Contains valves to prevent backflow of slowly moving blood and has less muscle and elastic fibres as blood in the veins is at a lower pressure.

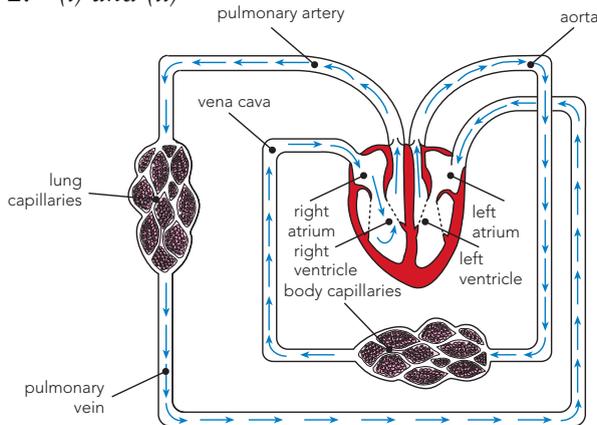
Capillary – Thin layer of cells to enable substances to diffuse to and from the plasma

(v) To direct the blood forward, towards the heart.

(vi)



2. (i) and (ii)



(iii)

a) Pulmonary arteries, lung capillaries, pulmonary veins

b) Aorta, other arteries branching from the aorta, body capillaries and vena cavae.

3.

(i) It moves materials from one part of the plant to another, e.g. sugar is transported in the phloem from the leaves to the roots.

(ii) In animals the blood flows in a circuit around the body, usually propelled by a heart. In plants the water and minerals flow only in one direction, i.e. from the roots to the leaves. Organic molecules transported in the phloem either move up or down but not in a circuit. There is no organ corresponding to the heart in a plant. No organs to propel the fluid along.

4. When the guard cells are turgid (full of water) they swell and open the aperture of the stoma. This allows gases ( $\text{CO}_2$ ,  $\text{H}_2\text{O}$ ,  $\text{O}_2$ ) to move in or out of the leaf (or stem). When the guard cells have lost water they become flaccid (soft). The aperture of the stoma closes. This prevents the movement of gases out of and into the leaf. It helps to prevent water loss (but the plant may not be able to obtain  $\text{CO}_2$  for photosynthesis).

5.

(i) Phloem.

(ii) Phloem transports sugar (sucrose) and other organic (e.g. amino acids) and inorganic (e.g. potassium ions, nitrates ions) material.

(iii) Xylem.

(iv) Xylem transports water and mineral ions from the roots to the leaves.

(v) a) Xylem has a larger diameter. It is made of cells which are dead and which form a continuous straw-like structure. They are strengthened through having cell walls which are lignified. Phloem are narrower. They consist of cells arranged end to end, which are connected by microfilaments. These connect adjacent cells. Phloem cells have mitochondria. Other organelles (nucleus, plastids) degenerate.

b) Xylem are dead cells with no cytoplasm remaining. Phloem are live cells with cytoplasm.

6.

(i) Absorbs water and minerals from the soil; it increases the absorptive surface area of the root, increasing its efficiency.

(ii) They cannot move down through the soil because soil is abrasive. The region of elongation is below them, just behind the root cap.

(iii) Water enters root hair cell, moves through adjacent cortex cells into root xylem, passes up xylem in stem into leaf, enters leaf mesophyll where photosynthesis may occur.

(iv) Water not used in photosynthesis may evaporate from mesophyll cell walls into leaf's intercellular spaces then pass out through stomatal pores into the atmosphere. As water evaporates more is pulled through the xylem.

7.

(i) 9.30 - 11 am.

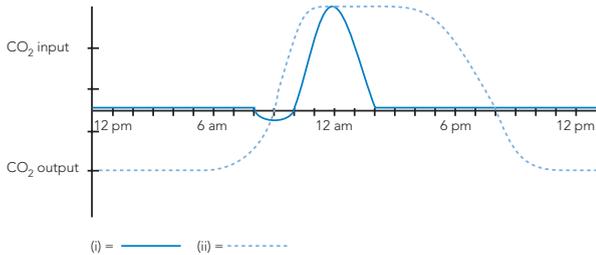
(ii) 11 am.

(iii) The guard cell's chloroplasts begin to make sugar. The osmotic pressure in the cells increases. Water moves by osmosis into the cells. They become turgid and open the stomatal pore between them.

(iv) As the temperature increases, the rate of water loss exceeds the rate of water intake through the roots. Cells in the plant, including the guard cells, begin to wilt. The stomatal pore closes.

- (v) Closure of the stomatal pores reduces water loss. If the plant loses too much water it will die.
- (vi) Yes. Once closed, carbon dioxide can no longer enter the leaf from the outside atmosphere. Therefore photosynthesis ceases and the plant must rely on stored starch/sugar to respire.

8.



Note: in (i) while stomates are closed, CO<sub>2</sub> cannot leave.

9.

- (i) (a) Freezing temperatures may cause soil water to freeze.  
 (b) Saline soil may exert an osmotic pressure which prevents water entering the root cells.  
 (c) Dry soil, due to low rainfall.
- (ii) (a) Reduce surface area and number of stomata – slower transpiration.  
 (b) Reflect heat radiation and trap layer of humid air around the leaf – slower transpiration.  
 (c) Less openings/pores from which water can escape.  
 (d) Reflect heat radiation – lower leaf temperature therefore less evaporation.  
 (e) Less direct sunlight and therefore heat radiation from sun is absorbed by leaf – therefore less evaporation.  
 (f) CO<sub>2</sub> for photosynthesis is stored within leaf for use during the day. Stomata are closed when evaporation rate would cause excessive water loss.  
 (g) Stems have lower density of stomata – slower transpiration.

### Section 3

(i)

- protozoa live and reproduce in water (or a fluid environment).
- being small to microscopic, they have a large SA:Vol.
- this enables them to exchange nutrients, oxygen and wastes rapidly with their external environment
- however their size is limited.
- as they grow larger, their SA:Vol becomes smaller.
- the exchange rate of nutrients, oxygen and wastes with their fluid environment becomes less efficient.
- while they are small, their acquisition of nutrients etc. can be achieved with a

minimum of energy usage i.e. by passive diffusion.

- a multicellular animal has a small SA:Vol.
  - it has large numbers of cells deep within its body, which cannot obtain nutrients and dispose of wastes efficiently by diffusion.
  - it needs a complex system of vessels and cells to move fluid carrying nutrients and oxygen to cells and remove wastes (including CO<sub>2</sub>) from cells.
  - it needs a pump (heart) to move the fluid (blood) to and from surfaces which absorb and eliminate nutrients, gases and wastes.
  - energy must be expended in both the synthesis of the system and in maintaining the flow of fluid through it.
  - however, the size of the organism is not limited by its SA:Vol, (more by its weight).
- (ii)
- the open transport system of an insect moves fluid around the body cavity.
  - the fluid is not confined to vessels.
  - a long tubular heart pumps fluids towards the head.
  - the fluid passes out in the head area and flows back along the body re-entering the long tubular heart through holes along its length.
  - the body fluids contain nutrients and metabolic wastes, which are obtained from the digestive system and disposed of by the excretory system.
  - the insect has a separate respiratory system to exchange gases (O<sub>2</sub> and CO<sub>2</sub>).
  - this is the tracheal system which absorbs O<sub>2</sub> through spiracles (holes) in the body surface and transports this via a system of vessels to the muscles. CO<sub>2</sub> is removed and pushed out through the tracheal system.
  - the closed transport system of a mammal is a system of vessels – arteries, capillaries and veins, which delivers both O<sub>2</sub> and nutrients to the body cells and removes CO<sub>2</sub> and other wastes from the tissues.
  - it is described as ‘closed’ because the blood cells do not normally leave the capillaries (except macrophages and neutrophils – white blood cells – capable of amoebic movement).
  - substances may diffuse to and from the capillaries as these vessels are permeable to smaller molecules (carbon dioxide, oxygen, glucose, urea, etc.).
  - a lymphatic system – a closed system of vessels similar to veins, drains excess fluid from the tissues, which is not collected by the veins. This fluid is carried back to the circulatory system.
  - the fluid is moved in the circulatory system by a pump, the heart.
  - a system of valves ensures that the fluid moves in a defined pathway.

- the open system serves the needs of a small animal like the insect because the movement of fluid in the body cavity is sufficiently rapid for its size. Its size however is limited.
- the closed system of the mammal is more complex and more energy demanding. It is necessary to deliver nutrients and oxygen and remove wastes rapidly in a large multicellular organism.

## TT 14: INQUIRY SKILLS & HUMAN ENDEAVOUR 2

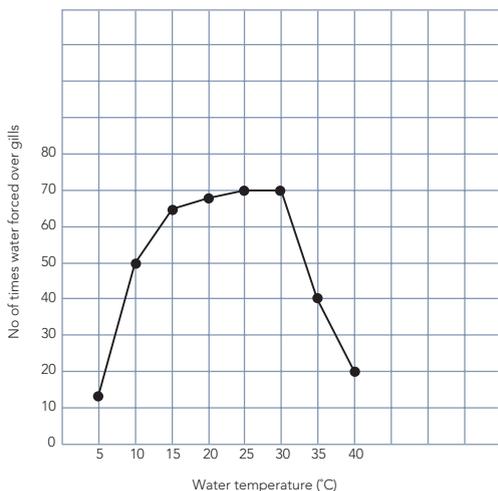
### Section 1

- |       |       |
|-------|-------|
| 1. d  | 11. c |
| 2. b  | 12. d |
| 3. b  | 13. a |
| 4. c  | 14. a |
| 5. c  | 15. b |
| 6. d  | 16. d |
| 7. c  | 17. a |
| 8. b  | 18. c |
| 9. a  | 19. a |
| 10. d | 20. c |

### Section 2

- As the water temperature increases, the fish's need for oxygen increases (or as the water temperature increases the fish becomes more active therefore needing more oxygen).
  - (a) Water temperature.  
(b) Number of times water was forced over gills.
  -

Graph: Breathing Rate of a Fish versus Temperature



- (a) The hypothesis is only partly supported, as temperature rises the rate of breathing increases, but at 15°C, it appears to level off and begins decreasing after 30°C.  
(b) This would improve the reliability of the results as the fish first chosen may have been atypical.  
(c) Randomly.

2.

$$(i) \text{ Length of cell} = \frac{\text{diameter of field}}{\text{no. of cells}}$$

$$= \frac{3500 \mu\text{m}}{5}$$

$$= 700 \mu\text{m}$$

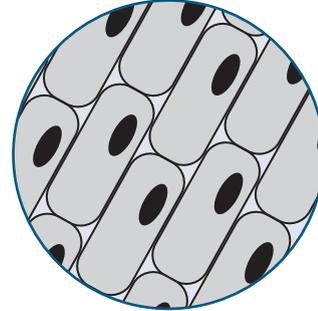
$$(ii) \text{ Diameter at } 100 \times = 3500 \times \frac{40}{100}$$

$$= 1400 \mu\text{m}$$

$$\text{Diameter at } 400 \times = 3500 \times \frac{40}{400}$$

$$= 350 \mu\text{m}$$

(iii)



(iv) Eukaryotic. There appears to be a distinct nucleus in each cell.

3.

- The drop of pond water appeared to be alive with a multitude of "little creatures" (moving single-celled organisms).
- The remains of the cell walls of the plant.
- Better instruments and stains revealed the cell nucleus and other large organelles like vacuoles, mitochondria and chloroplasts.
- Golgi body or Golgi apparatus – "packages" substances (e.g. enzymes) into vesicles which the cell may secrete.

4.

(i) **Magnification** – is the extent to which an object is enlarged by a microscope. It is expressed as the ratio of the image size to the actual size. When using a light microscope it is calculated by multiplying the magnifying power of the objective by the magnifying power of the ocular.

**Resolution** – the capacity of a microscope to separate two objects which are very close together and produce an image of them as separate objects.

- They believed the two lines represented layers of protein which had a lipid layer (not visible) between them – like a sandwich.
- Two layers of phospholipids – the bilipid arrangement.
- No. From past experience more will be learned and at least some of what we think is correct today will be shown to be erroneous or need modification.

