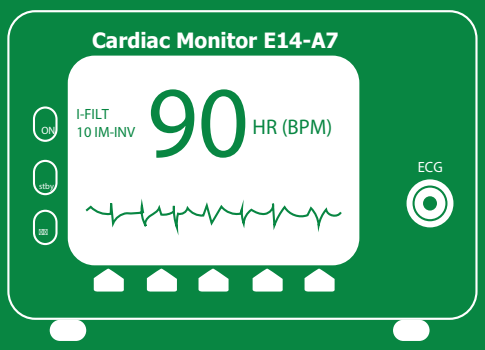
Year 11 General Human Biology
Unit 2 Workbook



Maintaining Healthy Body Systems

Student name: _____

Class: _____ **Teacher:** _____

STAWA
SCIENCE TEACHERS' ASSOCIATION OF WESTERN AUSTRALIA

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CONTENTS

Structure and use of general Human Biology resources

General information for teachers and students

This resource has been produced to support teachers and students in the absence of a textbook for this course. Each chapter corresponds to the topics outlined in the Science Understanding strand of the syllabus, with Science Inquiry and Science as a Human Endeavour incorporated where appropriate. The *Syllabus Dot Points* are included, and *Learning Intentions* and *Success Criteria* are provided so that teachers and students have a clear understanding of exactly what is expected to learn. Please note that these are suggestions from the writers only. Teachers and students are encouraged to formulate their own success criteria as part of the learning process.

Teachers should not use this book as their sole source of information and resources. This is a guide and provides some further resources to explore such as websites and educational films. Once again these are suggestions only. Practical activities are included in each chapter. These may include experiments, dissections, and interpretation of second-hand data. Safety issues have been highlighted where applicable. Teachers do not have to use all of the activities. These are suggestions but should be able to be completed even with somewhat limited resources. Students are encouraged to formulate their own tables for data collection and presentation, as well as practicing their graphing skills. There are several opportunities for students to draw labelled scientific diagrams.

Students should use this book as a source of essential information covering the syllabus dot points, but should seek other resources for greater depth of understanding. A glossary at the beginning of each chapter provides a list of key terms that students should define as they progress through the text. Students are encouraged to write their own notes using the *'Checkpoints'* as a guide. Some Checkpoint questions enable students to write answers in this book, but they are encouraged to write their own notes for revision. These have been included following each section of text information to enable students to consolidate their understanding of the key concepts and summarise the key points. *Chapter Review Questions* are found at the end of each chapter and should be answered by students in their notebooks as revision for each topic. There are *'Extras for Experts'* for students who want to check their depth of understanding of some concepts outlined in the chapter.

Glossary of key words used in the formulation of questions

Note – definitions in the glossary available from SCSA website syllabus documents are generic and applicable across all courses. Students should be aware of the meaning of the terms so as to be able to understand the questions asked in the book.

Word key	Definition
Account	Account for: state reasons for, report on. Give an account of: narrate a series of events or transactions
Advise	Recommend or inform
Analyse	Identify components and the relationship between them; draw out and relate implications
Apply	Use, utilise, employ in a particular situation
Assess	Make a judgement of value, quality, outcomes, results or size
Calculate	Ascertain/determine from given facts, figures or information
Choose (multiple-choice)	Decide or select the most suitable from a number of different options
Clarify	Make clear or plain
Classify	Arrange or include in classes/categories
Comment on	Make reference to and expand upon
Compare	Show how things are similar and different
Complete	Finish an outlined task
Consider	Reflect on and make a judgement/evaluation
Construct	Make; build; put together items or arguments
Contrast	Show how things are different or opposite
Correlate	Demonstrate a mutual or complementary relationship
Create	Make, invent something
Deduce	Draw conclusions
Define	State meaning and identify essential qualities
Demonstrate	Show by example
Describe	Provide characteristics and features
Determine	Decide, find out
Discuss	Identify issues and provide points for and/or against
Distinguish	Recognise or note/indicate as being distinct or different from; note differences between
Draw (diagrams etc.)	An instruction, as in *draw a circle*
Evaluate	To ascertain the value or amount of; appraise carefully
Examine	Inquire into

Word key	Definition
Explain	Relate cause and effect; make the relationships between things evident; provide why and/or how
Explore	Investigate, search for or evaluate
Extract	Choose relevant and/or appropriate details
Extrapolate	Infer from what is known
Identify	Recognise and name
Illustrate	Similar to 'explain' (see above), but requires the quoting of specific examples or statistics or possibly the drawing of maps, graphs, sketches, etc.
Interpret	Draw meaning from
Investigate	To plan, search or inquire into; examine in order to obtain the true facts
Justify	Support an argument or conclusion; give reasons for your statements or comments
Label (and annotate)	Identify by placing a name or word used to describe the object or thing
List	Provide a series of related words, names, numbers or items that are arranged in order, one after the other
Name	Provide a word or term used to identify an object, person, thing, place etc. (something that is known and distinguished from other people or things)
Outline	Sketch in general terms; indicate the main features of
Predict	Suggest what may happen based on available information
Propose	Put forward (for example, a point of view, idea, argument, suggestion) for consideration or action
Recall	Present remembered ideas, facts or experiences
Recount	Retell a series of events
Respond to...	Provide an answer; reply
Select	Choose somebody or something from among several
Show	Give information; illustrate
Sketch	A picture or diagram that is done quickly, roughly; a brief outline
State	Express the main points of an idea or topic, perhaps in the manner of 'describe' (see above)
Summarise	Express, concisely, the relevant details

Unit 2

Unit description

The focus of this unit is on the importance of regular health checks to prevent or manage medical problems.

The circulatory, respiratory and urinary systems facilitate the exchange, transport and removal of materials for efficient body functioning. Regular health checks can assess the risk of future medical issues and monitor current medical problems for the development of individual treatment plans in order to improve quality of life.

Students investigate blood pressure, heart rate, blood oxygen levels and lung capacity through practical activities. They explore the circulatory, respiratory and urinary systems through real and virtual dissections. Students analyse data from blood and urine samples to detect anomalies. They are encouraged to use information and communication technology to gather and interpret data, and communicate their findings in a variety of ways.

Unit content

Each unit includes the knowledge, understandings and skills described below.

Scientific Method

- Research a given topic and construct questions for investigation.
- Determine the appropriate methodology for investigations.
- Design scientific investigations, including the formulation of investigable questions and/or hypotheses, materials required, procedure to be followed to collect valid and reliable data, and identification of safety and ethical considerations.
- Conduct risk assessments to identify potential hazards and prevent potential incidents and injuries.
- Use equipment and techniques safely, competently and methodically for the collection of valid and reliable data, and use equipment with precision, accuracy and consistency.
- Represent qualitative and quantitative data in meaningful and useful ways, including the construction of appropriately labelled tables, process quantitative data using appropriate mathematical relationships and units, and draw appropriate graphs.
- Analyse data to identify and describe trends, patterns and relationships, including the use of appropriate mathematical techniques, and recognise errors and limitations in data.

- Draw conclusions consistent with the evidence and relevant to the question being investigated, identify further evidence that may be required, and recognise the limitations of conclusions.
- Evaluate the investigative procedure, including the relevance, accuracy, validity and reliability of data, and suggest improvements.
- Communicate information and ideas in a variety of ways using scientific conventions and terminology, including the selection and presentation of data and ideas to convey meaning to selected audiences in written, oral and multimedia formats.

Scientific literacy

- Distinguish between opinion, anecdote and evidence, and scientific and non-scientific ideas.
- Use reasoning to construct scientific arguments, and to draw and justify conclusions consistent with the evidence and relevant to the question under investigation.
- Identify examples of where the application of scientific knowledge may have beneficial, harmful and/or unintended consequences.

CHAPTER 1

Health Checks & Diagnosis

Syllabus dot points

- The purpose of regular health checks is to check for current or emerging medical concerns, assess the risk of future medical issues and prompt the maintenance of a healthy lifestyle.
- Undertaking regular health checks assists in the early detection of medical problems and increases the chances for effective treatment.
- Diagnosis of a medical problem leads to the development of individual treatment plans.

The Learning Intentions and Success Criteria are included as a guide to understanding expectations of students as outlined in the syllabus. Students could use them to review their understanding of the syllabus prior to assessments.

Learning intentions

1. Understand that regular health checks enable the early detection of medical issues.
2. Understand that early detection of medical issues enables prompt treatment and re-evaluation of lifestyle choices.
3. Understand that the use of various diagnostic techniques can result in accurate personalised treatment plans to improve health outcomes.

Success criteria

Be able to:

- Describe the common health checks available to people, such as blood tests and monitoring of blood pressure.
- Identify and describe the common medical issues that health professionals frequently check for and diagnose such as hypertension, diabetes, cancer and nearsightedness.
- Explain why some medical issues should be checked for and assessed more frequently than others and provide examples.
- Explain how regular health checks assess the risk of future medical issues.
- Provide examples of medical issues that can be diagnosed as future risks.
- Explain how regular health checks prompt the maintenance of a healthy lifestyle.
- Explain how regular health checks increases the chances for effective treatment.
- Explain how the diagnosis of medical problems can lead to the development of individual treatment plans.

Key terms

Identify and fill in the definitions for the following key terms:

Key term	Definition
Artery	
Atherosclerosis	
Blood	
Blood pressure	
Blood test	
Bowel cancer	
Breast cancer	
Cardiovascular disease	
Cholesterol	
Heart	
Heart failure	
Heart rate	
Hypertension	
Infection	
Melanoma	
Obesity	

Key term	Definition
Osteoporosis	
Platelet	
Prostate cancer	
Sphygmomanometer	
Stethoscope	
White blood cells	

Life processes

Introduction

Regular health checks play a vital role in safeguarding our well-being and ensuring we lead healthy lives. The significance of these check-ups goes beyond simply monitoring our current health status. They serve as proactive measures to identify both existing and potential medical concerns, mitigate future risks, and encourage the adoption of a healthy lifestyle.

This chapter delves into the purpose of regular health checks, highlighting the importance of staying proactive in detecting medical conditions, understanding the potential risks we face, and emphasising the importance of maintaining a healthy lifestyle for overall well-being. By exploring the various dimensions of health monitoring, this chapter aims to highlight the significance of regular health checks in promoting lifelong health and preventing the onset of serious medical issues.

Checkpoint

State two reasons for having regular health check ups.

_____

_____

Types of health checks

Regular health checks play a vital role in the early detection of medical problems, leading to more effective treatment. By conducting routine tests and screenings, healthcare professionals can spot any potential health issues before they escalate into more severe conditions. These check-ups monitor important indicators such as blood pressure, cholesterol levels, and blood sugar levels, which can provide early warning signs for conditions like hypertension, diabetes, or heart disease. Additionally, health checks may include cancer screenings, such as mammograms or colonoscopies, that can identify tumours or abnormal growths at an early stage when treatment options are more successful. Regular health checks empower individuals to take proactive measures for prevention, make necessary lifestyle adjustments, and initiate timely treatment, greatly increasing the chances of successful outcomes.

Checkpoint

Name three common checks that can provide early warning signs for disease:

1. _____ _____

2. _____ _____

3. _____ _____ _____

Name three conditions that can be detected by the three health checks you identified:

1. _____

2. _____

3. _____ _____

Blood tests

Blood tests are an essential tool used in the field of medicine for diagnosing various medical conditions. They provide valuable information about the overall health status of an individual, including identifying potential diseases, monitoring existing conditions, and evaluating the effectiveness of treatment plans. Some common blood tests are outlined below.

Full blood count (FBC)

The FBC is one of the most commonly performed blood tests. It provides information about the cellular components of the blood, including red blood cells, white blood cells, and platelets. Abnormalities in these components can indicate underlying health conditions. For example:

- Low red blood cell count (anaemia) suggests potential causes such as iron deficiency, vitamin B12 deficiency, or kidney problems.
- Elevated white blood cell count can indicate the presence of an infection or inflammation.
- Low platelet count may signify a bleeding disorder.

Blood chemistry tests

Blood chemistry tests measure various substances present in the blood, including electrolytes, enzymes, hormones, and metabolites. These tests help assess organ function and detect abnormalities related to liver, kidney, heart, and endocrine systems, among others. Common blood chemistry tests include:

- Liver Function Tests: Evaluate liver enzymes, bilirubin, and proteins to assess liver health and identify conditions such as hepatitis, fatty liver disease, or liver damage caused by medications.
- Kidney Function Tests: Measure creatinine, blood urea nitrogen, and electrolytes to assess kidney function and detect problems like kidney failure or urinary tract infections.
- Lipid Profile: Measures cholesterol, triglycerides, and other fats to evaluate the risk of developing cardiovascular diseases.
- Blood glucose concentrations: Measures concentrations of glucose in the blood, usually after fasting to evaluate the risk of developing diabetes and other diseases associated with obesity and diabetes.

Immunological tests

These blood tests evaluate the functioning and response of the immune system. They are used to diagnose and monitor conditions related to autoimmune diseases, allergies, and infections. Examples include:

- Antinuclear Antibody (ANA) Test: Detects antibodies associated with autoimmune diseases like systemic lupus erythematosus (SLE) or rheumatoid arthritis (RA).
- Allergy Testing: Measures specific antibodies in response to known allergens to identify allergic conditions like hay fever or food allergies.

Infectious disease testing

Blood tests are crucial for diagnosing infectious diseases caused by bacteria, viruses, parasites, or fungi. Examples include:

- Human Immunodeficiency Virus (HIV) Test: Detects the presence of antibodies against HIV to diagnose HIV infection.

Overall, blood tests provide valuable insights into an individual's health status. They play a vital role in diagnosing medical conditions, guiding treatment decisions, and monitoring the effectiveness of therapies. However, it's important to note that blood tests are just one component of a comprehensive diagnostic process, and their interpretation should be done by qualified healthcare professionals in conjunction with other clinical information.

Checkpoint

Describe the types of blood cells being monitored in a Full Blood Count (FBC):

_____

_____

_____

State five diseases that can be detected by having a blood test.

1. _____

2. _____

3. _____

4. _____

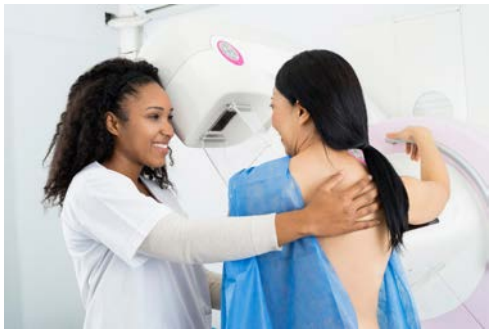
5. _____

Diagnosis of cancer

Diagnosing common cancers such as breast cancer, prostate cancer, skin cancer, and bowel cancer often involves a combination of various techniques. Some of the techniques commonly used in the diagnosis of these cancers are described here.

Breast cancer

- Physical Examination: A healthcare provider performs a thorough physical examination of the breasts, checking for any lumps, changes in size or shape, or skin abnormalities.
- Mammography: This is an X-ray imaging technique used to detect abnormalities in the breast, such as lumps or calcifications.
- Ultrasound: A breast ultrasound uses sound waves to create images of breast tissue and can help distinguish between solid masses and fluid-filled cysts.
- Magnetic Resonance Imaging (MRI): In some cases, an MRI scan may be used to obtain detailed images of the breast tissue, providing more information about the size and location of any abnormalities.
- Biopsy: If an abnormality is detected, a biopsy is performed to obtain a tissue sample for analysis. Different biopsy techniques such as core needle biopsy or surgical biopsy may be used.



The photo (above right) shows a woman undergoing a mammogram using the special machine that provides detailed images of the breast tissue.

The photo (right) shows a radiographer checking the mammogram images.

Prostate cancer

- Digital Rectal Examination (DRE): In a DRE, a healthcare provider manually examines the prostate gland by inserting a lubricated, gloved finger into the rectum to feel for any abnormalities in the gland.
- Prostate-Specific Antigen (PSA) Test: This blood test measures the levels of PSA, a protein produced by the prostate gland. Elevated PSA levels could indicate prostate cancer.

Skin cancer

- Visual Inspection: A dermatologist examines the skin using the naked eye, looking for any suspicious moles, lesions, or growths.
- Dermoscopy: Dermoscopy involves using a handheld instrument called a dermatoscope to visualize the skin at a higher magnification. It helps identify specific structural features of skin lesions more accurately.
- Skin Biopsy: If a suspicious area is found, a skin biopsy is conducted to remove a sample of the lesion for further examination under a microscope. Different biopsy techniques like shave biopsy, punch biopsy, or excisional biopsy may be used.

Bowel cancer

- Faecal Occult Blood Test (FOBT): A FOBT is a simple test that checks for hidden (occult) blood in the stool, which might indicate the presence of bowel cancer or other conditions. In Australia, all people over the age of 50 are provided with a Bowel Cancer Test Kit. This helps to detect the cancer early and decreases the chance of death.
- Colonoscopy: In a colonoscopy, a flexible tube with a camera (colonoscope) is inserted through the rectum to visualize the entire colon. It helps detect polyps or abnormal growths that could be cancerous.

Do the test! - Cancer Council WA (cancerwa.asn.au)

It is important to note that the exact diagnostic techniques may vary depending on the healthcare professional, the specific symptoms, and the stage of cancer suspected. Regular screenings and prompt consultation with a healthcare professional are crucial for early detection and diagnosis of these common cancers.

Checkpoint

Describe the tests available to diagnose breast cancer:

_____

_____

State the meaning of ‘faecal occult blood’.

_____

Diagnosis of cardiovascular disease

Regular check-up processes for detecting cardiovascular disease typically involve a combination of medical history assessment, physical examination, diagnostic tests, and cardiovascular risk assessment tools. Doctors can measure blood pressure and heart rate in their surgery, as well as listening to heart rhythms. These and other diagnostic tools are described below.

Medical History Assessment: Medical professionals gather detailed information about the patient's personal and family medical history. This includes asking about risk factors such as smoking, obesity, hypertension, diabetes, high cholesterol, and a sedentary lifestyle.

Physical Examination: A comprehensive physical examination is conducted, focusing on cardiovascular health. This may include measuring blood pressure, checking for signs of heart disease like abnormal heart sounds (murmurs), irregular heartbeats (arrhythmias), or fluid retention (swelling or oedema).

Blood Tests: Various blood tests are performed to assess the risk factors and potential signs of cardiovascular disease. These tests may include lipid profiles.

Electrocardiogram (ECG): An ECG records the electrical activity of the heart, helping to identify abnormal heart rhythms (arrhythmias), heart muscle damage, and signs of a previous heart attack.

Photo: an ECG graph showing the heart rhythm of a patient. This machine also monitors heart rate and blood pressure.

Stress Tests: These tests evaluate heart function during physical stress. The most common type is the exercise stress test, where the patient walks on a treadmill or cycles on a stationary bike while ECG and blood pressure are monitored. Alternatively, medication may be used to simulate the effects of exercise in specific cases.

Cardiac MRI: Magnetic resonance imaging (MRI) uses powerful magnets and radio waves to produce detailed images of the heart. It helps evaluate heart structure, assess blood flow, and detect areas of heart damage or reduced blood supply.

Coronary Angiography: In this invasive procedure, a contrast dye is injected into the coronary arteries, and X-ray images are taken to visualize any blockages or narrowing in the arteries. It is usually performed when other non-invasive tests indicate significant heart disease.

It is important to note that the specific tests and their frequency may vary based on individual risk factors, age, gender, and overall health.

Use of scans for diagnosing medical problems

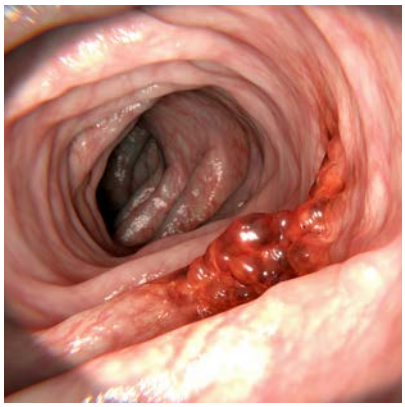
X-rays and scans are instrumental tools used in medical diagnosis to detect and identify various conditions and diseases. They provide detailed images of the internal structures of the body, allowing healthcare professionals to make accurate diagnoses. These tools are commonly used to detect damage to bones and joints, but can also be used to measure bone density to detect osteoporosis. Scans are used to diagnose brain and nervous systems diseases such as Alzheimer's disease. These tools are also used to detect tumours that diagnose cancer.

Activity: Body imaging journeys in inner space

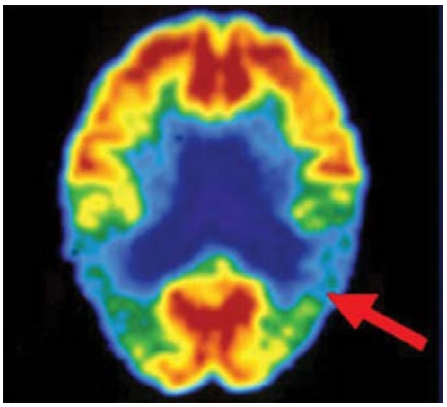
The second half of the 20th century saw fantastic developments in human exploration. At the forefront were the journeys humans made to the Moon, which represented truly significant advances in technology. Technological advances also enabled exploration of our own bodies to make similar leaps and bounds.

Today, a huge variety of imaging techniques are available to observe structure, function and dysfunction of the living body with out dissection to health professionals, such as surgeons, physiotherapists, sports scientists and other medical professionals. These techniques enable us to see the human body in a new light and, consequently, they influence decisions that are made about human health. Health professional need to have images of normal structures and functions to be able to recognise when dysfunctions occur. Here are some examples;

Endoscopy



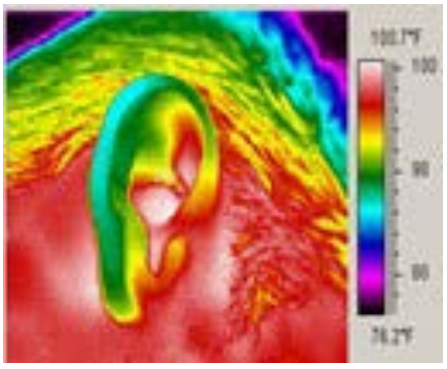
PET scan



MRI scan

X-Ray

Thermography

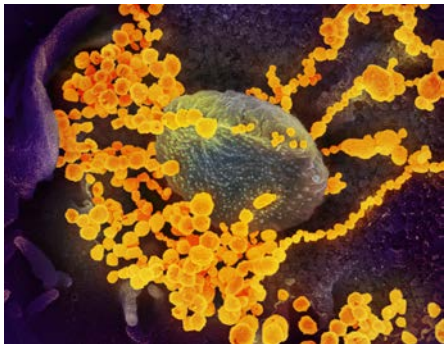


Ultrasound

Activity purpose

- To research the history of body imaging
- To increase your awareness of different imaging techniques,
- Understand why different techniques are used and
- Understand what information each technique provides for diagnoses of disease.