- 5.
- (i) Biofuels generally require sugar to ferment. This is obtained through photosynthesis. Microorganisms then anaerobically respire the sugar producing ethanol which is the fuel.
  - (ii) Microorganisms are used to anaerobically respire organic waste in landfill sites. Often methane is produced. This can be captured and used as a fuel. If it is allowed to escape into the atmosphere it contributes to global climate change. Using it as a fuel is less environmentally damaging.
  - (iii) Fluorescent dyes which absorb light of one wavelength and emit light of a different colour can be attached to particular molecules. This has enabled scientist to see where the tagged molecules are used in the cell. They are able to determine the biochemical reactions that the molecules are involved in and what products they may form, e.g. particular molecules which have a fluorescent probe attached can appear in the microtubules that make up spindle fibres when a cell begins to divide. The spindle fibres fluoresce.
  - (iv)  $\text{water} + \text{carbon dioxide} \rightarrow \text{glucose} + \text{oxygen}$   
Radioactive oxygen may be attached to the hydrogen in the water molecules or the carbon in the carbon dioxide (as both contain oxygen). If it is attached only to the water molecules and the oxygen produced shows radiation then it can be assumed that the some of this oxygen comes from the oxygen in the water molecules. If it is then attached only to the carbon dioxide and the oxygen shows no radiation it can be assumed that the all oxygen comes from the oxygen in the water
- 6.
- (i) Replacement – requires conducting research without the use of animals when this can achieve similar results.  
Reduction – a minimum number of animals should be used.  
Refinement – every animal used for research should not suffer unduly.
  - (ii) They have been adopted because society has demanded that animals be treated with care and dignity. In the past this has not always been the case.
- place 50 eggs (the control group) in this hole
  - dig a second hole, only half the depth of the average nest, e.g. 15 cm.
  - place 50 eggs (the experimental group) in this shallower nest hole.
  - each clutch of eggs is to be treated in the same way (apart from the depth of incubation).
  - other variables to be controlled include: the type of soil, moisture content of soil, the slope of the ground, amount of shade over the nest, age of eggs, tortoise species from which eggs were collected (one mark for each variable to max. of 3 marks).
  - determine the sex of the offspring as they emerge from the nest.
  - repeat the experiment with another randomly selected group of 100 eggs.
  - repeat the experiment using a deeper depth for the experimental group e.g. 45 cm deep.
  - an example of results which support the hypothesis: the control group produces males and females in the normal ratio (probably 1:1).
  - the experimental groups produce males and females in abnormal ratios, e.g. in deep (cooler) nests more males are produced, in shallow (warmer) nests more females are produced.
  - results which refute the hypothesis: the control group and the experimental groups show no significant differences in the ratio of the sexes.  
Note: other hypotheses that could be derived from these experiments on incubation temperature (only two are required).
  - Hypothesis: nests dug in shady areas will produce mainly male tortoises.
  - Hypothesis: male offspring will be produced from eggs on the outside of a nest clutch whereas female offspring will be produced from the inside of the clutch.
  - Hypothesis: in abnormally warm weather conditions during incubation, more females will be produced than males.
  - Hypothesis: the moisture content of the soil (which affects the heat conduction from the eggs) will affect the ratio of the sexes in a clutch.
  - Hypothesis: the slope of the soil, which affects water drainage, will affect the ratio of the sexes in a clutch.
  - Grammar, spelling, expression [2 marks].

### Section 3

- select (at least) 100 tortoise eggs (a large number).  
randomly from freshly laid eggs.
- divide the eggs randomly into two halves.
- 50 eggs are the experimental group.
- 50 eggs are the control group.
- dig one hole at the average depth of a tortoise nest (previously determined from field observation), e.g. 30 cm.

# GLOSSARY

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**Abiotic:** Factors in the environment which are not living, e.g. temperature, humidity, are described as abiotic factors. (cf. biotic).

**Absorption:** The uptake of substances into an organism or cell.

**Abundance:** The density of organisms in a particular part of their range, e.g. number of native cats per hectare of Jarrah forest near Dwellingup.

**Acquired characteristic/trait:** A feature which is not inherited. It is caused by the environment or by use, e.g. enlarged biceps through weight lifting.

**Activation energy:** The energy necessary for a chemical reaction to begin. Catalysts, including enzymes, lower the activation energy.

**Active absorption:** The movement of mineral ions from the soil into the root hair cells by active transport (see active transport).

**Active process:** A process that requires an external source of energy, e.g. protein synthesis, active transport.

**Active transport:** The movement of a substance (e.g. mineral ions and glucose) across a cell membrane from a region of low concentration to a region of high concentration. This process requires energy.

**Adaptation:** A trait which enables an organism to survive and reproduce better in its environment.

**Adenosine triphosphate (ATP):** A compound made up of adenine, ribose(sugar) and three phosphate groups. The three phosphate groups are bonded in a row and energy is stored in the bond between the second and third phosphates. If this third bond is broken that energy is released for use by the cell.

**Adhesion:** The attraction that particles of different kinds have for each other, e.g. water molecules are attracted to glass molecules by adhesive forces.

**Adult:** An animal or plant which has reached its full growth.

**Aerobic:** A biological process which requires oxygen. (cf. anaerobic).

**Aestivation:** When an animal becomes inactive during the summer. (cf. hibernation).

**Agonistic:** Animal behaviour, directed towards another animal, which is competitive. It may be aggressive or submissive, e.g. pecking, biting or rolling over on back.

**Air bladder:** An air-filled organ, which increases the buoyancy of an organism, i.e. helps it to float in water.

**Alga (plural – algae):** A photosynthetic organism living in the water or a damp habitat. Algae include several phyla in the plant kingdom, e.g. Rhodophyta, Phaeophyta, Chrysophyta, Pyrrophyta, protists, e.g. Chlorophyta and monera, e.g. Cyanobacteria.

**Alimentary canal:** Animal's digestive tract, a tube which runs from the mouth to the anus.

**Alveolus (plural – alveoli):** Microscopic air sac at the end of the bronchioles in the mammalian lung. It is highly vasculated and is where oxygen and carbon dioxide are exchanged between the air and the blood.

**Ambient temperature:** The temperature of the surroundings.

**Amino acid:** The basic organic molecular unit which when linked in a chain forms a protein molecule. Amino acids all contain nitrogen (attached to two hydrogen atoms, –NH<sub>2</sub>). See protein.

**Ammonia:** A highly soluble, very toxic gas (NH<sub>3</sub>) which is a nitrogenous waste produced by the breakdown of amino acids in the liver. Many fish excrete their nitrogenous waste as ammonia.

**Ammonotelic:** An animal which excretes most of its nitrogenous waste as ammonia, e.g. bony fish, tadpoles.

**Amphibia:** Vertebrates, which live on land, but return to the water to reproduce. Fertilisation and embryonic development takes place externally in the water. When the young hatch, they appear as aquatic larvae (e.g. tadpoles) which undergo metamorphosis in changing into the terrestrial adult (e.g. frog).

**Amylase:** An enzyme which breaks down starch or glycogen, e.g. salivary amylase in humans begins the chemical digestion of starch in the mouth.

**Anabolism:** The production of more complex molecules from simpler ones. Anabolism may be called

synthesis and it requires energy input. (cf. catabolism).

**Anaerobic:** A biological process which occurs in the absence of oxygen, e.g. fermentation. (cf. aerobic)

**Anatomy:** The structure of an animal or plant. (Also used to refer to the study of animal and plant structure.)

**Angiospermae:** A flowering plant. Major class of the phylum Tracheophyta (vascular plants) which produce flowers and seeds enclosed within a fruit.

**Animal:** An organism which is heterotrophic, able to move and has body cells which do not have a cell wall. (cf. plants).

**Annual:** An angiosperm which completes a life cycle within one year, e.g. Kangaroo paw, petunia.

**Antenna (Plural – antennae):** Sensory structures attached to the head of most arthropods (excluding all spiders).

**Antibiotic:** A substance which destroys or inhibits the growth of micro-organisms like bacteria.

**Anus:** Opening of the digestive tract, out of which faeces are expelled from an organism.

**Aorta:** The large artery which carries blood away from the heart to other arteries which deliver oxygenated blood to the body cells.

**Apical meristem:** A region just behind the tip of a plant shoot or root in which cells divide (by mitosis) rapidly.

**Appendage:** A part of the body attached to the main trunk, e.g. wings, arms, proboscis.

**Aquatic:** Living in water (marine or fresh).

**Arachnida:** A class of the phylum Arthropoda which has eight legs, no antennae and two main body parts, e.g. spiders, ticks, scorpions.

**Arboreal:** Type of animal which lives mostly in trees.

**Arteriole:** A small branch of an artery.

**Artery:** A blood vessel carrying blood away from the heart.

**Arthropoda:** An invertebrate phylum which has jointed appendages and

exoskeleton, e.g. Insecta, Arachnida, Crustacea.

**Atrium (Plural – atria):** Heart chamber which receives blood from body cells or lungs, and pumps it into a ventricle, another heart chamber, which in turn pushes blood into the arteries.

**Autotroph:** An organism capable of making its own food by photosynthesis in most cases or by chemosynthesis in some bacteria.

**Aves:** A class of the phylum Chordata which consists of birds; animals which have feathers, a four chambered heart, forelimbs adapted for flight and which lay a hard shelled egg.

**Bacillus (Plural – bacilli):** Rod shaped bacteria.

**Bacterium (Plural – bacteria):** Microscopic organisms which have no membrane bound organelles. Bacteria are therefore prokaryotes. Saprophytic bacteria are very important in the decomposition of dead organisms.

**Bacteriophage:** A virus that attacks bacteria.

**Basal metabolism:** The rate of metabolism which is just sufficient to provide the energy for life while an organism is awake and resting.

**Behaviour:** The way or pattern in which an animal acts.

**Benthos:** Organisms which live on the bottom of the ocean and lakes.

**Bettong:** Marsupial. Rat-kangaroo with short nose.

**Bilateral symmetry:** An organism which can be divided in half such that each half is approximately a mirror image of the other, e.g. humans, insects.

**Bile:** A fluid produced by the liver which emulsifies fats in the digestive system.

**Binomial nomenclature:** The two-word naming system for organisms used by scientists. The first word is the genus name and the second the species name. The genus is spelt with a capital, e.g. *Canis familiaris*.

**Bioaccumulation:** Some substances taken in by organisms accumulate or build up in their tissues. These substances are not excreted. Their accumulation is called bioaccumulation.

**Biochemical process:** A chemical reaction or series of reactions that occur in living cells.

**Biodegradable:** When a substance is capable of being broken down by bacteria or other decomposers.

**Biodiversity hotspot:** An area of the biosphere that has rich biodiversity and is threatened with destruction by human activity, e.g. SW Australia.

**Biofuels:** Fuels made from living things or their wastes.

**Biology:** The scientific study of life. Biology includes botany, zoology and ecology and other related disciplines.

**Biomagnification:** Substances which bioaccumulate may be passed up the food chain to higher order consumers; because higher order consumers eat many lower order consumers, the percentage by weight of these substances increases in the higher order consumers. This increase is called biomagnification.

**Biomass:** The total mass of living matter in a given area, normally expressed as the dry weight per unit area, e.g. kg/m<sup>2</sup>.

**Biome:** An important and distinct community which has particular abiotic and biotic features, e.g. temperate forest, grassland.

**Biosphere:** That part of the Earth where living things live.

**Biota:** The plants and animals in an area.

**Biotechnology:** Industrial use of biological processes, e.g. fermentation, genetic engineering.

**Biotic:** Environmental factors which are living, e.g. predators, competitors. (cf. abiotic).

**Bipedal:** An animal which walks on two legs.

**Bird:** A member of the class Aves.

**Birth Rate:** The number of births per thousand of population in a given time (usually one year). (See death rate).

**Blood cells:** The three cellular parts of the blood; red blood cells or erythrocytes which carry oxygen, white blood cells or leucocytes which provide protection from bacteria and viruses and platelets or thrombocytes which help the blood to clot and reduce bleeding.

**Blood pressure:** The pressure, largely caused by the heart, which forces the blood along the blood vessels. The pressure increases when the heart contracts (systolic pressure) and decreases when the heart relaxes (diastolic pressure).

**Blood sugar:** The sugar (mainly glucose) which is dissolved in blood plasma.

**Blood:** A mixture of plasma and blood cells, which travels in the circulatory system, pushed along by the heart. Blood carries oxygen and nutrients to

the cells and removes carbon dioxide and wastes from the cells.