Electron microscopy



Materials

- Access to the Internet or library.

CT scan

Procedure

1. Find out when each of the eight imaging techniques were invented and applied to human disease diagnosis. Present this information as a timeline and use the timeline in your introduction.
2. Select any two of these imaging techniques to research (one from each list);

   List 1.
   - Endoscopy
   - PET scan (positron emission tomography)
     MRI scans (magnetic resonance imaging)

   List 2.
   - Thermography
   - Ultrasound
   - CT scans (computed tomography)
   - Electron microscopy

3. Make sure that your research allows you to write answers to these focus questions. You should also take advantage of what is available on the internet and use appropriately chosen images to illustrate what you are talking about.
   - What is involved in the imaging technique? What would it be like to experience having this technique used on yourself? If you have undergone any of these imaging techniques, you may like to use and explain your own images.
   - What can be "seen" in the images produced by this technique? Do the images show structures in the body, or processes that are happening, or both?
   - Why do doctors send patients to have this particular imaging? Where in Perth, or the region in which you live, can you get this kind of imaging done? If possible, find out the cost of the

procedure and how much you might get back from health insurance.
- How has the imaging technique improved our understanding of ourselves? What influence has it had in assisting decision-making for health professionals?
- How do your two chosen techniques compare? In what ways are they similar/different?

4. Presentation alternatives;
   - Poster: a large sheet of paper (about A3 – A2 size) with information in clear precise language plus diagrams and/or pictures that are linked clearly to your text.
   - PowerPoint presentation: You will need to produce around 20 slides that feature information in clear precise language plus diagrams and/or pictures that are linked clearly to your text.
   - Word document: At least 4 pages of size 12 font information that features information in clear precise language plus diagrams and/or pictures that are linked clearly to your text.

Eyes and ears

The need for testing eyesight and hearing arises because these two sensory functions are crucial for the overall well-being and quality of life of individuals. Problems related to eyesight and hearing can significantly impact daily activities, cognitive abilities, communication, and overall physical and mental health.

Eyesight testing

There are many reasons for testing eyesight, especially as people get older.

- **Vision problems:** Regular eye tests help detect problems such as myopia (nearsightedness), hyperopia (farsightedness), astigmatism, and presbyopia (age-related loss of near vision). Detecting these issues ensures appropriate corrective measures like glasses, contact lenses, or surgery can be prescribed.
- **Eye diseases:** Testing eyesight helps identify potential eye diseases such as glaucoma, cataracts, macular degeneration, diabetic retinopathy, and others. Early detection and intervention increase the chances of successful treatment and prevention of vision loss.
- **Monitoring eye health:** Regular eye exams allow monitoring and tracking changes in eye health, identifying potential risks, and preventing future complications.
- **Overall health indicators:** Eye examinations can sometimes reveal underlying health conditions like diabetes, hypertension, autoimmune diseases, or certain types of cancer.

Common types of eye tests include

- **Visual acuity tests:** The most common eye test, involving reading letters or numbers from a distance chart to assess the sharpness and clarity of vision.
- **Refraction tests:** Measures the refractive errors to determine the appropriate prescription for glasses or contact lenses.
- **Retinal examination:** Checks the back of the eye (retina), optic nerve, and blood vessels using specialized instruments.
- **Tonometry:** Measures intraocular pressure to screen for glaucoma.

Photo to the right: retinal examination can check for damage to blood vessels and other structures in the back of the eye.

Activity: Sight testing

Our eyes can focus on objects at various distances. This is called 'accommodation'. This ability varies as we get older or due to the differences between people.

Activity purpose

- To investigate the smallest distance at which you can focus clearly on an object (near point).
- To appreciate the range of vision in young adults.

Materials

per pair of students

- 1 m rule
- a white card (approximately 10 cm x 4 cm) with the letters A, E, I, O, U printed in black in size 20 font - or a piece of printed material of this size

Time required

- 60 minutes

Procedure

1. Hold the card about 3 cm from your eyes and gradually move it away until you can see the print clearly.
2. Have your partner measure the distance between the page and your eyes.
3. Hold the card at arm's length and slowly bring it towards your eyes until the print goes out of focus.
4. Draw up a suitable table to record your data.
5. Measure and record this distance.
6. Repeat steps 1 - 4 three times.
7. Calculate the average distance at which you focused clearly on the letters.
8. Follow the same procedure to calculate the average for your partner.
9. Collect average distance data from the other people in your class.
10. Calculate the average 'near point' for the people in your class.

Results

Questions

Compare your 'near point' measurement to the class average.

_____

_____

Calculate the range of 'near point' measurements. Why is there a range of measurements?

_____

_____

You may have noticed your parents, grandparents or older people in general often hold objects at arm's length when trying to read. As people get older the eye's muscles that control the ability to focus at close distances become weaker. The following data was collected from people in different age groups.

Age	Average "near point" distance
10	7.5
20	9.0
30	12.5
40	18.5
50	55.0
60	125.0

Graph this information:

Using your graph, estimate the average 'near point' distance for a:

15 year old? _____

45 year old? _____

70 year old? _____

How can the eye problem of changing 'near points' be treated?

_____

_____

Age increases 'near points' and decreases 'far points'. Describe how this would affect the vision of an older person.

_____

_____

Describe any factors that may change the rate at which the near and far points change.

_____

_____

_____

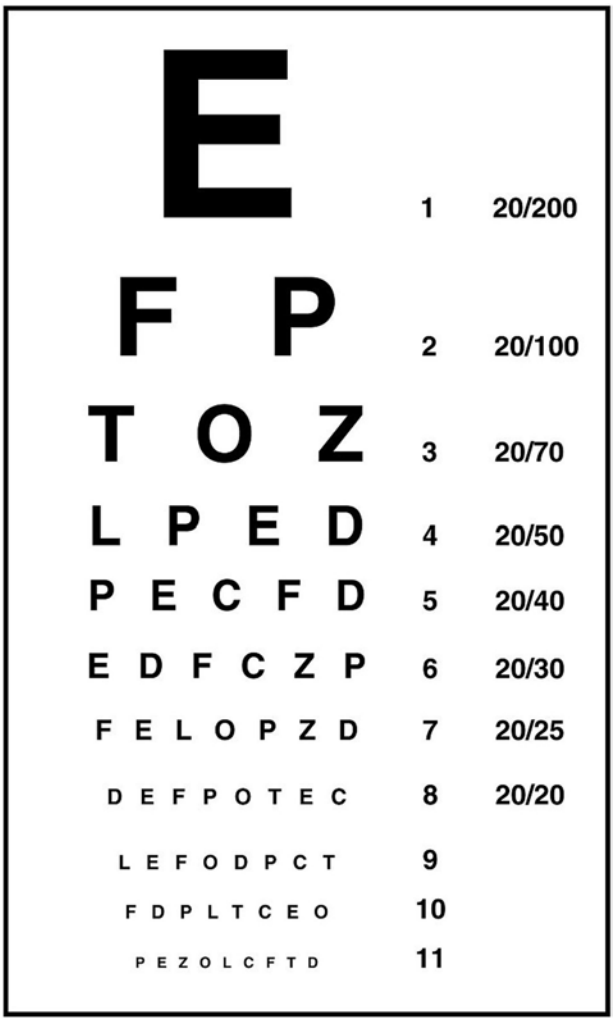
_____

Extension 1

People also have 'far points' - the furthest distance at which objects are clearly in focus. Design an investigation to measure 'far points'.

Extension 2

Test your eyesight using the standard Eye Chart.



Describe the role of the following specialists.

Optician _____

_____

Optometrist _____

_____

Optical technician _____

_____

Audiologist _____

_____

Name three other professions that are based on scientific understanding of sound and sight?

1. _____

2. _____

3. _____

Extension 3

List some industries that are high risk for eye safety.

_____

_____

_____

_____

_____

_____

Describe how high risk industries reduce the risk of eye injuries to their workers.

_____

_____

_____

_____

_____

_____

Hearing testing

As people get older the small bones in the middle ear and the ear membranes become stiff and don't conduct sound very well. Younger people may also suffer from hearing loss for many reasons including constantly listening to very loud music.

Reasons for testing hearing include:

- **Hearing loss detection:** Testing helps identify hearing loss, whether it's due to environmental factors, aging, genetic factors, or other health conditions.
- **Communication:** Adequate hearing is essential for comprehension, speech development, interpersonal interactions, and effective communication.
- **Diagnosis of underlying conditions:** Some hearing problems can be symptomatic of underlying medical conditions like infections, ototoxicity, autoimmune diseases, tumours, or age-related degeneration.
- **Early intervention and prevention:** Timely detection of hearing loss enables the implementation of interventions like hearing aids, assistive listening devices, or cochlear implants to minimize the impact on communication and overall quality of life.

Some common types of hearing tests include:

- **Pure-tone audiometry:** Measures the quietest sounds a person can hear at different frequencies to assess hearing thresholds.
- **Speech audiometry:** Evaluates a person's ability to perceive and understand speech at various volumes.
- **Tympanometry:** Measures the movement of the eardrum and middle ear to detect problems such as middle ear infections, blockages, or eustachian tube dysfunction.
- **Otoacoustic emissions (OAE) test:** Measures sound waves produced by the inner ear's hair cells in response to external stimuli, assessing the functioning of the inner ear. If the hair cells are damaged nerve deafness can result. This is the most common deafness due to being exposed to constant loud noises.

Activity: Hearing tests

What did you say??

Is it something to do with my hearing or the way that it was said???

Can you imagine your world without your ears? Would you miss the noise, the fuss, the nagging, the music?

Many students today have portable, personal sound systems that they plug into their ears and listen to loud music at concerts. Do these activities have any effect on your hearing? What is your hearing like now? How will you know if your hearing is getting better or worse? Our ability to locate sounds is based on the hearing ability of both of our ears. The sounds reach our ears at slightly different times. The brain is able to interpret the time difference to locate the source of the sound.

Activity purpose

- To investigate the ability to locate sound.

Materials

per small group

- blindfold
- tuning fork
- 1 m rule

Time required

- 45 minutes

Procedure

Organise the order in which your group members will be tested.

The following procedure is to be followed for each member of the group.

1. Member 1 is to sit on a chair in front of a desk. Make sure the person is always looking in the same direction - to the front.
2. Put the blindfold on Member 1.
3. Another group member is to stand about 2 - 3 m from the blindfolded person and strike the tuning fork. (It should be at various points around the student sitting on the chair.)

4. The blindfolded person is to point to where they think the sound is coming from.
5. The third member of the group is to record the accuracy of locating the sound using:
   0 - pointing straight at the sound
   1 - slight error (can use + and - to indicate left or right error)
   2 - major error.
6. These need to be discussed in your group to have a consistent recording of data.
7. The striker of the tuning fork needs to be careful to make sounds at random locations, not in a pattern.

Repeat the procedure for all members of the group.

Questions

Explain the need to make sounds at random locations?

_____

_____

_____

Compare the results from different people in your group.

_____

_____

_____

State the location of the sound that was the most difficult to locate accurately.

_____

Suggest how the results may differ with the type of sound used.

_____

_____

Explain why it is important for us to be able to locate sounds accurately.

_____

_____

_____

Diagnosis results in individual treatment plans

The diagnosis of a medical problem plays a vital role in the development of individual treatment plans. When a medical condition is accurately diagnosed, healthcare professionals can gain a deeper understanding of the underlying cause and nature of the problem. This knowledge allows them to tailor treatment plans to suit the specific needs of each patient. It also enables people to change their lifestyles to assist in their recovery and maintenance of good health. This could include changes to a healthier diet, more regular exercise and monitoring changes in their own bodies that may indicate medical problems.

By identifying the exact condition, medical practitioners can select appropriate treatment options, ranging from medications and surgeries to lifestyle changes and therapies. Diagnosis enables healthcare providers to assess the severity and progression of the disease, which guides them in designing a comprehensive and personalised treatment plan. Overall, the diagnosis of a medical problem acts as a crucial foundation for creating individualised treatment approaches that maximize the chances of successful outcomes and improved patient well-being.

Checkpoint

Describe all of the possible health check tools that could be used to detect the following medical problems:

Hypertension

_____

Reduced hearing in one ear

_____

Breast cancer

_____

Diabetes

_____

Chapter review questions

- State three reasons for having regular health check ups.
- Describe three types of health checks that doctors can use to diagnose health issues.
- Name and describe three checks that a doctor could use to diagnose cardiovascular disease.
- State three diseases that could be diagnosed using blood tests.
- Describe how regular health checks can lead to early diagnosis and better outcomes for patients.
- State the name of the diagnostic tool used to determine blood pressure.
- Describe three types of scans that could be used to diagnose cancer.
- Name the diseases that can be diagnosed using various eye tests.
- Explain why early diagnosis of diseases associated with the eyes is very important.
- Describe how people can protect themselves from developing deafness.
- Explain how individualised treatments provide better outcomes for people with specific diseases.
- Describe three changes that could be made to lifestyle that would assist in the maintenance of a healthy body.

Extras for experts

- Explain how the early diagnosis of cancer and individual treatment can result in better outcomes for the patient.
- Explain the advantages of early diagnosis and treatment of disease for individuals, health care facilities and governments.

"Activity: Hearing tests" extensions:

1. Repeat the investigation
   - with one ear covered or plugged.
   - with earphones and music.
   - in a quiet room compared to a noisy room.
2. Design an investigation that will demonstrate hearing sensitivity differences between people.
3. Find out about some industries that require workers to have hearing tests at regular intervals? Why is this required?
4. Describe activities that adolescents engage in that are high risk to hearing?

CHAPTER 2

Circulatory System

Syllabus dot points

- The transport of materials around the body is facilitated by the structures of the circulatory system.
- The structure of the heart facilitates the efficient flow of blood around the body.
- The blood vessels have specialised structures that enable efficient distribution of blood around the body.
- The blood is made up of plasma, blood cells (red and white) and platelets, each with particular functions.
- The removal of toxins and maintenance of healthy blood sugar levels are two of the many important functions performed by the liver .
- Measuring blood pressure and heart rate and blood tests provide information about circulatory system health and blood tests provide information about liver health.
- The function of the circulatory system can be compromised by cardiovascular diseases.
- The function of the liver can be compromised by disease associated with excessive alcohol intake.

The Learning intentions and Success criteria are included as a guide to understanding expectations of students as outlined in the syllabus. Students could use them to review their understanding of the syllabus prior to assessments.

Learning intentions

1. Understand that body cells require substances to be transported to them to maintain optimum performance.
2. Understand that all waste products must be removed from cells and tissue fluid to be excreted.
3. Understand that the circulatory system that consists of the heart, blood vessels and blood, enable the delivery of substances to cells and the removal of wastes from cells.
4. Understand that the liver plays a vital role in the removal of toxins from the blood and helps regulates blood glucose levels.
5. Understand that the body relies on a healthy circulatory system to ensure the efficient movement of materials around the body.

Success criteria

- Describe the structure and function of the heart and blood vessels (arteries, capillaries and veins).
- Label diagrams of the heart and blood vessels (arteries, capillaries and veins) and sketch diagrams showing the main structures.
- Describe the major structures of the heart and annotate diagrams showing the blood flow through the heart.
- Name and describe the major blood vessels that enter and leave the heart.

- Describe the role of the valves within the heart.
- Describe and explain the difference in structure between the atria and ventricles, and the right and left ventricles.
- Explain how the structure of the blood vessels is related to their function.
- Explain why exchange of materials occurs only via the capillaries due to structure of the walls of the blood vessels.
- Describe the components of blood including red blood cells, white blood cells, platelets, and plasma.
- Relate the structure of the blood cells to their function.
- Describe the role of blood (transport of gases, nutrients, wastes/protection against pathogens, toxic substances, blood loss/regulation of water content, protection against damage through blood clotting)
- Describe the role of the liver in the removal of toxins from the body.
- Describe the role of the liver in the maintenance of healthy blood glucose concentrations.
- Explain how the measurement of blood pressure and heart rate can provide vital information about the health of the circulatory system.
- Explain how the information provided by blood tests can inform people about the health of the circulatory system and liver function.
- Name the diseases associated with the circulatory system.
- Describe how cardiovascular diseases decrease the efficiency of the transport of substances around the body.
- Describe how people can help prevent circulatory system diseases from occurring.
- Explain how the function of the liver can be compromised by excessive alcohol intake.

Key terms

Identify and fill in the definitions for the following key terms:

Key term	Definition
Artery	
Atherosclerosis	
Atrium	
Bicuspid valve	
Blood	
Capillary	

Key term	Definition
Cardiovascular dis-ease	
Cirrhosis (liver)	
Deoxygenated blood	
Heart	
Liver	
Oxygenated blood	
Plasma	
Platelet	
Pulmonary circulation	
Red blood cell	
Semilunar valves	
Stroke	
Systemic circulation	
Tricuspid valve	
Vein	
Ventricle	
White blood cell	

The circulatory system

All cities and towns have transport systems to enable people to get from one place to another. Cars and busses travel on roads to get from the city for example, where they work, to the shops, sport centres and home, and then back again.

The circulatory system is a transport system that enables substances carried in blood to move from a central pump, the **heart**, through tubes that are the blood vessels. The substances include blood cells, water, nutrients and wastes. In this scenario, we can think of the city being the central point, the **heart**, the roads being the **blood vessels**, the cars and busses are different **blood cells** and the shops, sports centres and home as organs relying on the transport system.

Checkpoint

The human body has a transport system called the circulatory system.

Identify the substance transported around the body in the circulatory system.

_____

Name the organ that acts as the pump to move this fluid around the body.

_____

Name the structures that represent the 'roads' called in the circulatory system.

_____

Describe what you think is the purpose of the circulatory system.

_____

_____

Functions of the circulatory system

The circulatory system has many functions. Oxygen and nutrients are transported to cells, and wastes are removed, being delivered to organs such as the kidneys, liver and lungs for excretion. It circulates heat that has been produced by the activity of the cells, and maintains a constant body temperature. Other chemical substances such as hormones, water and ions such as sodium and chloride are transported in the blood to all organs and tissues in the body. The blood contains special white blood cells that are responsible for protection against disease-causing micro-organisms, and provide immunity.

Checkpoint

Functions of the circulatory system are:

- transport _____ and _____ to cells.
- transport _____ _____ and other _____ away from cells.
- transport chemical _____ (hormones).
- distribute _____ and maintain body temperature.
- maintain_____ _____ and ion concentration of body fluids.
- protection against _____ - _____ micro-organisms.

Components of the circulatory system

In humans, the heart is a four chambered organ that pumps blood from the body to the lungs, and then from the lungs to the body. The blood that returns from the body has less oxygen in it, as the oxygen has been used by the cells for cellular respiration. It is thus said to be **deoxygenated**. The blood is **oxygenated** in the lungs, returns to the heart, and is pumped around the body.

The blood vessels carry blood to and from the heart. The **arteries** carry blood away from the heart and the **veins** carry blood to the heart. The **capillaries** are tiny blood vessels, only one cell thick, that occur between the arteries and veins. They allow substances such as oxygen, glucose and carbon dioxide to be delivered directly to the cells.

The blood is mostly **plasma**, a clear, yellowish fluid that carries substances. The **red blood cells** are the most numerous cells in blood, as they carry oxygen to the cells and tissues. **White blood cells** are larger but less numerous than red blood cells, and are responsible for protection and immunity. **Platelets** are cell fragments responsible for blood clotting.

Checkpoint

Components of the circulatory system:

- H _____
- Blood vessels
  - A _____
  - V _____
  - C _____
- Blood
  - R _____ _____ _____
  - W _____ _____ _____
  - p _____
  - P _____

State the functions of the following parts of the circulatory system.

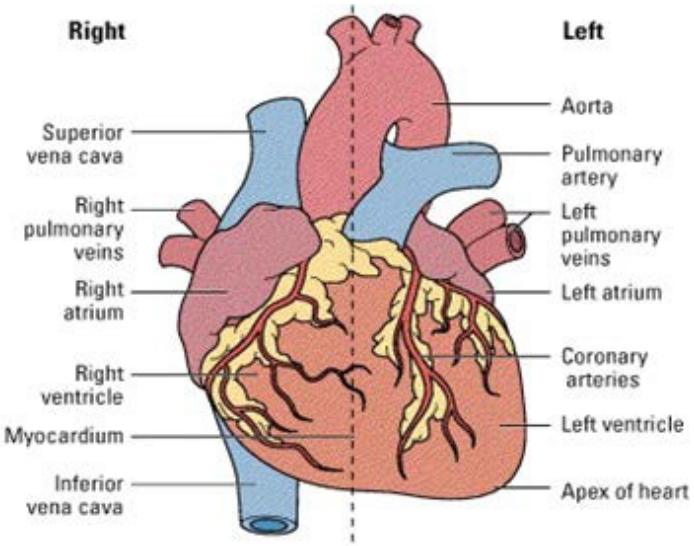
- heart _____
- arteries _____
- capillaries _____
- red blood cells _____
- platelets _____

The Heart

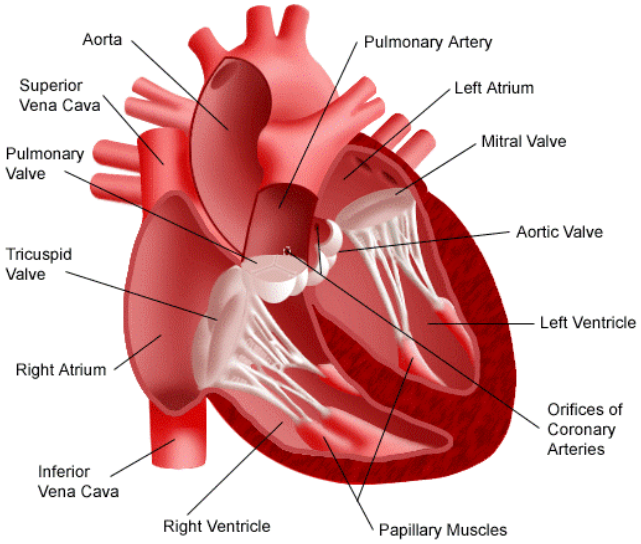
The heart is made of cardiac muscle and has four chambers: the right and left **atria** and the right and left **ventricles**. The right **atrium** receives blood from the body through a large vein called the vena cava and the left **atrium** receives blood from the lungs through the pulmonary veins. Once the atria fill with blood, it is pumped to the ventricles through **valves**. These **valves** prevent the blood from flowing back into the atria.