**Blue-Green algae:** (See Cyanobacteria).

**B Lymphocyte:** A leucocyte which produces antibodies. Alternatively called a B cell. (See T Lymphocyte).

**Bone:** A living tissue which is hard and provides support in animals.

**Botany:** The scientific study of plant life.

**Bronchiole:** A fine tube which branches from a bronchus and terminates in several alveoli of the lungs.

**Bronchus (Plural – bronchi):** Large branch of the trachea which carries air to the left or right lung.

**Bulb:** An underground bud which has thickened leaves for food storage, e.g. onion.

**Burr:** A seed case which is covered by prickly hooks which is frequently dispersed in the hair of animals.

**Byproduct:** A chemical formed by a reaction or a process which is not the principal or main substance formed.

**Caecum:** Part of the digestive tract which forms a pouch. It is large in herbivorous animals and is the site for the bacterial digestion of cellulose.

**Calibration:** The adjusting of an instrument to ensure that its readings are accurate.

**Cancer:** The uncontrolled growth of cells. Often these cells are able to spread via the circulatory or lymphatic system to invade other tissue.

**Capillary:** The finest branch of the circulatory system in which blood exchanges oxygen and nutrients for carbon dioxide and wastes in body tissue.

**Capture-Recapture:** Method of estimating a population size.

**Carbohydrate:** An organic compound containing carbon, hydrogen and oxygen in which the ratio of hydrogen to oxygen is 2:1, e.g. glucose C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>.

**Carbon Dioxide:** A colourless, odourless gas present in the atmosphere in small amounts (approx. 0.03% by volume). CO<sub>2</sub> is essential for photosynthesis.

**Carbon fixation:** When carbon dioxide is removed from the atmosphere (or water) by photosynthetic organisms which use carbon dioxide to produce carbohydrates.

**Carnivore:** An animal that mainly eats other animals.

**Carrying capacity:** The population of a species which a particular area can support.

**Catabolism:** The chemical breakdown of complex molecules into simple substances. This type of process gives out energy. (cf. anabolism)

**Catalyst:** A chemical which speeds up chemical reactions but is itself not used up. (cf. enzyme)

**Cell:** The basic “building block” of living things (except viruses). Consists of a membrane bounded protoplasm.

**Cell differentiation:** The development of specialised cells in multicellular organisms from unspecialised cells in the early stages of the organisms’ growth.

**Cell division:** This occurs when a cell’s nucleus divides followed by division of its cytoplasm. Each time division occurs two cells are formed. (cf. meiosis and mitosis). See cytokinesis.

**Cell membrane:** The protective layer of lipids and proteins which encloses a cell’s protoplasm.

**Cell wall:** The rigid but permeable outer boundary of plant, bacterial, fungal and some algal cells. In plant cells it is made of a polysaccharide called cellulose.

**Cellulose:** A carbohydrate which forms the cell wall of plants.

**Centrifuge:** A machine which spins solutions so fast that substances of different densities are separated. It can be used to separate the different compounds, organelles or parts of organelles found in ground up cells.

**Centriole:** A small organelle which lies just outside the nucleus of animal cells. It forms the spindles during cell division and is found in pairs.

**Centromere:** The point of attachment of two chromatids. The spindles attach to the centromeres during cell division.

**Chemosynthesis:** The synthesis of complex organic chemicals where the energy is not provided by the sun but by chemical decomposition.

**Chitin:** A polysaccharide that forms the exoskeleton of arthropods and the cell walls of fungi.

**Chlorophyll:** A green pigment which absorbs light energy during photosynthesis.

**Chlorophyta:** A plant phylum often called green algae. May be unicellular or multicellular, mostly live in fresh water.

**Chloroplast:** A membrane bounded organelle which contains chlorophyll. The site of photosynthesis in eukaryotic cells.

**Chordata:** An animal phylum in which animals have a notochord (flexible rod) and below this a dorsal nerve. These animals also have pharyngeal (‘gill’) slits during their development.

**Chromosome:** Chromatin which has shortened and thickened (“condensed”) to become visible (with the aid of a microscope) as a separate body during cell division.

**Ciliata:** Protozoan class that move using hair like structures called cilia, e.g. Paramecium.

**Cilium (Plural – cilia):** Short hair-like structure protruding from specialised cells which beats rhythmically to move the cell or move substances over the cell, (e.g. in the trachea, ciliated epithelial cells help clear the lungs of mucus and dust, etc).

**Circulation:** The flow of fluid through the circulatory system or lymphatic system.

**Circulatory system:** The group of organs through which blood and lymph flow through the animal’s body supplying oxygen and nutrients to cells and removing carbon dioxide and other waste.

**Class:** A subdivision of a phylum which in turn is divided into orders.

**Classification:** Grouping organisms according to their shared structural features (and their evolutionary relationships).

**Climax community:** A community which has reached its final stage in ecological succession. It is stable while the environment remains unchanged, e.g. rainforest.

**Cloaca:** The opening through which gametes, faeces and urine pass from the body of amphibians, fish, reptiles and birds.

**Closed circulatory system:** Blood stays within this type of system. Blood cells do not normally move out of it (except some white blood cells which are motile). Only smaller molecules and ions move in and out of this system through the capillaries. Vertebrate and echinoderm have closed circulatory systems.

**Cnidaria:** A phylum which is radially symmetrical with stinging tentacles. Members have a single opening for food to enter and waste to leave. This is the gastrovascular cavity which also serves as a respiratory surface. Examples include jellyfish and sea anemones.

**Coelom:** The cavity in which internal organs are housed in many animals.

**Cohesion:** The attraction that particles of the same kind have for each other, e.g. water molecules are attracted to other water molecules by cohesive forces.

**Cold-Blooded:** See Poikilothermic.

**Collaboration:** Working together, e.g. grain-borer beetles breaking through the outside of a wheat seed, termites constructing a mound.

**Collenchyma:** Plant cells which have thickened walls. The thickening is mainly in the corners. These cells provide support in young plant stems but are replaced by sclerenchyma in older plants.

**Colony:** Organisms living as a group in close association, e.g. bacteria on an agar plate.

**Combustion:** The process of burning. It usually involves the rapid oxidation of a substance which produces heat, light and often the release of carbon dioxide.

**Commensalism:** A relationship between two organisms in which only one organism benefits by the association, but the other appears to be unaffected.

**Common ancestor:** Where two species have evolved from the same species, that species is called their common ancestor.

**Community:** The plants, animals and micro-organisms which live together in a particular place at a particular time.

**Companion Cell:** A cell attached to the side of each sieve tube cell in phloem tissue which contains a nucleus (unlike the sieve tube cell) and appears to control the activities of the sieve tube cell.

**Competition:** An association between two organisms where both strive to obtain the same resource (e.g. food, shelter, mates). May be interspecific (between two species) or intraspecific (within the one species).

**Concentration:** The amount of a solute in a given volume of solvent.

**Concentration gradient:** The change in the concentration of a solute that may occur from one part of a solution to another part of that same solution.

**Coniferopsida:** A class of gymnosperms which reproduce using cones. The ova are not enclosed and pollination generally occurs by wind.

**Consumer/Heterotroph:** An organism which feeds on other organisms. First order consumers (herbivores) feed on plants, second order consumers (carnivores) feed on first order consumers (and so on).

**Contractile vacuole:** An organelle found in fresh water protozoa which pumps excess water from the cytoplasm.

**Control:** An experiment that can be used as a comparison to test the effect of one variable upon another.

**Convolution:** A fold in a membrane or tubule which increases its total surface area.

**Corridor:** A strip of vegetation which connects two otherwise isolated communities. The corridor enables some organisms to migrate from one community to the next which would otherwise be difficult.

**Cortex:** The outside layer of tissue in an organ.

**Cotyledon:** A leaf-like structure which contains the stored food of a seed.

**Crustacea:** An arthropod class which has ten or more appendages, including two pairs of antennae and gills, e.g. crabs, crayfish.

**Cultivar:** A variety of a plant species bred to promote a desirable trait that does not occur in nature.

**Culture:** To grow micro-organisms or tissue in a prepared medium, e.g. agar plate.

**Cuticle (Waxy):** Layer of waterproof material secreted by epidermal cells in plants, which reduces water loss to the atmosphere.

**Cyanobacterium (Plural – cyanobacteria):** A bacterial phylum in which the cells contain chlorophyll which is not enclosed in a membrane, e.g. they do not possess chloroplasts. (Blue-green alga).

**Cyst:** A sac which encloses a dormant organism or larval stage.

**Cytology:** The scientific study of cells.

**Cytoplasm:** The fluid part of the cell including the organelles (other than the nucleus) and the cell membrane. (cf. protoplasm).

**Cytoplasmic streaming:** The flowing mass movement of cytoplasm within some cells.

**Cytosol:** The fluid part of the cytoplasm, not the organelles.

**Data:** A collection of observations of variables that is either quantitative or qualitative.

**Deamination:** The breakdown of excess amino acids in the liver. This involves the removal of the amino group of atoms (NH<sub>2</sub>) from the amino acid. Ammonia (NH<sub>3</sub>) is formed. This is excreted by many aquatic animals, which have no “water problem”. It is converted to urea (CO(NH<sub>2</sub>)<sub>2</sub>), by mammals and uric acid (C<sub>5</sub>H<sub>4</sub>N<sub>4</sub>O<sub>3</sub>) by birds and reptiles for excretion.

**Death rate:** The number of deaths per thousand of a population per year. (cf. birth rate).

**Decay:** To breakdown, rot or decompose. This is carried out by bacteria and fungi.

**Deciduous:** Describes a tree or shrub which annually sheds its leaves. Usually this occurs during autumn, although in arid climates it may occur in early summer.

**Decompose:** See decay.

**Decomposer:** A heterotrophic organism which breaks down the remains and wastes of other organisms, returning nutrients to the soil or water.

**Deficiency Disease:** A disease caused by an insufficient intake of an essential nutrient, e.g. scurvy.

**Deforestation:** The removal of most of the trees in a forest or woodland area.

**Dehydrate:** To lose water.

**Denaturation:** The change in the shape of an enzyme due to heat or pH. This results in the enzyme losing its catalytic properties.

**Denitrification:** The process whereby some soil bacteria break down nitrates to return nitrogen to the atmosphere.

**Detritivore:** An animal which eats dead organic matter which accumulates in an environment, e.g. earthworms.

**Density of species:** The numbers of a particular organism in a unit of area (or volume).

**Density-dependent factor:** A variable which affects a population more as its size increases in a given area, e.g. disease.

**Density-independent factor:** A variable which may affect a population size regardless of its density, e.g. a cyclone.

**Deoxygenated:** Having lost oxygen. In mammals, blood that is deoxygenated usually carries carbon dioxide in the form of bicarbonate ions, attached to haemoglobin in red blood cells and dissolved in the plasma.

**Dependent variable:** A variable which responds to changes in the independent variable. Sometimes called the “responding” variable.

**Desertification:** The change in an ecosystem which results in a loss of plants and topsoil leaving the area desert-like and unsuitable for agriculture.

**Detritus:** Dead organic matter.

**Diastole:** The period of a cardiac cycle during which the heart muscles are relaxed. (cf. systole).

**Dichotomous:** Term used to describe a key used for identifying organisms where there are two choices at each point.

**Dieback:** A disease caused by fungal attack on the roots of a plant, e.g. Jarrah Dieback (which affects many different species) is caused by the fungus *Phytophthora cinnamomi*.

**Differentiation:** The development of specialised cells as they mature.

**Diffusion:** The movement of particles from an area of high concentration to an area of low concentration in a fluid.

**Digestion:** The breakdown of larger more complex organic matter into simpler compounds so that they can be absorbed by an organism.

**Dilation:** A process in which an organ or vessel widens. Blood vessels may dilate allowing more blood to flow through them.

**Diplopoda:** A class of arthropods with segmented bodies which have two pairs of legs per segment. Commonly called millipedes.

**Disaccharide:** A carbohydrate which has molecules produced when two monosaccharides combine, e.g. sucrose.

**Dispersal:** To spread away from point of production. This often occurs with seeds and pollen when they are carried by wind, water and animals.

**Display:** A ritual behaviour carried out by an animal to attract a mate or communicate in some way with animals of the same species, e.g. courtship displays.