Once the **ventricles** have filled with blood, the heart muscle contracts and pumps the blood though arteries. The right **ventricle** pumps blood to the lungs via the pulmonary arteries, and the left **ventricle** pumps blood to the body via the biggest artery in the body, the aorta. There are **semilunar valves** between the ventricles and the arteries to prevent backflow of blood.

External anatomy of the heart



Interior view of the heart

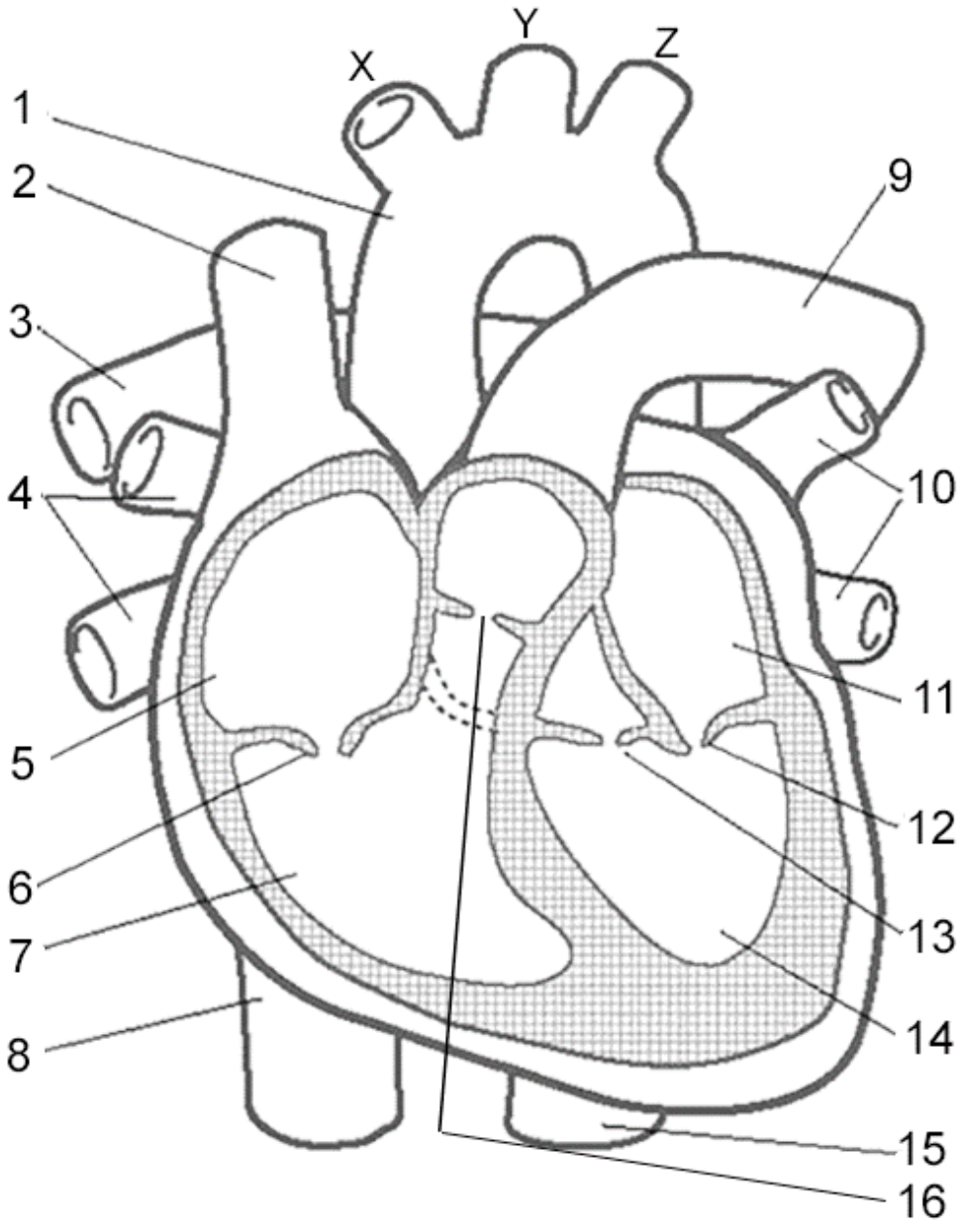


Checkpoint

Label all of the parts of the heart that are numbered.

Use the key below to colour each of the heart structures in the diagram of a human heart.

- ☐ Right atrium (l. green)
- ☐ Left atrium(orange)
- ☐ Left atrium(red)
- ☐ Left ventricle (yellow)
- ☐ Vena cava (pink)
- ☐ Pulmonary vein (purple)
- ☐ Pulmonary artery (blue)
- ☐ Aorta (dk. green)



Humans have a double circulation: the **systemic and pulmonary circulation**.

The **pulmonary circulation** takes **deoxygenated** blood from the right ventricle to the lungs through the pulmonary artery and returns **oxygenated** blood to the left atrium via the pulmonary veins.

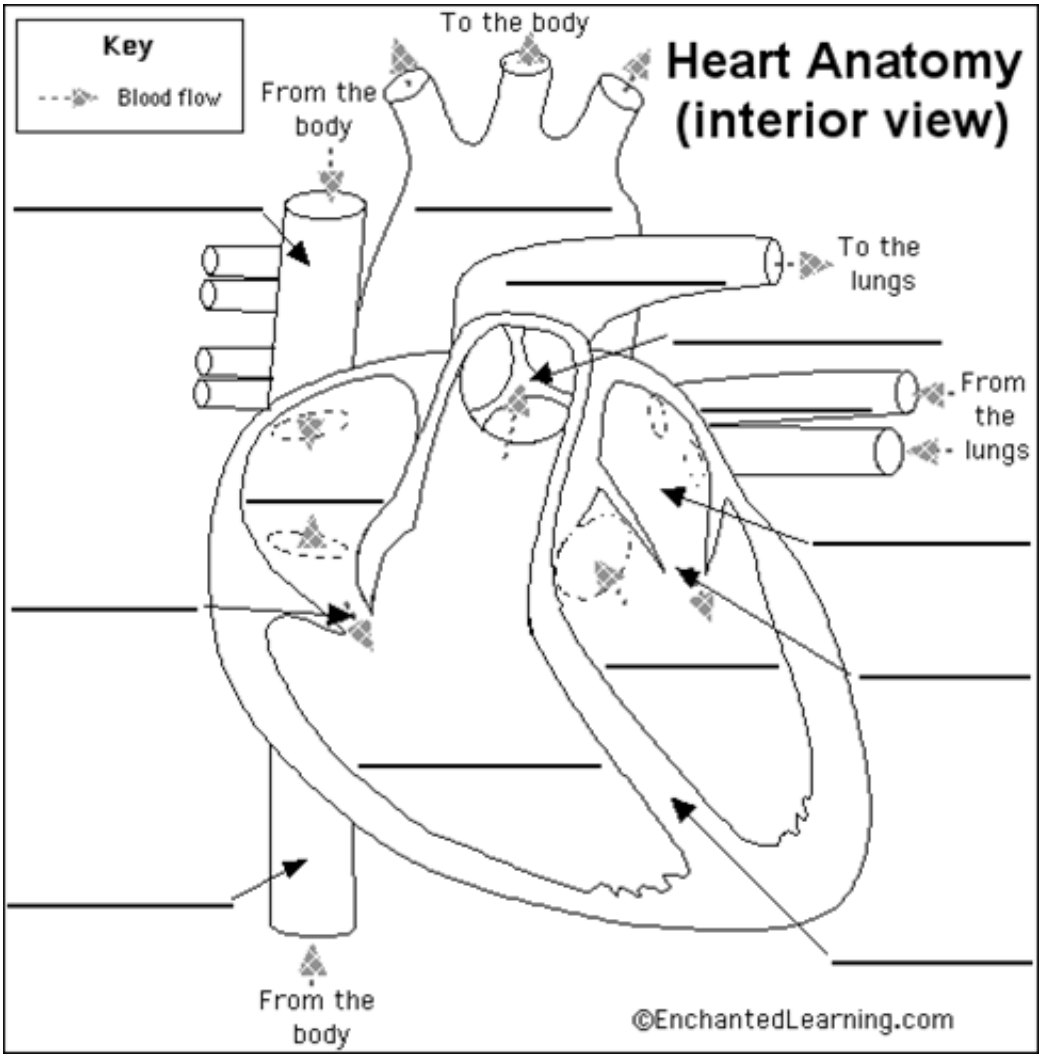
The **systemic circulation** takes **oxygenated** blood from the left ventricle to all tissues of the body through the aorta and returns **deoxygenated** blood to the right atrium via the vena cava.

The diagram below shows blood flowing through the heart. The arrows show the direction it moves through the heart.

Blood that is carrying lots of oxygen and low amounts of carbon dioxide is called **oxygenated blood**.

Blood that is carrying low levels of oxygen and high amounts of carbon dioxide is called **deoxygenated blood**.

Label the diagram and colour the arrows – blue for deoxygenated blood and red for oxygenated blood.



Into which chamber does deoxygenated blood flow into the heart from the body?

_____

Colour this chamber on the previous diagram blue.

From which chamber does deoxygenated blood flow out of the heart and to the lungs?

_____

Colour this chamber on the previous diagram blue.

Into which chamber does oxygenated blood from the lungs flow into the heart?

_____

Colour this chamber on the previous diagram red.

From which chamber does oxygenated blood flow out of the heart?

_____

Colour this chamber on the previous diagram red.

The flow diagram below shows the **flow of blood** through the heart. Fill in the missing words:

right atrium → _____ _____ → pulmonary artery

→ _____ → pulmonary veins →

_____ _____ → left ventricle → _____ → body.

Activity: Heart dissection

The heart and lungs are very closely arranged in the thoracic cavity. Humans have a 4-chambered heart with complete separation of both systemic and pulmonary circuits. One circuit loop goes from the right ventricle of the heart to the capillaries in the lungs, where gas exchange occurs. Blood then is returned to the left atrium of the heart.

The lungs are on a completely separate circuit to the rest of the body. Blood leaving the left ventricle goes to the capillaries in the rest of the body then returns to the right atrium. Both need to work together to supply the body with oxygen and remove carbon dioxide.

Activity purpose

- To identify the features of the heart that allow for efficient movement of blood.

Materials

- 1 x safety glasses
- 1 x sheep heart
- 1 x scalpel
- 1 x blunt probe
- 1 x dissecting scissors
- 1 x forceps
- 1 x dissecting board or tray
- 1 x dissecting or stereo microscope
- 1 x ruler
- gloves

Time required

- Approximately 60 minutes

Safety

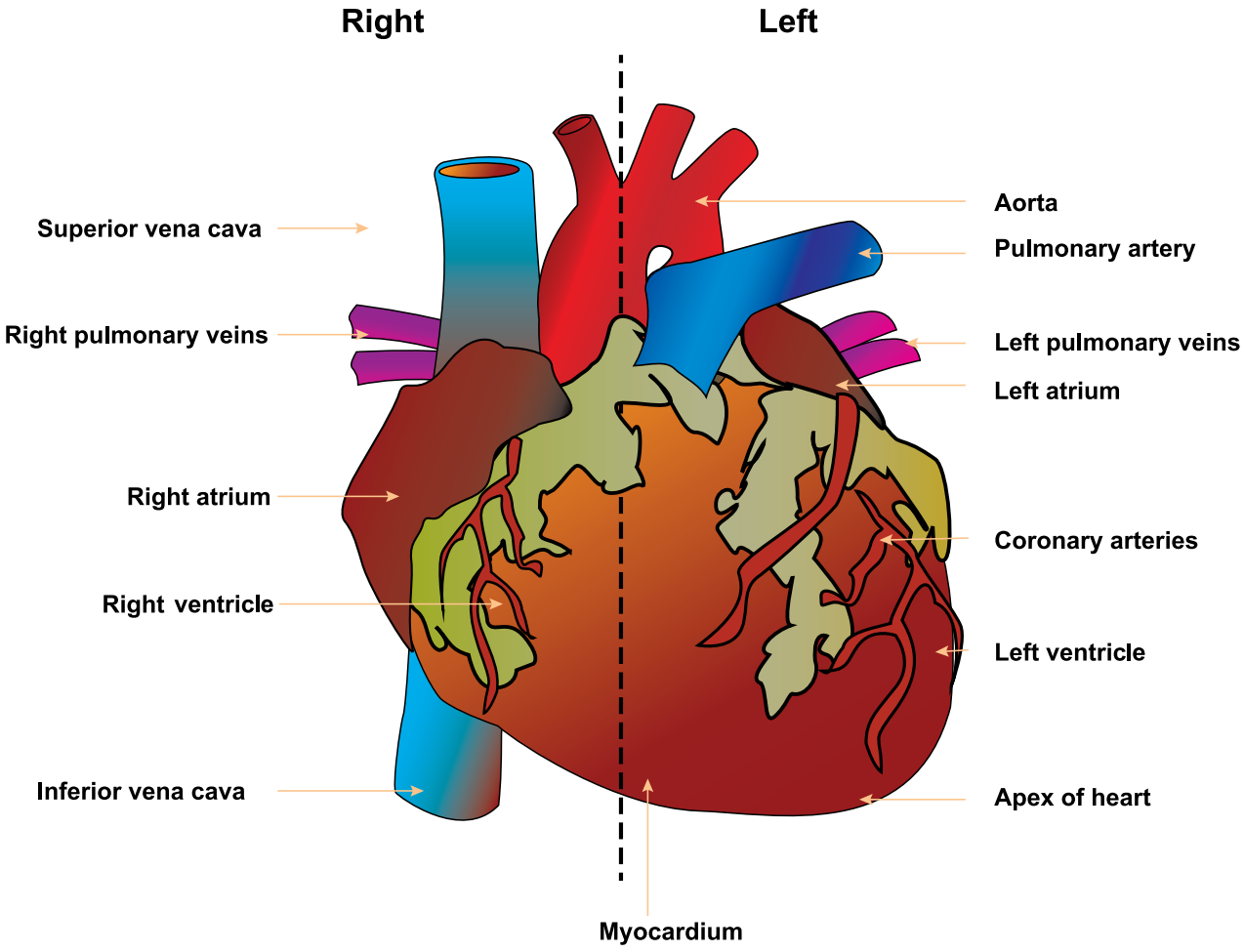
- Scalpel blades are extremely sharp. When cutting, make sure you're your fingers are distanced from the blade and cut away from your body. When you are not using the scalpel, place it on the dissecting tray. DO NOT use it to probe the heart. DO NOT wash the scalpel.
- Wear gloves at all times. Remove them by pulling the glove from your wrist over your hand, avoiding contact with any blood or tissue.

- Wash your hands following the activity.
- Dispose of all animal matter and gloves according to the teachers' instructions.

Procedure

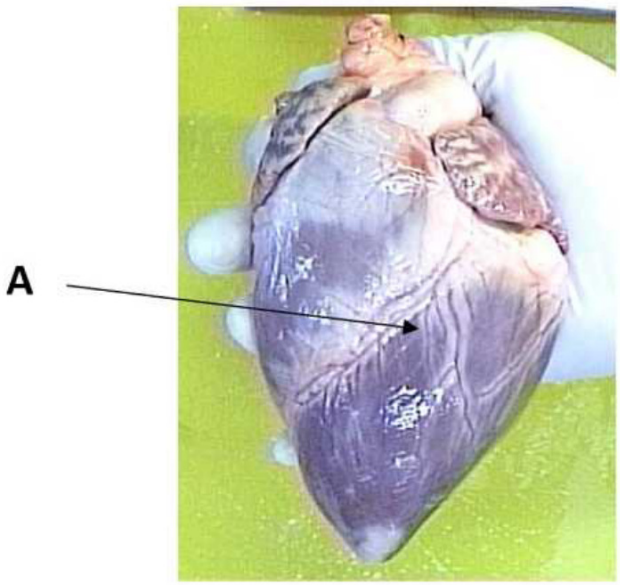
1. Arrange the heart as shown in the diagram below.
2. Identify the structures shown in Diagram 2 on your heart.
3. Locate the arteries and veins.
4. Answer Questions 1-3 on the page 50.
5. Use the blunt probe or use your finger to follow each blood vessel into the heart.
6. Answer Questions 4 and 5 on page 50.
7. Use the scissors to cut lengthwise down the blood vessels to the top of the heart and continue to cut through the wrinkled areas of the heart where the blood vessels end.
8. Stretch the wrinkled walls.
9. Answer Questions 6-10 on the pages 50-51.

External anatomy of the heart



You have been looking at the atria and the blood vessels attached to them. Now you will explore the larger chambers of the heart - the ventricles.

Orientation of the heart for dissection of the ventricles



1. Orient the heart as shown in the photo above.
2. Use the scalpel to cut a line about 1 cm away from and parallel to the blood vessel A. Cut gently, using your fingers to spread the incision so you can tell when you reach the cavity. Make the opening about 5 cm long
3. Do the same for the other side - again about 1 cm from blood vessel A.
4. Answer Question 11 (page 51).
5. Keep cutting through to the atria on each side.
6. Locate the valves between the atria and the ventricles. Name these valves.

    - Left atrium and left ventricle _____

    - Right atrium and right ventricle _____

7. Look carefully at the valves to explain why they have the prefixes ‘tri’ and ‘bi’ in their names.
8. Adjacent to the bicuspid valve is the point where the aorta is attached to the left ventricle. Look at the valves located here.
9. Carefully manipulate them with the blunt probe.
10. Answer Questions 12-14 (page 51).
11. The tricuspid and bicuspid valves are anchored in the walls of the heart at the papillary muscles by the ‘chordae tendinae’ (cords made of tendons).
12. Try pulling one of these cords out of the muscle.
13. Answer Questions 15 and 16 (page 51).

Questions

1. How did you identify which blood vessel is the aorta?

2. Identify two differences between the arteries and veins attached to the heart.

3. Identify the white material around the top of the ventricles. What function might it have?

4. Identify the blood vessels attached to each heart chamber and name each.

5. Did you meet any resistance when trying to get the probe into the heart? In which vessels? Explain a possible cause.

6. Name the wrinkled areas.

7. Are the wrinkled areas thick or thin?

8. Describe any difference between the left and right wrinkled areas.

9. How far will the walls stretch? Measure them stretched and unstretched.

10. Explain why these chambers have these characteristics.

11. Describe the difference between the thickness of the walls on each side.

12. Give a reason for the atrioventricular valves being called 'semi-lunar' valves.

13. How many 'semi-lunars' are in each valve.

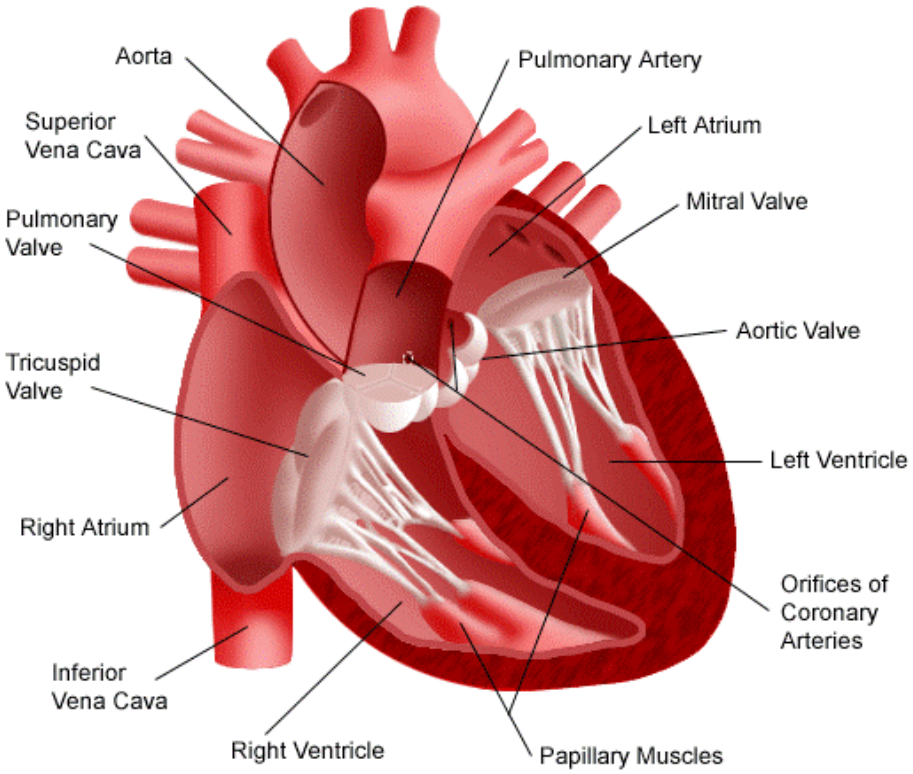
14. Explain how the heart valves function to regulate the direction of blood flow.

15. Explain why the chordae tendinae cords important.

16. Explain why the cords are so strong.

Identify the structures seen in your heart dissection using the diagram below.

Interior view of the heart



Use arrows to show the pathway of blood flow between the parts in the diagram below. Label the arrows with the names of the structures they represent.

Flow of blood in the circulatory system

Lungs

Right Atrium

Left Atrium

Right Ventricle

Left Ventricle

Body

There is no direct connection between the right and left sides of the heart. Explain.

_____

_____

Comparisons: state the differences between the following and explain why they occur.

Atrial and ventricular walls

_____

_____

_____

Left and right ventricular walls

_____

_____

_____

Bicuspid and tricuspid valves

_____

_____

_____

Aorta and pulmonary arteries

_____

_____

_____

Semi-lunar and tri/bi-cuspid valves

_____

_____

_____

Arteries and veins

Left and right sides of the heart

Blood in the pulmonary artery and the aorta

Pulmonary circulation and systemic circulation

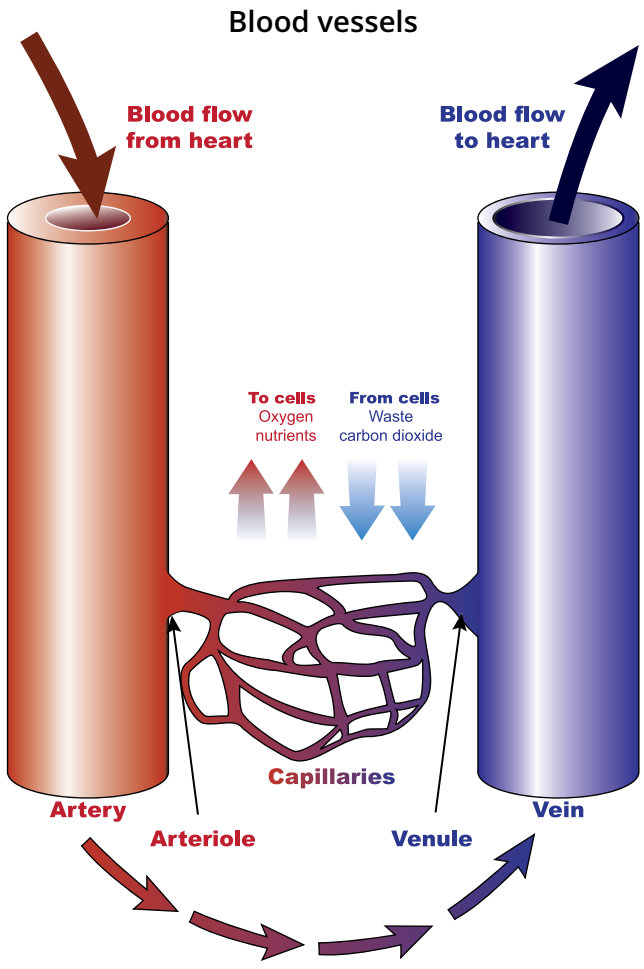
Blood vessels

There are three main types of blood vessels.