**Distribution:** The area over which a species can be found.

**Diurnal:** An organism which is active during the day. (cf. nocturnal).

**Diversity:** The range of types of organisms living in an environment.

**Division:** Alternative name for a phylum, commonly used in the plant kingdom.

**DNA:** A chemical made up of units called nucleotides of which chromosomes are mostly composed. Full name is deoxyribonucleic acid.

**Dorsal:** On the upper side of the body.

**Dryland salinity:** Clearing too many deep rooted trees in semi-arid areas. Following the removal of trees the water table rises, particularly in winter, bringing salt that is in the soil to the surface.

**Duct:** Tube like structure which carries secretions in the body.

**Ecdysis/Moulting:** The shedding of an arthropod exoskeleton, for growth, caused by a hormone called ecdysone.

**Echinodermata:** A invertebrate phylum which is entirely marine. They have an internal skeleton made up of

calcareous spiracles just under the skin and a water vascular system which controls the movement of tube feet, e.g. starfish, bristle star, sea urchin.

**Ecology:** The scientific study of the inter-relationships between communities and their environments.

**Ecosystem:** The living community in a particular area, together with its non-living surroundings and the interactions that occur between the two.

**Ecosystem diversity:** This refers to the number of different types of naturally occurring ecosystems within an area.

**Ecosystem resilience:** The capacity of an ecosystem to withstand disturbance and to recover from change.

**Ectoparasite:** A parasite which lives on the body surface, e.g. in the skin or hair or on leaves, (cf. endoparasite).

**Ectothermic:** See poikilothermic.

**Egestion:** The elimination of undigested food from the gut.

**Electron:** The small (it is 1/1836 the size of a proton) negatively charged particle in an atom.

**Electron micrograph:** A photo taken with the aid of an electron microscope.

**Electron microscope:** A microscope which uses electrons to magnify the image of an object. (cf. light microscope) It has higher magnification (up to 500,000 x) and greater resolution than a light microscope.

**Elimination/Defaecation/Egestion:** The removal of indigestible body wastes from the alimentary tract.

**Emigration rate:** (e) The number of organisms leaving a population per 1,000 per year.

**Emulsify:** To physically break oil into smaller droplets e.g. bile salts physically divide (digest) lipids into small droplets which can then be more quickly chemically digested by lipase because of the oil's increase in surface area to volume ratio. Endangered species: An organism that is threatened with extinction.

**Endemic:** A disease which is constantly present in a particular part of the world, e.g. malaria in the tropics.

**Endocytosis:** The process whereby a cell's membrane either folds inwards to absorb a fluid (pinocytosis) or protrudes outwards and engulfs a larger solid particle (phagocytosis).

**Endoparasite:** A parasite which lives inside the body of its host. (cf. ectoparasite).

**Endoplasmic reticulum (abbreviated as ER):** A network of membranes which form channels within the cytoplasm of a eukaryotic cell. Used to transport materials about the cell.

**Endothermic:** See homeothermic.

**Energy:** The capacity to do work.

**Environment:** An organism's biotic and abiotic surroundings. All the factors which affect an organism during its life.

**Enzyme:** A protein which acts as a biological catalyst.

**Enzyme inhibitors:** Chemicals that either occupy the active site of an enzyme preventing its substrate from forming an enzyme-substrate complex (a competitive inhibitor) or change the shape of the enzyme (and its active site) so that it no longer fits the substrate (a non-competitive inhibitor).

**Ephemeral:** A plant with a short life cycle.

**Epicormic shoot:** A bud growing from the trunk of a tree usually after a bush fire.

**Epidermis:** The outer layer of cells which covers an organism.

**Epiphyte:** A plant which climbs over another plant, using it for support.

**Erythrocyte:** A red blood cell. A corpuscle which carries oxygen.

**Ethanol:** An organic chemical, colourless liquid (ethyl alcohol, C<sub>2</sub>H<sub>5</sub>OH). It is produced in fermentation.

**Eukaryote:** A cell which has membrane bounded organelles, including a nucleus, e.g. Amoeba, human cells.

**Eutrophic:** A body of water with adequate dissolved nutrients for its community. (cf. oligotrophic).

**Eutrophication:** The action of increasing levels of nutrients in lakes and rivers. Usually this results in increased algal growth which upsets the stability of the ecosystem.

**Evaporation:** The change from a liquid to a gas, e.g. water to water vapour.

**Evergreen:** Plants which keep most of their leaves all year round, shedding leaves continuously but slowly.

**Evolution:** The gradual change in a species which occurs over millions of years due to the cumulative effect of mutations and natural selection.

**Excreta:** Faeces. The solid waste of undigested matter produced by animals.

**Excretion:** The removal of metabolic wastes. These include CO<sub>2</sub>, urea, uric acid. (cf. elimination).

**Exhalation:** Forcing air from the lungs.

**Exocrine gland:** A gland which empties its product into a duct, e.g. salivary glands, lacrimal glands, gastric glands. (cf. endocrine).

**Exocytosis:** The removal, by means of a vacuole, of wastes or products via a cell's plasma membrane. (cf. endocytosis).

**Exoskeleton:** A skeleton on the outside of the body. Arthropods produce a tough external covering called an exoskeleton.

**Exotic:** An introduced plant or animal.

**Ex situ conservation:** Conservation of a species carried out by removing some of its population from its natural area and breeding this group in a habitat which is not threatened, e.g. captive breeding programs at the Perth Zoo.

**External fertilisation:** When an egg is laid in the water and a sperm cell fuses with it outside the female's body.

**Extinct:** A species which has not been sighted alive for fifty years or more.

**Extracellular:** Outside the cell. The fluid which surrounds a cell inside a multicellular organism is called extracellular fluid.

**Extracellular digestion:** Digestion which takes place outside of a cell.

**Extracellular fluid:** The fluid which surrounds cells inside a multicellular organism.

**Extrapolation:** To estimate by extending the known data. Often this involves extending a graph beyond the data that has been plotted to estimate a value that falls outside the known range.

**Faeces:** Solid wastes produced by the digestive system eliminated via the anus.

**Facilitated diffusion:** The passive movement of substances through a cell membrane which is assisted by a transport molecule (a protein imbedded in the membrane).

**Fauna:** The animals that live in a particular area.

**Fecundity:** The reproductive capacity of an organism.

**Feral:** Domesticated animals that have become "wild" or gone back to a natural way of life.

**Fermentation:** Anaerobic respiration of sugary fruit juice in yeast cells that produces alcohol and carbon dioxide.

**Fern:** A plant species belonging to the phylum (division) Pteridophyta. Ferns have leaves called fronds under which develop spores. The plants have a life cycle involving the alternation of two generations, the sporophyte (which is the larger more conspicuous plant) and the gametophyte.

**Field of view:** This is the circular area that is viewed when looking into the ocular of a microscope.

**Filicopsida:** Member of the phylum Tracheophyta which is commonly called a fern.

**Fire regimes:** The frequency and intensity of the bushfires that have occurred in a particular area.

**Fish:** Any one of three vertebrate classes that live in water. They are Agnatha (jawless fish), Chondrichthyes (cartilaginous fish) and Osteichthyes (bony fish).

**Flaccid:** Condition of cells or tissues when they lose water and become soft and limp.

**Flagellate:** A micro-organism with at least one flagellum.

**Flagellum (Plural – flagella):** A whip-like organelle which generally propels a cell forward.

**Fledgling:** A very young bird which is still dependent on its parents for food and protection.

**Flora:** The plants that live in a particular area.

**Flower:** A structure found on angiosperms which contains the gametes used in sexual reproduction.

**Flowering plant:** A member of the phylum Tracheophyta which is classed as an Angiospermae because it produces flowers.

**Fluorescence:** The emission of light from a substance that has absorbed light or has been excited by another form of radiation.

**Fluorophores:** Fluorescent chemicals that are special molecules which emit light when light of a particular wavelength illuminates them. The light used in a light microscope can be selected to cause this fluorescence.

**Food:** Nutrients that are ingested via the mouth.

**Food chain:** A diagram which shows simple feeding relationships involving a plant (producer) which is eaten by an animal (first order consumer) which is eaten by another animal (second order consumer) and so on. Arrows link each organism to the next showing the direction in which the energy and nutrients move.

**Food pyramid:** A diagram which shows the mass of producers, first

order consumers, second order consumers and so on in the food chain in a community. The plants are drawn at the base.

**Food web:** A diagram used to show the many interacting food chains in a community.

**Forest:** A community which is more closed, more densely populated by tall trees. The trees cast over 30% shade at midday in summer or the canopy covers over 30% of the sky when looking straight up.

**Fragmentation:** A type of asexual reproduction in which an organism is broken into smaller parts and each part develops into a new organism (by mitosis) e.g. starfish.

**Freshwater:** Water containing little dissolved solutes. (cf. marine water).

**Fronde:** A large leaf produced by ferns and palms.

**Fruit:** A structure which normally develops from the wall of the ovary and encloses the seeds. It may be succulent, woody or dry. If the fruit develops from a swollen receptacle it is called a 'false' fruit.

**Fruiting body:** A structure which contains spores in fungi.

**Fungus:** (Plural – fungi): In the modern classification scheme, a member of a kingdom which is mostly multicellular, forms threadlike filaments called hyphae from spores. The hyphae branch to form a network called a mycelium. The cell walls are chitin and the organism is heterotrophic. (Once classed as Eumycota in the plant kingdom).

**Generalisation:** A statement which applies to many cases, e.g. "living things are made up of cells."

**Gene:** A section of a chromosome which codes for a particular protein.

**Genetic diversity:** This refers to the variations within a species that is due largely to the number of alleles within the population.

**Genetics:** The study of heredity, i.e., the study of how features are passed from parent to offspring.

**Genus (Plural – genera):** A group of similar or closely related species. A genus is a subdivision of a family.

**Germination:** When a plant seed or spore begins to grow.

**Gill slits:** These are openings on the lateral sides of the head found in aquatic vertebrates (and the other vertebrates during the embryonic stage). Gills are located in these slits to absorb oxygen from the water as it flows through the mouth and out through the slits.

**Gill:** An organ used by aquatic animals for gas exchange. It is where oxygen enters and carbon dioxide leaves the organism.

**Gizzard:** A section of the digestive tract in which food is mechanically digested by grinding it into smaller particles.

**Gland:** An organ or tissue which secretes a substance used somewhere else in the body. See exocrine and endocrine glands.

**Glucose:** A simple sugar (monosaccharide) formed by photosynthesis and used as a source of energy in respiration (formula C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>).

**Glycerol:** An alcohol which forms part of the structure of lipids.

**Glycogen:** A carbohydrate (polysaccharide) made up of a long chain of glucose molecules. Animals store glucose in this form in the liver and muscles. It is convenient in this form as it is not as soluble as glucose and therefore exerts less osmotic effect. It is readily converted to glucose and is a convenient source of energy.

**Glycolysis:** The anaerobic breakdown of glucose into pyruvate or pyruvic acid. It is the common metabolic pathway at the beginning of both aerobic and anaerobic respiration.

**Golgi Body/Apparatus:** An organelle found in eukaryotic cells which packages the substances (e.g. enzymes) which the cell secretes.

**Gonad:** An organ which produces the gametes, e.g. testis, ovary.

**Granum (Plural – grana):** Part of a chloroplast which consists of a stack of thylacoids containing chlorophyll, where the light dependent stage of photosynthesis occurs.

**Greenhouse effect:** This is a rise in the average temperature of Earth's atmosphere, together with a rise in the sea level and changing climatic conditions over Earth generally. This is generally believed to be due to an increase in the levels of carbon dioxide and methane in the atmosphere. These have increased because humans have burnt an ever increasing amount of fossil fuel which produces carbon dioxide and used farming techniques (such as paddy fields) and grazing animals that produce large amounts of methane gas. (Earth's atmosphere naturally traps heat, however, humans have increased the amount of heating).

**Greenhouse gas:** A gas which contributes to global warming, especially carbon dioxide and methane.

**Growth:** An increase in the number and size of cells.

**Guard cell:** A specialised epidermal cell which when paired with another similar 'sausage' shaped cell forms a stomatal pore.

**Gut:** The digestive tract or alimentary canal.

**Guttation:** Water loss from a plant which is due to root pressure.

**Gymnospermae:** A class of the phylum Tracheophyta which reproduces by cones. The seeds are exposed rather than enclosed.