1. **Arteries** carry blood away from the heart. They have thick muscular walls and have elastic tissue to enable them to dilate (get larger) or constrict (get smaller). This allows the blood flow to be regulated to various parts of the body. During exercise, for example, blood flow needs to be redirected to the muscles. They have a small **lumen** and tend to be under high pressure from the heart.

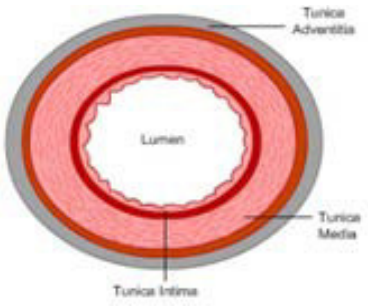
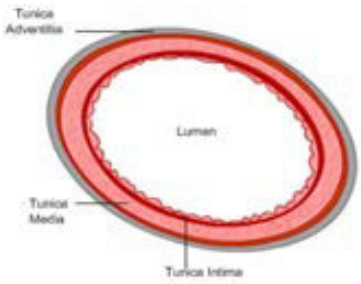
2. **Veins** carry blood towards the heart. They are less muscular than arteries as they are not under the same amount of pressure as the arteries. Most veins must carry blood back to the heart against gravity as blood moves from the feet, for example, up to the heart. They contain **valves** to help prevent backflow of blood, and very large **lumen** diameters to decrease the resistance against blood flow. Veins also rely on the contraction of skeletal muscles and the diaphragm to help push the blood back towards the heart.

3. **Capillaries** lie between the arteries and veins and carry blood through the tissues to deliver oxygen, nutrients and other substances to the cells, and carry wastes away from the cells. They are microscopic and are only one cell thick. Capillaries are very permeable and this also enables the efficient diffusion of substances to and from the cells across the membrane.



Checkpoint

Complete the table:

	Artery	Capillary	Veins
Diagram			
Function			
Blood pressure (high/low)			
Thickness of wall (thick/thin)			
Wall has muscle tissue (yes/no)			
Wall has elastic tissue (yes/no)			
Has valves (yes/no)			

Activity: Blood vessels

Activity purpose

- To examine blood vessels and the circulation of blood.

Materials

- Prepared slides of blood vessels
- Microscope

Time required

- Approximately 30 minutes

Procedure

1. Collect a microscope and set it up correctly. If you are not sure what to do, ask your teacher.
2. Collect prepared blood vessel slide.
3. Focus the prepared slide under LOW power (objective lens x4).
4. In the space below, draw and label an artery and a vein.

Artery

Vein

Blood

Blood is a fluid connective tissue. It consists of a clear yellowy liquid called **plasma** and blood cells, and platelets.

Cell types found in smears of blood from normal individuals

A: Red blood cells (erythrocyte)

B: White blood cell (large lymphocyte)

C: Neutrophil

D: Eosinophil

E: Neutrophil

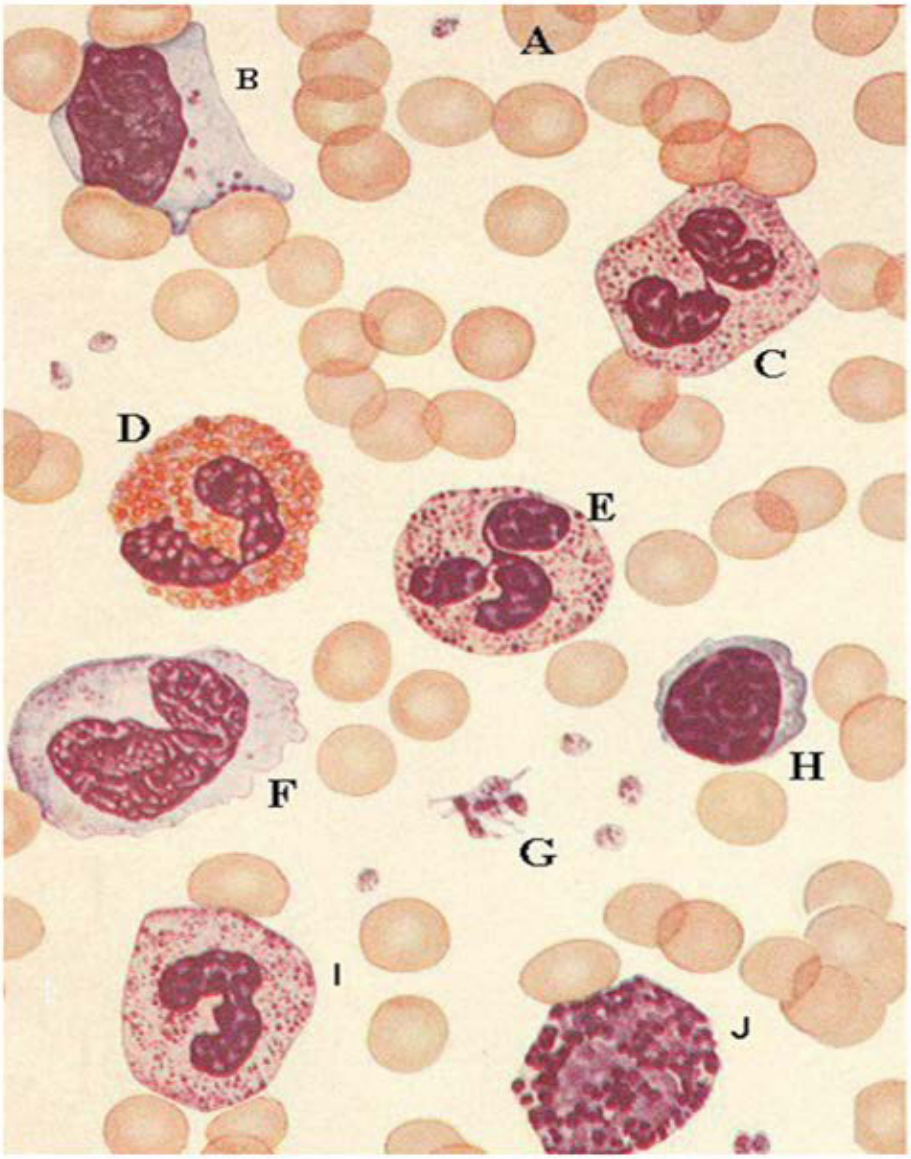
F: Monocyte

G: Platelets (thrombocytes)

H: Lymphocyte

I: Neutrophil

J: Basophil



Note: The arrangement is arbitrary and the number of white blood cells in relation to red blood cells and platelets is greater than would occur in an actual microscope field of view.

Plasma makes up about 55% of the volume of the blood. It is about 90% water. It contains the blood cells, dissolved substances such as oxygen and chemicals such as hormones and nutrients.

Red blood cells are biconcave discs and have no nucleus. This allows them to be flexible as they squeeze through tiny capillaries. It also increases their surface area to allow more haemoglobin to be carried by these cells. Haemoglobin is the pigment that gives the red blood cells their colour. They only live for 120 days.

White blood cells are larger than red blood cells, but there are fewer of them. These cells have a nucleus and are classified according to the shape and size of the nucleus, as well as whether or not they are granular. These cells are important for defence against disease-causing micro-organisms. They only live for a few days. Some of them can change shape and ingest bacteria, dead cells or cell fragments. This is called phagocytosis.

Platelets are tiny fragments of cells that have no nucleus. They are responsible for the process of blood clotting. If a blood vessel is damaged, such being cut, the platelets release chemicals that attract more platelets and other chemicals to begin the process of clotting.

Checkpoint

Blood is made up of the following:

Blood component	% of blood
Plasma	
Cellular Material	

Describe plasma. What is it made up of?

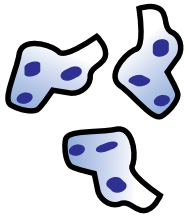
_____

_____

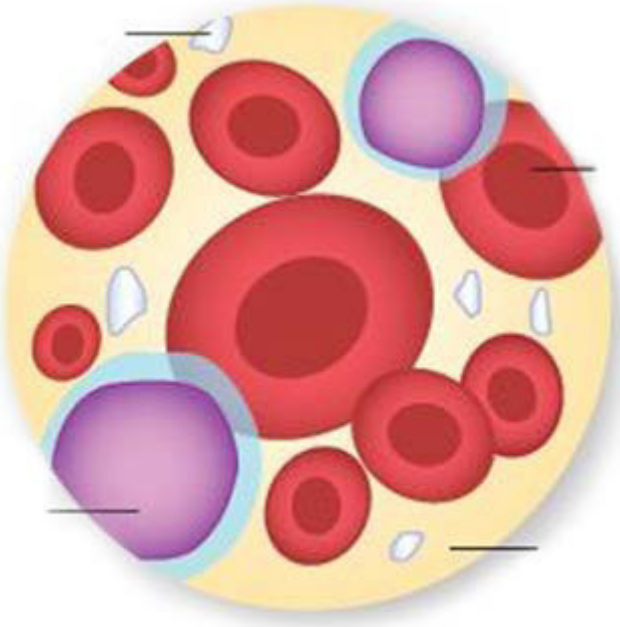
_____

_____

There are three types of blood 'cells', complete the first two columns of the table below by naming the different types of blood cells:

	Common name	Special characteristics	Function
			
			
			

Label the parts of the blood:



Activity: Blood - specialised cells

The body can't be composed of only one type of cell. There are many specialised activities that the body needs to do. Having specialised cells increases the efficiency with which these activities are carried out. Blood is a very good example of where cells are specialised to carry out the different functions of blood.

Activity purpose

- To observe different functions of specialised cells.
- To relate the different structure of cells to their functions.

Materials

- prepared slides of blood cells
- microscope
- micrographs of blood cells - coloured photographs would be preferable
- Some suitable micrographs are at the following sites:
  - Elements found in Blood https://biologydictionary.net/blood-cell/
  - Under the microscope http://medcell.med.yale.edu/systems_cell_biology/blood_lab.php
- text books with diagrams of blood cells

Time required

- Approximately 60 minutes

Procedure

1. Set up your microscope to view the blood slides.
2. Use the micrographs or text books to identify the types of cells you can see.
3. At high power, count the number of different types of cells in the field of view.
4. Draw up a table to list the types of blood cells. Draw a diagram and list the function for each cell type in your table.
5. Describe the differences between the cells seen under the microscope.

Table: Blood contents

Draw a table that will allow you to sketch each type of blood cell that you can see under the microscope.