**Habitat:** The place in an environment where a particular animal or plant lives.

**Habitat fragmentation:** When the normal range or distribution of an organism is divided by barriers which prevent the movement of individuals and gene flow over its normal distribution.

**Haemocoel:** The cavity in the body of arthropods and molluscs through which blood moves. The blood is not confined to vessels, as it is an open circulatory system.

**Haemoglobin:** A compound which binds to both oxygen and carbon dioxide and is important in transporting these gases within the blood, particularly that of vertebrates.

**Heart chambers:** These are the compartments that make up more complex hearts e.g. mammalian and avian hearts have 4 chambers, amphibians have 3 chambers.

**Heath:** A community dominated by low shrubs.

**Herb:** An angiosperm with a green non-woody stem.

**Herbivore:** A plant eating animal. (cf. carnivore and omnivore)

**Heterotroph:** An organism which cannot make its own food, but relies on the organic matter produced by other organisms, e.g. animals, fungi, bacteria (other than cyanobacteria and chemosynthetic bacteria). (cf. autotrophs).

**Hibernation:** Becoming dormant during the coldest season of the year. (cf. aestivation).

**Hirsute:** Having a covering of hair or hair-like bristles.

**Histology:** The study of tissue structures and tissue functions in organs.

**Holdfast:** A structure found on some algae which anchors them to rocks such as those on a reef.

**Home Range:** The area in which an animal lives.

**Homeostasis:** The maintenance of stability within the body of an organism.

**Homo:** The genus to which modern man belongs, i.e. Homo sapiens.

**Hormone:** A chemical released in small amounts from special tissue which brings about change in another part of the organism. Endocrine glands produce hormones in animals.

**Host:** An organism in or on which a parasite lives.

**Hydrophilic:** A particle or that part of a particle which is attracted to water. (cf. hydrophobic).

**Hydrophobic:** A particle or part of a particle which is repelled by water. (cf. hydrophilic).

**Hydrophyte:** A plant which is adapted to live in damp or aquatic conditions.

**Hypertonic:** A solution, which because of its higher concentration, gains water by osmosis from another less concentrated solution through a semi-permeable membrane. (cf. hypotonic).

**Hypha (Plural – hyphae):** A filament which consists of a number of cells attached end to end which make up the body of a fungus.

**Hypothesis:** An educated guess put forward to explain an observation. To be described as a hypothesis the proposition must be testable. When evidence accumulates to support the hypothesis it becomes classified as a theory.

**Hypotonic:** A solution which being less concentrated loses water to another more concentrated solution by osmosis through a semi-permeable membrane. (cf. hypertonic).

**Ileum:** The second half of the small intestine, where most of the food absorption occurs.

**Immigration rate:** (i) The number of organisms entering a population per 1,000 per year.

**Inbreeding:** The crossing of individuals of close relationship or within a small population.

**Independent variable:** A variable which is deliberately changed in an experiment in order to measure the possible effect on another variable (called the dependent variable). Sometimes the independent variable is called the "manipulated" variable.

**Inferior ovary:** When the petals and sepals are attached at the top of the ovary. (cf. superior ovary).

**Inflorescence:** A shoot which bears flowers.

**Ingestion:** The taking in of food and water by an animal.

**Inhibit:** To limit the action of a process or function, e.g. to limit the production and release of a hormone from an endocrine gland.

**Inorganic:** Compounds which do not contain carbon (except carbon dioxide, carbon monoxide and carbonates).

**Insectivore:** An animal or plant which feeds on insects.

**In situ conservation:** conservation of a species of plant or animal in its natural environment.

**Inspiration:** Drawing air into the lungs, i.e. inhaling.

**Instar:** The stage between moulting in insects.

**Intercellular spaces:** Gaps between cells which are either fluid filled as in most tissues or air-filled as in the leaves of terrestrial plants.

**Internal environment:** The factors which create the surroundings of cells within a multicellular organism. This consists of intercellular fluid which surrounds the cells.

**Interspecific:** Between species. Competition for resources between two species is described as interspecific. (cf. intraspecific)

**Interstitial cells:** Cells located in the testes which produce testosterone.

**Interstitial:** Between cells.

**Intertidal zone:** The area between low and high tide. Sometimes called the littoral region.

**Intestinal Juices:** Fluids produced by the walls of the intestine which assist in the digestion of food.

**Intestine:** Part of the digestive tract between the stomach and the anus in mammals.

**Intracellular:** Inside a cell. Organelles are intracellular structures.

**Intraspecific:** Within a species. Competition between two animals of the same species is intraspecific. (cf. interspecific).

**Invagination:** An infold which occurs in a membrane during pinocytosis or in a line of cells to form a cavity.

**Invasive species:** An introduced species which does not naturally occur in an area and which causes environmental damage to that area.

**Isotonic:** When two solutions have the same concentration of dissolved solutes they are said to be isotonic. (cf. hypertonic and hypotonic)

**Jarrah (*Eucalyptus marginata*):** A eucalypt which grows very tall and is indigenous to Western Australia.

Noted for its fine hard timber and slow growth.

**Jejunum:** The section of the small intestine between the duodenum and the ileum. A large proportion of food digestion occurs here, but there is also some absorption.

**Jellyfish:** A member of the phylum Cnidaria which is shaped like a saucer with stinging tentacles which trail below or behind the animal. It moves by jet-like propulsion.

**Juvenile:** A young organism which is not sexually mature.

**Karri (*Eucalyptus diversicolor*):** A eucalypt which grows naturally in the south west corner of W.A. Like jarrah it is an excellent building timber.

**Keystone species:** A species that relative to its small population has a disproportionately large effect on its environment.

**Kidney:** The principle excretory organ in vertebrates, which filters the blood and eliminates nitrogenous wastes from the body. Kidneys may also regulate the concentration of other substances in the blood including water.

**Kingdom:** One of the five main divisions of living things. The five kingdoms are Monera (Bacteria and Cyanobacteria), Protista (protozoa and single-celled algae), Fungi (moulds and mushrooms), Plantae (Tracheophyta and non-vascular plants), Animalia (Chordata, Arthropoda and other animals).

**Krill:** Small crustaceans which are the main food for baleen whales in Antarctica.

**Lacteal:** A tiny tube which lies inside the villi of the intestine and absorbs the products of lipid digestion in the intestine. These tubes are part of the lymphatic system.

**Lactose:** Milk sugar which is a disaccharide made up of glucose and galactose (two monosaccharides).

**Lamella (Plural – lamellae):** Flat membranes that contain chlorophyll and connect grana within the stroma of a chloroplast. Lamellae create a system in which all the thylacoids within a chloroplast are interconnected.

**Large intestine:** The last section of the intestine in which water is reabsorbed from the wastes and some vitamins are absorbed.

**Larva (Plural – larvae):** The juvenile form of an animal which is unlike its adult parent. The larva may develop into a pupa which undergoes metamorphosis in changing into the adult body form.

**Lateral:** On the side of an organism.

**Law:** A theory which has so much accumulated evidence to support it that the majority of the scientific community accept the theory as true.

**Leaf:** The organ on a plant in which the majority of its photosynthesis occurs.

**Learning:** The behaviour of an animal which is acquired through experience (not innate).

**Legume:** A family of plants particularly important because their roots often have nodules which contain nitrogen-fixing bacteria.

**Lenticel:** A small hole in the bark of the stem or in the roots of plants which allows gaseous exchange.

**Leucocyte:** A white blood cell. There are several types but they all have nuclei and are associated with providing the body with protection from pathogens, such as parasitic bacteria and viruses.

**Leucoplast:** A membrane bounded organelle found in some plant cells which normally stores starch.

**Lichen:** A combination of an alga and a fungus which lives in a mutualistic relationship. The alga photosynthesises and produces food for both itself and the fungus, while the fungus absorbs moisture and nutrients for both organisms. Lichens are crust-like in appearance, often a grey-green colour.

**Life cycle:** The sequence of all the various stages from fertilisation to the death of an organism.

**Lignin:** An organic compound which is a major component of wood. Lignin strengthens the walls of xylem cells.

**Lignotuber:** An enlarged base of plant stem which is fire-resistant.

**Limiting Factor:** A variable in an organism's environment which restricts its growth and reproduction.

**Linnaeus, Carl (1707-1778):** A Swedish botanist who developed the binomial nomenclature system of naming species and the hierarchical classification of organisms according to their structural characteristics.

**Lipid:** A fat or an oil, which is composed of fatty acids and glycerol.

**Littoral:** The zone between low and high tide at the edge of the ocean.

**Liver:** A large organ which stores sugar as glycogen, helps maintain blood sugar, breaks down toxins and used red blood cells, converts excess amino acids to carbohydrates and urea and has several other important functions associated with the chemistry of the body.

**Lumen:** The opening or space in a vessel through which fluids pass.

**Lung:** An organ which consists of millions of sac-like structures called alveoli, which is used for gaseous exchange with the atmosphere.

**Lymph:** The fluid which passes from the tissues into the lymphatic system and eventually drains into the circulatory system. Similar to plasma but lacking as many large proteins.

**Lymph node:** An area of the lymphatic system where several lymph vessels meet.

**Lymphatic system:** System of tubes or vessels which drain excess fluid from tissue beds and carries it back into the circulatory system.

**Lymphocyte:** A white blood cell which is found in the lymphatic system. There are two types of lymphocytes, T cells and B cells. T cells produce chemicals which stimulate other cells (e.g. macrophages – yet another type of white blood cell) to attack invading bacteria. B-cells produce antibodies which directly attack foreign cells or materials.

**Lysis:** The process whereby a cell absorbs water to such an extent that it bursts or when a cell is destroyed by antibodies rupturing its cell membrane.

**Lysosome:** An organelle which is involved in intracellular digestion.

**Macroinvertebrate:** An invertebrate that can be seen with the unaided eye.

**Macronutrient:** A substance which is required by an organism in large amounts, e.g. oxygen, nitrogen, hydrogen, carbon. (cf. micronutrient).

**Macrophage:** A white blood cell which engulfs foreign materials including bacteria and their toxins, using phagocytosis.

**Macroscopic:** Visible without the aid of a microscope.

**Magnification:** The extent to which an object is enlarged by a microscope. It is expressed as the ratio of the image size to the actual size. When using a light microscope it is calculated by multiplying the magnifying power of the objective by the magnifying power of the ocular.

**Malaria:** A disease caused by a protozoan (*Plasmodium*) which is transferred from one person to another via a female mosquito (the vector). The symptoms include fevers, chills and sweating. Malaria is endemic in the tropical areas of Africa, Central and Southern America and Asia.

**Mallee:** A form of plant which has multiple stems arising from a large underground root.

**Malnutrition:** Poor diet due to a deficiency of an essential nutrient.

**Malpighian tubules:** These are tubes which branch from the digestive tract, in insects and spiders which absorb nitrogenous wastes and some ions from the fluid in the body cavity and empty these into the hind gut; from the hind gut they are excreted with the faeces.

**Mammalia:** A member of phylum Chordata which is placed in the class Mammalia because it has mammary glands which are used to suckle its young, has hair and is homeothermic.

**Mangrove:** This refers to a type of tree or shrub which lives partly submerged in salty water. Because the roots are in water, these plants often use aerial roots called pneumatophores to obtain oxygen from the atmosphere. These are roots which rise vertically and protrude into the air.

**Marine:** Living in the sea or ocean or associated with them.

**Marri:** (*Corymbia calophylla*) A large tree native to southern W.A. A Red Gum because of the red sap which is visible on its trunk.

**Marsupial:** Mammals which give birth to their young in a relatively immature stage of development and which have a pouch in which the young develop further, e.g. kangaroos, possums, koalas, chuditch.

**Mastication:** The grinding, mechanical digestion of food.

**Medium (Plural – Media):** The substance on which a micro-organism (e.g. bacteria) is grown in the laboratory.

**Mega:** Prefix meaning one million, e.g. a mega joule (MJ) means one million joules.

**Mesophyll:** Layer of chlorophyll containing cells found in the leaf, e.g. palisade and spongy mesophyll.

**Mesophyte:** A plant which favours moderate water conditions. (cf. hydrophyte and xerophyte).

**Metabolic rate:** The rate at which chemical processes occur within the body of an organism.

**Metabolic waste:** A chemical produced by the biochemistry of the cells that is not required by the body and may become toxic if allowed to accumulate in the body, e.g. urea, carbon dioxide, lactic acid, uric acid, ammonia.

**Metabolism:** The chemical processes which occur within the body of an organism. These include both anabolic and catabolic processes.

**Metamorphosis:** A change in the body of an organism as it changes from the larval to the adult stage. Often insects and crustacea are very different in their larval stage from their adult stage. If they are wormlike larva,

then the change is called “complete metamorphosis.”

**Methylene blue:** A stain used in microscopy to highlight the cell nucleus. The nuclear material turns blue with methylene blue.

**Microbiology:** The scientific study of micro-organisms.

**Microclimate:** The abiotic conditions which exist in a microhabitat.

**Micrograph:** A photograph taken with the aid of a microscope, e.g. electron micrograph and light micrograph.

**Microhabitat:** A very small habitat, e.g. in the bark of a tree.

**Micrometre ( $\mu\text{m}$ ):** One millionth of a metre, (often called a micron).

**Micronutrient:** A nutrient required in very small quantities, e.g. vitamins, trace elements. (cf. macronutrient)

**Microorganism:** A microscopic single-celled living thing, e.g. bacteria, protozoa, viruses, some algae and some fungi.

**Microtome:** A device used to cut very thin slices of tissue to use in microscope slides.

**Microvilli (singular microvillus):** Very small projections of cytoplasm from some cells which increases the cells' total surface area for absorption, e.g. epithelial cells of the intestine.

**Migration:** The movement of animals which usually occurs seasonally as animals seek food, water or warmer conditions.

**Mildew:** A fungal growth found on plants which is white and powdery.

**Millilitre (mL):** One thousandth of a litre.

**Millipede:** (See Diplopoda).

**Mimicry:** The imitation of another species which may give protection or reproductive advantage, e.g. the stick insect mimics a stick for camouflage.

**Mitochondrion (Plural – Mitochondria):** A cell organelle in which aerobic respiration occurs.

**Model:** A scientific idea in which a process is represented by a diagram or a physical structure in order to develop a better understanding of the process and test predictions based on the idea, e.g. the fluid mosaic ‘model’ of the cell membrane.

**Monera:** One of the five kingdoms in which the organisms do not have organelles bounded by membranes. These organisms are simple, have no distinct nucleus and are microscopic. They are prokaryotes which include only bacteria and cyanobacteria.

**Monoculture:** A crop in which only one plant species is grown, e.g. a field of wheat.

**Monocyte:** Alternative name for macrophage.

**Monomer:** A molecule that can bond with similar molecules to form a long chained molecule or polymer, e.g. glucose.

**Morphology:** A branch of biology that deals with the structure and form of organisms.

**Monosaccharide:** A simple sugar, e.g. glucose, fructose, galactose, ribose and deoxyribose. These are carbohydrates which have only five or six carbon atoms in each molecule.

**Mortality:** The death rate normally expressed as the number per thousand per year in a population.

**Moss:** A small plant which lives in damp habitats, has no real vascular tissue and shows obvious alternation of generations. Moss is classified in the phylum Bryophyta.

**Motile:** An ability to move independently by using cilia, flagella or amoeboid movement.

**Moulting:** Shedding of the exoskeleton in arthropods to allow for growth. Alternatively called ecdysis.

**Mouth:** That part of the digestive tract at which food enters.

**Mulga:** Plant community in which wattles (*Acacia*) are the dominant species.

**Multicellular:** Many celled organism.

**Mutualism:** A relationship between two organisms of different species in which both organisms benefit, e.g. lichen.

**Mycelium:** A network of filaments (hyphae) which make up the main body of a fungus.

**Mycorrhiza:** A special symbiotic relationship that many fungi have with plant roots. Usually these are mutualistic, as both organisms benefit. The fungi decomposes organic matter in the soil, making it available for the plant's roots, while food from the plant keeps the fungus alive.

**Nanometre:** One thousandth of a micrometre or  $10^{-9}$  metre. Used as a measure of the dimensions of cell organelles.

**Native:** An organism which has not been introduced to a particular environment. It is indigenous.

**Nectar:** A sugary liquid produced by flowers which attracts insects and birds.

**Neurone:** A nerve cell. Most neurones have long extensions of the cytoplasm which convey electro-chemical impulses.

**Neutrophil:** A white blood cell or leucocyte which moves by amoeboid movement and uses phagocytosis to destroy foreign bacteria and proteins in the body.

**Niche:** The function of a particular organism in its community.

**Nitrate:** A soluble compound containing the NO<sub>3</sub><sup>-</sup> group, e.g. sodium nitrate, NaNO<sub>3</sub>. Nitrates are very soluble and are an important source of nitrogen for plants. They are absorbed by the roots from soil.

**Nitrification:** The conversion of ammonia from decaying organic matter into nitrites and then nitrates by nitrifying bacteria. Nitrates can be absorbed by plants through their roots.

**Nitrogen:** A chemically inactive, colourless, odourless gas which makes up 78% of our atmosphere.

**Nitrogen fixation:** The conversion of atmospheric nitrogen into nitrates. This is carried out mostly by nitrogen-fixing bacteria which either live in the soil or in root nodules of legumes (e.g. beans, peas, acacias).

**Nitrogenous base:** Organic substances containing nitrogen which make up the genetic code in DNA and RNA molecules (e.g. cytosine, guanine, adenine, thymine and uracil).

**Nitrogenous waste:** A compound containing nitrogen which is not required by the body and which is normally excreted e.g. urea, ammonia, uric acid, creatinine.

**Nodule:** A small bulge. Nodules found in the roots of legumes contain nitrogen-fixing bacteria.

**Non-ruminants:** A mammal herbivore that does not regurgitate its ingested food and does not have a four chambered stomach. Normal digestion occurs in the stomach and small intestine. Similarly absorption occurs largely in the small intestine. The caecum is large and contains bacteria that breaks down cellulose.

**Notochord:** A long flexible rod shaped tissue which extends along the body of all chordates during their development. It lies between the digestive tract and the nerve cord. In vertebrates (a sub phylum) it develops into the vertebral column.

**Nuclear membrane:** A double layered membrane around the nucleoplasm perforated by holes or pores sufficiently large to allow the passage of RNA from the nucleus.

**Nucleic acids:** Long chains of nucleotides which form DNA and RNA molecules in the cell.

**Nucleolus:** A dark staining area within the nucleus of a cell where RNA is synthesised.

**Nucleoplasm:** The protoplasm or living fluid of the nucleus of a cell.

**Nucleus (Plural – nuclei):** Large cell organelle bounded by a nuclear membrane which is double layered and has pores. The nucleus contains nucleoplasm with DNA and RNA.

**Numbat:** A marsupial which feeds mainly on termites. It is restricted to small areas in the south-west of W.A. and is the state's animal emblem.

**Nut:** A mature fruit which is dry and remains closed.

**Nutrient:** A substance which supplies living things with the raw materials for growth and/or energy. See macronutrients and micronutrients.

**Nymph:** The juvenile stage of an insect which undergoes incomplete metamorphosis. The nymph resembles the adult but has reduced wings and reproductive organs, e.g. locusts.

**Objective:** The lower microscope lens on a light microscope which is closest to the object under view. (cf. ocular).

**Ocular lens:** The lens of a light microscope which is nearest the eye of the user (cf. objective lens).

**Oesophagus:** A muscular tube connecting the mouth and the stomach, which is part of the digestive tract.

**Oligotrophic:** A water body which contains little dissolved organic and inorganic matter.

**Omnivore:** An animal which eats both plant and animal food (cf. carnivore, herbivore).

**Open circulatory system:** A circulatory system in which the fluid flows through the body cavity in direct contact with organs and is not confined to blood vessels, e.g. insects.

**Order:** A subdivision of a Class which is itself divided into two or more families.

**Organ:** A collection of tissues which together carry out one or more major functions in an organism, e.g. leaf, kidney.

**Organelle:** A small structure within the cytoplasm of a cell which carries out a particular function, e.g. mitochondrion.

**Organic:** A relatively complex chemical compound which contains carbon (exceptions include carbon

dioxide, carbon monoxide and compounds of carbonates).

**Organism:** A living thing, e.g. plant, animal, micro-organism.

**Osmoregulation:** The maintenance of suitable concentrations of water and dissolved salts in an organism's body cells. This is achieved in a variety of ways depending on the organism's environment. Osmoregulation may involve contractile vacuoles, kidneys, impermeable body coverings, special gill cells which secrete salts, the production of dry wastes (e.g. uric acid) and various behavioural adaptations including burrowing and nocturnal activity.

**Osmosis:** The movement of a solvent (usually water) by diffusion through a selectively-permeable membrane.

**Osmotic pressure:** The pressure which is due to osmosis. Where a cell has a high concentration of dissolved solutes its osmotic pressure will be high. Water has a strong tendency to enter the cell if the extracellular solution is less concentrated.

**Oxygenated:** Containing oxygen. In mammals, blood which is oxygenated has most of the oxygen attached to haemoglobin in its red blood cells.

**Oxygen debt:** The amount of oxygen needed by the body to restore its oxygen supply to normal after exercise.

**Oxyhaemoglobin:** The molecule formed when oxygen and haemoglobin combine. The bond between these two substances is weak and breaks down easily in tissue which has a low oxygen concentration.

**Ozone depletion:** Increased levels of chlorofluoro-carbons (CFC's) in the upper atmosphere. CFCs have been used in refrigeration, air conditioning and in other industrial processes.

**Palisade:** A layer of column shaped cells which lies just below the epidermis on the upper surface of most leaves. These cells have a high concentration of chloroplasts and carry out most of the leaf's photosynthesis. (See mesophyll).

**Parasite:** An organism which lives in or on another living thing (its host) to the detriment of the host organism.

**Parenchyma:** Thin walled cells which form the packing tissue in a plant. These cells are found in the central (pith) and outer (cortex) areas of stems and near the centre of some leaves. They often store starch.

**Passive:** A process which does not involve the use of chemical energy, e.g. diffusion.

**Pasteurisation:** A process in which milk, beer or wine are heated and held at a given temperature for a fixed time

in order to destroy particular micro-organisms that may spoil them.

**Pathogen:** A disease causing organism.

**Pelagic:** Organisms which drift or swim in the open ocean and lakes, unattached to the bottom or shore.

**Peptide Bond:** The chemical link between two amino acid molecules in a peptide, polypeptide or protein molecule.

**Perennial:** A plant which lives for more than one year. (cf. annual).

**Peristalsis:** Muscular contractions which move along a tube such as the digestive tract and the oviduct, to move the contents, food and ova respectively.

**Permeable:** A substance which allows other substances to pass through it, e.g. limestone is a permeable rock as it allows water to pass through it.

**Perspiration:** The combination of water, urea and organic salts which is excreted by sweat glands. It is produced in order to lose heat.

**Petal:** Part of the flower which is often flat, brightly coloured and attracts animals for pollination.

**Petiole:** The stalk which attaches many leaves to a branch or stem.

**pH:** The acidity or alkalinity of a solution. It is dependent on the concentration of H<sup>+</sup> ions. Acid solutions (with higher H<sup>+</sup> ion concentration) have a pH of less than 7, alkaline solutions have a pH greater than 7. A neutral solution has a pH of 7.

**Phagocytosis:** A process in which a cell grows a false foot or pseudopod. This engulfs food which is then enclosed within a cytoplasmic vacuole until it is digested. Macrophages and Amoeba are phagocytes.

**Phloem:** The tissue in vascular plants which carries sucrose and other organic compounds from photosynthesising leaves to the roots and from the roots to other parts of the plant.

**Phosphate:** A compound containing the phosphate (PO<sub>4</sub><sup>3-</sup>) group. It is an important constituent of ATP and nucleotides.

**Phospholipid:** A complex lipid which contains phosphate. The lipids which make up the cell membrane are phospholipids.

**Photomicrograph:** A photograph taken through a microscope. Often called a micrograph. An electron micrograph is obtained using an electron microscope.

**Photosynthesis:** The manufacture of glucose by green plants, using light,

chlorophyll and enzymes and the raw materials carbon dioxide and water. A byproduct of photosynthesis is oxygen.

**Phototropism:** A growth response to light, e.g. when green plants grow towards light this is called positive phototropism.

**Phyllode:** A flattened stem or petiole which photosynthesises and therefore functions as a leaf but with fewer stomata. This is an adaptation possessed by xerophytes, e.g. Acacia (wattles), in which the leaves are often reduced to spines or prickles.

**Phylogeny:** This is the evolutionary development of a species in its environment, which is likely to have occurred over a long period of time.

**Phylum (Plural – phyla):** A subdivision of a kingdom. A phylum therefore contains two or more classes. In the Plant kingdom the word phylum is often substituted by “division”.

**Physiology:** The way in which an animal or plant functions. (Also used to refer to the study of animal and plant function, i.e. how they work.)

**Phytoplankton:** Microscopic plants which drift in the ocean and lakes. (cf. zooplankton).

**Pinocytosis:** Occurs when a cell membrane forms an infold which engulfs a liquid droplet, e.g. lipid. (cf. phagocytosis).

**Pioneer organisms:** Organisms that are the first to colonise a newly exposed area or a disturbed or cleared area of land or water.

**Pit:** A thin section of the cell wall between two adjacent cells. Pits in xylem vessels provide an alternative path for water flow.

**Pith:** The cells which make up a soft core in plant stems. (See parenchyma).

**Placental mammals:** Mammals which develop in the uterus of the female obtaining nutrients and oxygen via the placenta. Most mammals are placental. Notable exceptions include marsupials and monotremes.

**Plankton:** A mixture of microscopic animals and plants (or protista) which live near the surface of the water of lakes and oceans.

**Plant:** A living organism which is composed of cells with cellulose cell walls, can carry out photosynthesis using chlorophyll and is generally unable to move.

**Plasma:** The liquid or non-cellular part of the blood.

**Plasma membrane:** The cell membrane. A layer of lipid and protein molecules which encloses the cell.

**Plasmolysis:** The shrinkage of the cell membrane away from the inside of a plant cell or bacterium due to water loss.

**Plastid:** A membrane bounded organelle found in plant cells which contains chlorophyll (chloroplast), pigment (chromoplast) or starch (leucoplast).

**Platelet:** A cell fragment found in mammalian blood which is important in forming blood clots which reduce bleeding. Also called a thrombocyte.

**Platyhelminthes:** An phylum of simple animals with flat wormlike body that is bilaterally symmetrical. Flatworms have a gastrovascular cavity with a single opening.

**Plumule:** The immature shoot, part of the embryonic green plant, which later develops into the stem and leaves. (See radicle).

**Poikilothermic (ectothermic):** An animal whose body temperature depends on the temperature of its surroundings. (cf. homeothermic).

**Pollen:** A small sac containing a number of male gametes produced by Angiospermae (flowering plants) and Gymnospermae (conifers).

**Pollination:** The transfer of pollen from the anther to the stigma in flowering plants or from a male cone to a female cone in gymnosperms.

**Pollution:** Addition of materials, noise, or heat to the environment which reduces the likelihood of the natural flora and/or fauna surviving there.

**Polymer:** A molecule made up of a long chain of monomers, e.g. glycogen is made up of a long chain of glucose molecules.

**Polysaccharide:** A polymer molecule made up of many simple sugars, e.g. starch, cellulose and glycogen.

**Population:** A group of organisms of the same species living in the same place at the same time. (cf. community).

**Population composition:** The structure of a population, which indicates the proportion of the population in each age band e.g. proportion of young to adult to aged.

**Precipitation:** Rain, hail, snow or sleet.

**Predation:** To kill another animal for food.

**Predator:** An animal which captures, kills and eats other animals as food.

**Prediction:** A statement made about a future event (in science, the prediction is normally based on a hypothesis).

**Prey:** An animal which is killed and eaten by a predator.

**Primary growth:** Growth at the root and stem tips which adds length to the plant growth. This involves cell division and expansion.

**Primary succession:** Succession which begins on a newly created substrate, e.g. a lava flow, exposed igneous rock.

**Proboscis:** A long tube-like structure used by animals such as insects to draw food into the mouth.

**Producer:** An organism which makes its own food by photosynthesis (or chemosynthesis). An autotrophic organism, e.g. green plant, cyanobacteria.

**Productivity:** The increase in the total organic matter in a population or community in a given time. This is a measure of the difference between the rate at which organic matter is synthesised and the rate at which food is respired.

**Progeny:** The offspring.

**Prokaryotic:** A type of organism which has cells that have no membrane bounded organelles, e.g. bacteria and cyanobacteria. (cf. eukaryotic).

**Protein:** An organic compound containing carbon, hydrogen, oxygen, nitrogen and sometimes sulphur. Proteins are made up of long chains of amino acids joined by peptide bonds. Proteins are essential components of cells being used for structure and enzymes.

**Protista:** A single-celled eukaryotic organism, e.g. protozoa, eukaryotic algae.

**Protoplasm:** All the living parts of a cell. This includes the cell membrane, cytoplasm and nucleus. It does not include cell secretions or the cell wall in plants.

**Protozoa:** Single-celled organisms.

**Pseudopodium:** An outgrowth of the cytoplasm and cell membrane produced to engulf food by some single celled organisms and white blood cells or to assist in locomotion (e.g. Amoeba, white blood cells). (See phagocytosis).

**Pulmonary:** Associated with the lungs, e.g. pulmonary arteries carry blood from the heart to the lungs.

**Quadrat:** An area of study. Quadrats are usually definite areas (e.g. 1 m<sup>2</sup>) selected at random in order to estimate the average density of a particular organism in a particular region.

**Quadruped:** A four-legged animal. (cf. Biped).

**Qualitative:** Refers to data which has no numerical values associated with it,

e.g. to describe the production of heat energy by active animals as "high" is to assign a qualitative value to the production. (cf. quantitative)

**Quantitative:** Refers to data which has numerical values. e.g. to express the heat energy released by an organism as "15 J/hour" is to assign a quantitative value to this variable.

**Race:** Subset of a species.

**Radial symmetry:** Organised around a circular plan, e.g. jellyfish are radially symmetrical.

**Radio tracking:** A transmitter attached to an animal sends out a signal in the form of radio waves. The signal can be detected by an appropriate recorder.

**Rainforest:** A dense forest where the canopy covers the sky almost entirely. Because little light penetrates to the forest floor, few plants grow over the ground. Rainforests have great biodiversity, especially tropical rainforests.

**Random:** A process of selecting in which each item has an equal chance of selection. The process is therefore unbiased.

**Reactant:** A substance which is chemically changed during a chemical reaction.

**Rectum:** The last section of the digestive tract between the colon and the anus.

**Red blood cell:** (See erythrocyte).

**Reef:** Rock, sand or coral which lies in the ocean close to the surface.

**Reliable data:** Data that because of sufficient trials and replicates is dependable.

**Remnant:** A small area of native bush or forest which has been left undisturbed.

**Reproduction:** The process in which organisms produce new young.

**Reptilia:** A class of vertebrates which belong to the phylum Chordata. They have dry scaly skin, are poikilothermic, terrestrial, lay shelled eggs, e.g. snakes, turtles, crocodiles, lizards.

**Residual volume:** The amount of air left in the lungs after a most forceful exhalation. (See tidal volume).

**Resolving power:** The capacity of a microscope to visually separate two objects which are close together. The resolving power of an electron microscope is much greater than that of a light microscope, so that the former instrument enables much finer detail to be observed.

**Resource:** Any environmental factor which is required for survival of

a particular organism, e.g. water, oxygen.

**Respiration:** The chemical breakdown of organic matter, often glucose, in order to release energy. Respiration takes place in cells.

**Respiratory organ:** A structure through which oxygen is obtained and carbon dioxide lost in an animal, e.g. gills, lungs, trachea (insects), skin (amphibians).

**Retranslocation:** The movement in phloem of stored nutrients from the roots, stems or leaves to other parts of a plant for use in those parts. (Especially movement of stored sugar in the roots or stem to the site of growing tissue in the leaves before they become photosynthetically active.)

**Rhizome:** A horizontal stem which either grows on the surface of the soil or just underground. Rhizomes provide a means by which the plant spreads and undergoes asexual reproduction as parts break away from the original parent plant.

**Ribosome:** An organelle, which is either attached to the endoplasmic reticulum or free in the cytoplasm, on which protein synthesis occurs.

**Rickets:** A deficiency disease caused by a lack of sufficient vitamin D in children. The bones are soft and often deformed.

**Rickettsias:** Tiny bacteria which live and reproduce only inside other cells.

**Risk assessment:** To determine before conducting a new experiment the dangers involved in order to plan to minimize them for the safety of all involved.

**Root:** That part of a vascular plant which is normally under the soil and which absorbs water and mineral nutrients for the plant. It also anchors the plant and may store food and minerals.

**Root hair:** A specialised root epidermal cell found in vascular plants which has an elongated process, which increases its surface area for the absorption of water and minerals from the soil.

**Root nodule:** A swollen lump of tissue on a root which may contain nitrogen-fixing bacteria.

**Root pressure:** The pressure that pushes water a small distance up the xylem from the lower end near the roots. Minerals are actively transported into the xylem from the root cells. Their presence there causes water to move by osmosis into the xylem this creates the root pressure.

**Ruminant:** A mammal herbivore which has a specialized stomach where the ingested plant matter is fermented

before being digested. Ruminants regurgitate food from the stomach and further chew it so that it can be more completely digested, e.g. cattle, sheep and goats.

**Runner:** (See Rhizome).

**SI units:** The internationally agreed set of units which uses decimals and includes seconds, metres and kilograms.

**Saline:** A solution containing salt, e.g. sea water.

**Salinity:** A measure of the salt concentration.

**Salt marsh:** A swampy area close to the ocean which has high salinity levels because it is flooded at high tide.

**Salt:** Sodium chloride or any inorganic compound which forms ions in solutions.

**Sample:** A small part of a population intended to show what the whole (of a population) is like.

**Sapling:** A young tree, generally not more than 2 metres tall.

**Saprophyte:** A fungus which breaks down dead organic matter.

**Saturated:** A solution which is unable to dissolve any more solute without added solvent or a change in the temperature.

**Savannah:** A community of grasses in tropical and subtropical areas. Trees are sparsely distributed and the plants are generally well adapted to dry conditions.

**Scale:** A thin flat structure covering animals like fish and reptiles and some insects.

**Scavenger:** An animal which feeds on the dead remains of others.

**Scurvy:** A disease caused by a deficiency of vitamin C in the diet. Symptoms include skin sores and bleeding gums.

**Seaweed:** Any one of many large algae which live in the ocean.

**Secondary growth:** Cell division which occurs in the vascular cambium between xylem and phloem. This causes the thickening of the stem and roots.

**Secondary succession:** Succession that occurs when an existing community is disturbed.

**Seed:** The structure in angiosperms and gymnosperms which contains the embryonic plant.

**Seedling:** The young plant.

**Selectively-permeable:** (see semi-permeable)

**Semi-permeable:** Permeable to some particles but not to all, e.g. cell membranes. Alternatively called selectively, differentially or partially permeable.

**Sepal:** A petal-like structure which helps protect the flower bud.

**Sex:** Classification which indicates the type of gamete produced. If motile, small gametes are produced, the organism is referred to as male. Larger non motile, (i.e. cannot propel themselves) gametes are produced by females.

**Sieve element:** A living cell which helps form the vessel in phloem tissue through which sugar and other organic materials are transported. It does not contain a nucleus but does contain other organelles. It is connected to cells above and below by cytoplasmic strands which pass through pores in the cell walls they share. A cell attached to one side called a "companion cell" contains a nucleus which is believed to control the sieve element's activities.

**Sieve plate:** The common wall between adjacent sieve elements which contains pores through which cytoplasmic strands pass from one sieve element to the next.

**Sieve tube:** A chain of sieve tube elements arranged end to end to form a long conduction vessel, which carries sucrose, amino acids and some other organic compounds in the vascular tissue.

**Single species conservation:** A single species is targeted for conservation. This approach may have positive effects on other associated species.

**Small intestine:** Part of the digestive tract between the stomach and the large intestine, where much of the chemical digestion and absorption of food takes place.

**Soil:** The layer of smaller weathered particles of rock in which plants grow. It contains organic matter (humus) formed from the remains of dead organisms, water, minerals, air and micro-organisms.

**Soluble:** A substance that dissolves.

**Somatic cell:** A body cell other than a gamete e.g. a red blood cell, a muscle cell.

**Spatial succession:** The change in species structure that occurs from one point in an environment to another point.

**Specialised:** Structurally developed to carry out a particular function.

**Species:** A group of organisms which are interbreeding in their natural environment and producing viable offspring or a group of organisms that

are structurally and functionally very similar.

**Species diversity:** This refers to the numbers of different species within an ecosystem.

**Sphincter:** A ring of muscle which closes a tube.

**Spiracle:** A pore leading into the body, branching until they form finer tubes for the delivery of oxygen to the interior cells of insects.

**Spongy mesophyll:** Photo-synthetic cells which generally lie below the palisade mesophyll cells in a leaf. Large air spaces between these irregular shaped cells allow gases to diffuse rapidly within the leaf.

**Stamen:** Male part of a flower being made up of the filament and the anther.

**Starch:** A carbohydrate consisting of a long chain of glucose molecules. Starch is sparingly soluble and therefore is a form in which glucose is stored in plant cells. It does not increase the osmotic pressure in the cell to the extent that glucose will.

**Stem:** That part of a plant which supports the leaves and contains vascular tissue for transport between the roots and leaves. The stem may be woody or herbaceous.

**Stoma (Plural – stomata):** An opening or pore for gas exchange in the epidermis of a leaf or stem which is created by two guard cells.

**Stomate:** Alternative name for stoma.

**Stroma:** The fluid part of a chloroplast outside the thylacoids; where the light-independent stage of photosynthesis occurs.

**Structural adaptation:** A physical part of an animal or plant which is inherited and assists it to survive and reproduce in its particular environment e.g. webbed feet of a duck, extensive root system of a desert plant.

**Style:** Female part of the flower in which pollen grows down to the ovary. It connects the stigma to the ovary.

**Subspecies:** A race. A group of organisms which shares common features and is marginally different from other populations of the same species.

**Substrate:** In ecology this refers to the surface on which an organism lives. It may be living or non-living.

**Succession:** A series of changes which occurs when plants and animals colonize a new area. There is a general increase in biodiversity and complexity with time, until a 'climax' community becomes established.

**Succulent fruit:** A soft swollen ovary wall or receptacle of a flower which enclosed the seeds, e.g. apple or orange.

**Succulent plant:** A plant which has water storing cells in either or both its leaves and stem. This is a xerophytic adaptation.

**Sucrose:** A disaccharide consisting of the two monosaccharides glucose and fructose. This is the sugar often added to tea and coffee to sweeten their taste. It is also the form in which glucose is normally transported in the phloem.

**Sugar:** A sweet tasting carbohydrate, e.g. sucrose, glucose.

**Superior ovary:** When the petals and sepals are attached below the ovary.

**Sustainable:** An activity involving a natural community which can be maintained without affecting the viability of the community's populations of organisms.

**Swamp:** An area of land covered either permanently or periodically by still water.

**Symbiosis:** The living together of two organisms of different species. Parasitism, mutualism and commensalism are all symbiotic relationships.

**Synthesise:** To make. Anabolic reactions are synthesis reactions because new types of compounds are made.

**System:** A group of organs which together carry out a major function (or major functions) within the body, e.g. nervous system.

**Systole:** The phase in the cardiac cycle in which the heart muscles contract. When the ventricles undergo systole, blood is forced into the pulmonary arteries and the aorta.

**Tadpole:** The larval stage of the frog and toad. It is aquatic, a herbivore, has gills and a tail. As it metamorphoses it loses its tail and gills and develops legs and lungs.

**Talon:** A predatory bird's claw.

**Taxonomy:** The science of classifying organisms.

**Temporal succession:** The change in species structure or communities that occurs in an area over time.

**Terrestrial:** Living in or on land.

**Theory:** A hypothesis for which supporting evidence has been obtained but which needs more evidence for it to be accepted generally as a law.

**Thylakoid:** A membrane bounded sac which has chlorophyll and other photosynthetic pigments on its outer surface. The pigments absorb light

energy which is used in the light dependent stage of photosynthesis that occurs in the inner part (the lumen) of the sac.

**Tidal Air:** The volume of air which is breathed in and out in a single breath under normal conditions.

**Tidal Estuary:** The region at the mouth of a river which is influenced by the tides.

**Tissue:** A group of similar cells which together perform a particular function. Organs are composed of two or more tissues.

**T Lymphocyte:** A white blood cell that produces chemicals which stimulate the activity of other types of white blood cells and thereby assists in the elimination of particular invading micro-organisms in the body. Alternatively called a T cell. (See B Lymphocyte).

**Tolerance:** The extent to which an organism can survive change in an environmental factor, e.g. a particular bacterium may only live in water which has a temperature range of 10° – 30°C. Outside this range is beyond the tolerance of this bacterium.

**Toxin:** A poisonous substance produced by an organism, particularly a micro-organism.

**Tracheal system:** A network of tubes, found in insects, which delivers oxygen and removes carbon dioxide from the body cells. It has body openings called spiracles which lead into trachea which branch into smaller tubes called tracheoles. The tracheoles are fluid filled near their tips. Oxygen dissolves in this fluid and passes directly by diffusion to the cells.

**Trace element:** An element which is required for normal growth which is needed in only very tiny quantities. (See micronutrient).

**Trachea:** Part of the respiratory system. In vertebrates it is a tube which carries air from the pharynx to the bronchi. In insects trachea extend from the spiracles (pores) into the body, branching until they form finer tubes for the delivery of oxygen to the interior cells.

**Tracheid:** A specialised dead cell which together with other tracheids forms a tube through which water passes from the roots to the leaves in ferns and gymnosperms. Tracheids are elongated cells with tapered ends which overlap. Where they overlap pits occur which allows water to pass from cell to cell. These cells carry out a similar function to xylem.

**Tracheophyta:** A vascular plant. The phylum Tracheophyta includes flowering plants, conifers and ferns.

**Transect:** A line or strip along which the distribution of organisms is plotted.

**Translocation:** The movement of sugar and other materials from the leaves to other parts of the plant (roots or stem) via the phloem vessels.

**Transpiration stream:** The flow of water in xylem vessels from the roots through the stem, into the leaves (and out through the stomata).

**Transpiration:** The loss of water by evaporation from the leaves (or stem) of a plant.

**Transport system:** Collection of cells and organs which move substances around the internal environment of an organism e.g. vascular system in plants, circulatory system in mammals, tracheal system in insects.

**Treeline:** Altitude at which trees cease to grow on a high mountain or the latitude (as the poles are approached) at which trees cease to grow.

**Trophic level:** The position of an organism in a food chain, e.g. the trophic level of a producer is at the beginning of the food chain.

**Turbidity:** Refers to the clarity of water. How clear the water is depends on the concentration of dissolved solutes and the size and amount of suspended particles in the water.

**Turgid:** Refers to a cell which is filled with water. Plant cells become turgid when surrounded by distilled water but do not lyse (burst) because their cell wall prevents this from occurring. (cf. flaccid).

**Ultrastructure:** Parts of a cell which cannot be seen with the aid of a light microscope but only become visible if an electron microscope is used, e.g. double membranes and pores of the nucleus.

**Ultraviolet light (UV):** Electro-magnetic radiation with a wavelength which is shorter than visible light and therefore cannot be detected by human eyes.

**Umbel:** A flower type in which the small flowers are arranged such that many small flowers branch from a single stem and form a dense cluster.

**Unicellular:** Single-celled, e.g. Amoeba, bacteria.

**Urea:** An organic compound, formula CO(NH<sub>2</sub>)<sub>2</sub>, which is a waste product of the breakdown of excess amino acids in mammals. This nitrogenous metabolic waste is toxic and is excreted by the kidneys. It is soluble in water.

**Urethra:** A tube which carries urine from the bladder to the external environment. In males it also conducts semen during an ejaculation.

**Ureotelic:** An animal which excretes most of its nitrogenous waste as urea e.g. mammals, frogs, sharks, crocodiles, turtles.

**Uric acid:** A sparingly soluble, non toxic solid which is a nitrogenous waste. Reptiles, birds and many invertebrates excrete nitrogenous wastes as uric acid (formula is C<sub>5</sub>H<sub>4</sub>N<sub>4</sub>O<sub>3</sub>).

**Uricotelic:** An animal which excretes most of its nitrogenous waste as uric acid e.g. birds, snakes, lizards, snails, insects.

**Urine:** The liquid waste produced by the kidneys. Urine generally contains water, urea, uric acid, excess minerals, salts and hormones.

**Vacuole:** A membrane (tonoplast) bounded sac found in the cell's cytoplasm which stores water and minerals, pigments, starch, sugars or wastes. Animal vacuoles (called vesicles) are smaller than plant vacuoles.

**Valid experiment:** One that is soundly designed with the use of a control.

**Variable:** A factor which can change, e.g. temperature.

**Variation:** A feature or characteristic which is different within a species. Variation in the offspring of sexually reproducing organisms is greater than that found in the offspring of asexually reproducing organisms.

**Vascular:** Referring to the tubes which carry materials within the organism, e.g. the circulatory system in vertebrates is made up of vascular tissue and the phloem and xylem vessels in plants are vascular tissue.

**Vascular bundle:** A group of xylem and phloem vessels clustered together with fibre cells found in the roots, stem and leaves of higher terrestrial plants. Sometimes referred to as veins in plants.

**Vascular system:** The circulatory system in vertebrates or the phloem and xylem in plants.

**Vasoconstriction:** The reduction in the diameter of blood vessels which reduces blood flow through them.

**Vasodilation:** The increase in the diameter of blood vessels which increases blood flow through them.

**Vector:** An intermediate host which transfers pathogens from one organism to another.

**Vegetative reproduction:** A type of asexual reproduction where part of a parent plant produces a new plant, without the fusion of gametes, i.e. cuttings.

**Vein:** A blood vessel which returns blood to the heart. Vascular tissue in plants is sometimes called a vein.

**Ventilation:** Moving air or water containing oxygen over the respiratory surface so that gaseous exchange can occur.

**Venule:** A very small vein which connects blood capillaries to a vein.

**Vertebra (Plural – vertebrae):** A segment of the backbone which protects the spinal cord and provides anchorage for muscles.

**Vertebrata:** A Sub-phylum of Chordata in which the notochord, present during embryonic development, becomes the bones which form the vertebrae, e.g. fish, amphibians, reptiles, birds and mammals.

**Vesicle:** A small vacuole found in animal cells.

**Vessel:** Any tube-like structure which carries fluid.

**Viable:** Having the potential to mature and produce healthy offspring.

**Villus (Plural – villi):** A microscopic finger-like projection from the small intestine which absorbs nutrients from the digested food in the digestive tract. Villi increase the total surface area of the small intestine.

**Virtual dissection:** A dissection that is not of the real animal or plant. It may be conducted on a lifelike model, by using computer images or by watching videos.

**Waste:** A substance which is present in the body but which is not required and may become harmful if allowed to accumulate. It is therefore eliminated in the urine, faeces, expired air or sweat.

**Water cycle:** The flow of water through an ecosystem, e.g. water may evaporate from the sea, form clouds, be precipitated as rain onto the land, flow back into the sea.

**White blood cell:** A leucocyte.

**White-tailed Black cockatoo:** Two closely related species of black cockatoo which are very similar and live in the south-west of W.A. They are the Long-billed (Baudin's) and the Short-billed (Carnaby's). Both species are classified as endangered.

**Wood:** Old lignified xylem vessels which make up the bulk of a tree or stem of a shrub.

**Woodland:** A community with more open, more sparsely populated plants and animals. The plants are generally lower; the trees are spaced apart more. A popular woodland definition requires the shade of trees to be less than 30% at midday in summer.

**Xeromorph:** A plant which is adapted to survive almost total dehydration, e.g. some plants which live in very dry areas.

**Xerophyte:** A plant which is adapted to live in a dry environment. It may have reduced leaf size, phyllodes instead of leaves, stomata on only one side of the leaf, water storage cells, leaves reduced to spines, thick waxy cuticle, extensive root system, mallee form of growth. (cf. halophyte and xeromorph).

**Xylem:** Dead cells which stand end to end with their common upper and lower cell walls missing. The column forms a straw-like structure. Water and minerals pass up this vessel from the roots to the leaves in vascular plants.

**Yeast:** A type of single-celled fungus. Yeast reproduces asexually by budding.

**Zoology:** The scientific study of animals.

**Zooplankton:** The microscopic animals which together with phytoplankton live and drift near the surface of the water in oceans and lakes.

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