Questions

What are the functions of blood?

How many different types of cells are found in blood?

Were all the types of cells visible on your blood slide? Explain why you may not have seen all the blood cell types on your blood smear slide.

Explain why blood cells look different to the textbook descriptions under the microscope e.g. colour, shape etc.

Are platelets blood cells? Explain your answer.

Why are platelets important?

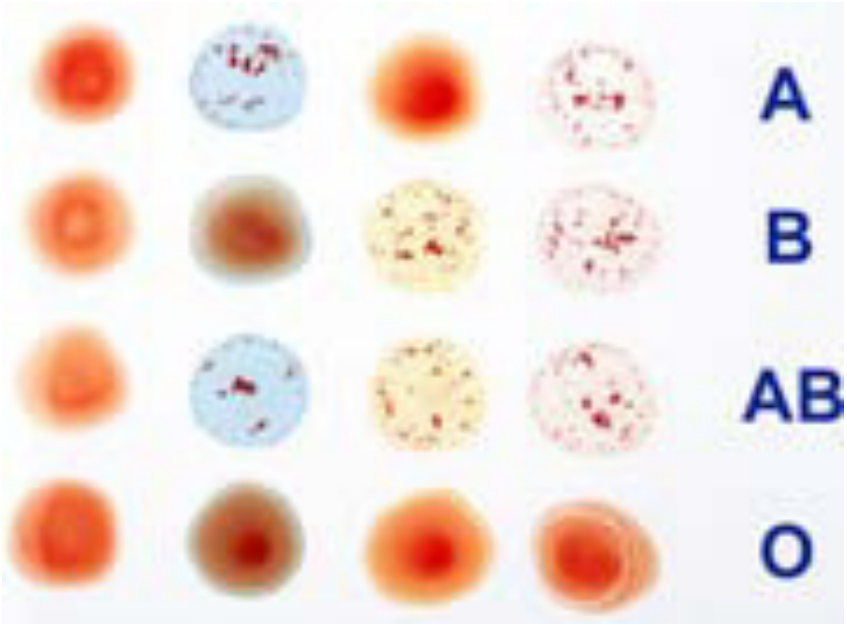
What products can be made from donated blood?

Extra if you are interested

How do you test for blood type?

The way to determine a person's blood type is to mix some of their red blood cells with antibodies in a test tube or special testing paper. If anti-A causes clumping, the person is group A. If anti-B clumps the blood, they must be B. If both antibodies cause a reaction, they're AB and if neither has an effect, they are O.

Spot on: A blood-type test shows four blood-type reactions to antibody serums



Why is it important to know your blood type?

_____

_____

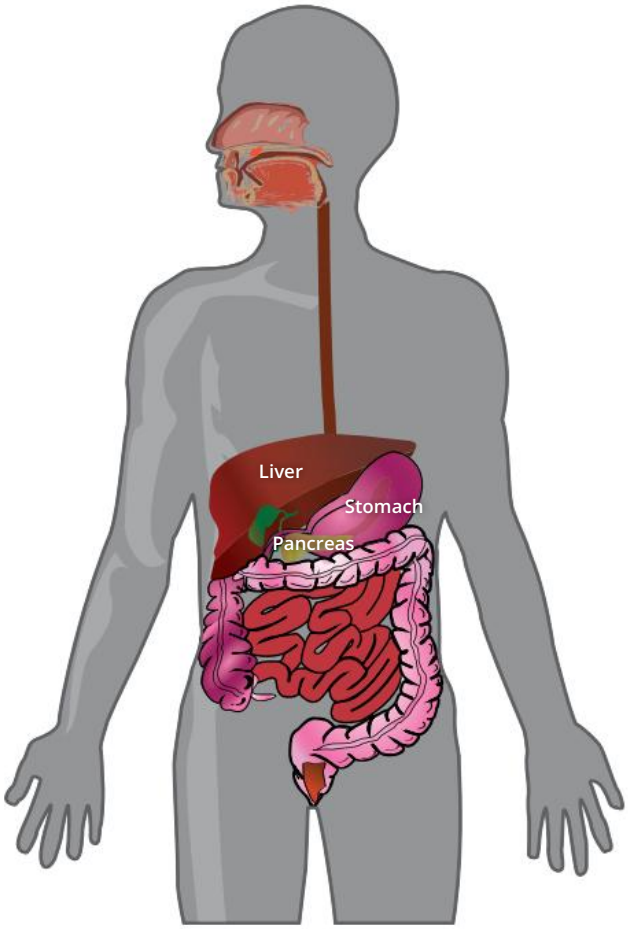
_____

_____

_____

Liver function

The liver is one of the largest organs in the body. It is located on the right hand side of the abdomen next to the stomach. It has many functions and is involved in digestion as an accessory organ producing bile for fat digestion. The liver plays a crucial role in maintaining overall health by performing a wide range of functions, including the removal of toxins and regulation of blood sugar levels. It acts as a filter for the blood coming from the digestive tract before it enters the rest of the body. It is responsible for processing and eliminating toxins, drugs, and other harmful substances from the bloodstream.



The liver cells detoxify harmful substances through a two-step process called detoxification. The toxins are made soluble and easier to excrete by special enzymes. The liver cells, known as hepatocytes, are responsible for these detoxification processes.

The liver metabolizes various drugs, including medications such as paracetamol, caffeine, and alcohol. It converts these substances into forms that can be easily eliminated from the body.

The liver also plays a vital role in maintaining healthy blood sugar levels, which is essential for proper brain and muscle function. It regulates blood sugar levels by storing glucose in the form of glycogen. When blood sugar levels drop, such as between meals or during physical activity, the liver converts stored glycogen back into glucose and releases it into the bloodstream. This process is called glycogenolysis.

In certain situations, like fasting or prolonged exercise, when glycogen stores are depleted, the liver can synthesize new glucose molecules from non-carbohydrate sources, such as amino acids and glycerol (fats), through a process called gluconeogenesis. This ensures a continuous supply of glucose to the body.

The liver is influenced by hormones, primarily insulin and glucagon, which help maintain blood sugar balance. Insulin signals the liver to take up glucose from the bloodstream, promoting its conversion

into glycogen or fat for storage. In contrast, glucagon signals the liver to release glucose into the bloodstream, increasing blood sugar levels. The liver also helps in preventing blood sugar spikes and maintaining stability. It converts excess glucose into glycogen for storage or into fatty acids for long-term energy storage.

In summary, the liver's function in removing toxins and regulating blood sugar levels are crucial for overall health. Its detoxification processes and elimination of toxins support the body's natural defense mechanisms, while the liver's involvement in blood sugar regulation ensures a constant energy supply for various bodily functions.

Checkpoint

Describe the location of the liver in the body.

_____

_____

_____

State the name for a liver cell.

_____

Name the process that enables toxins to to be easily excreted from the body.

_____

List 3 types of drugs that are metabolised by the liver for elimination.

_____

_____

_____

Name the molecule that is formed from glucose during glucose regulation in the liver.

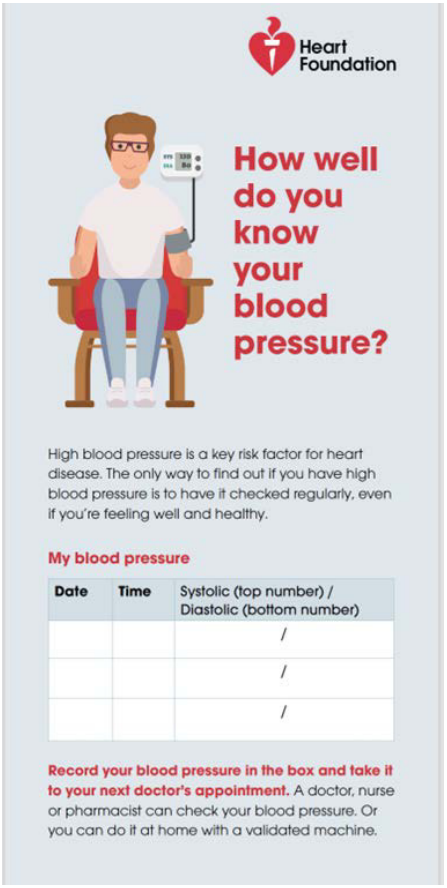
_____

Circulatory system health

Measuring blood pressure and heart rate and blood tests provide information about circulatory system health and blood tests provide information about liver health. In Chapter 1 you studied some of the ways that health professionals determine whether or not a person is at risk of developing a health issue or is suffering a medical problem. You will recall that there are many diagnostic tests that can be done to determine if the heart is healthy, the blood vessels are functioning well and the blood contains the optimum levels of various ions, blood cells and nutrients.

Diagnosis of cardiovascular disease

Blood pressure measures the pressure of the blood on the walls of the arteries as the heart pumps it around the body. Blood pressure will go up and down naturally throughout the day depending on the activity a person is participating in. It will be lower during sleep and restful activities and higher during standing or walking, and especially if a person is exercising. Heart rate measures how fast the heart is beating each minute. If heart rate increases, then blood pressure will tend to increase as well. Normal average blood pressure for an adult aged between 20 and 40 is 120/80 and average heart rate is between 60-80 beats per minute. Health professionals measure blood pressure using a special instrument called a sphygmomanometer.



Heart Foundation

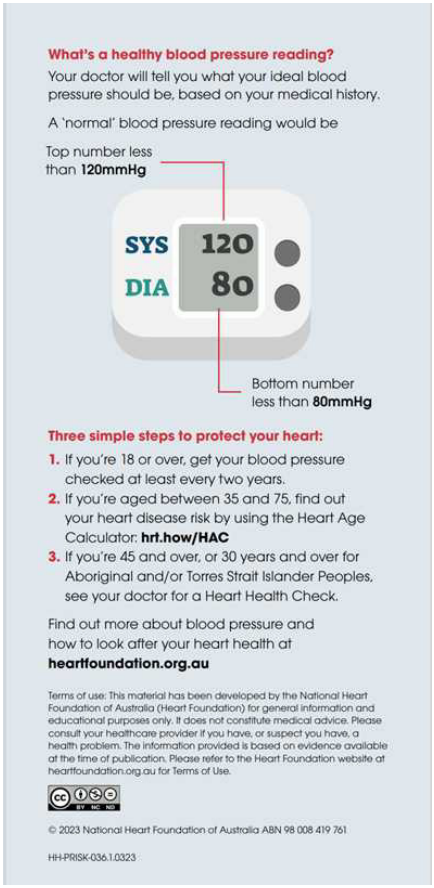
How well do you know your blood pressure?

High blood pressure is a key risk factor for heart disease. The only way to find out if you have high blood pressure is to have it checked regularly, even if you're feeling well and healthy.

My blood pressure

Date	Time	Systolic (top number) / Diastolic (bottom number)
		/
		/
		/

Record your blood pressure in the box and take it to your next doctor's appointment. A doctor, nurse or pharmacist can check your blood pressure. Or you can do it at home with a validated machine.



What's a healthy blood pressure reading?

Your doctor will tell you what your ideal blood pressure should be, based on your medical history.

A 'normal' blood pressure reading would be

Top number less than **120mmHg**

SYS 120
DIA 80

Bottom number less than **80mmHg**

Three simple steps to protect your heart:

1. If you're 18 or over, get your blood pressure checked at least every two years.
2. If you're aged between 35 and 75, find out your heart disease risk by using the Heart Age Calculator: **hrt.how/HAC**
3. If you're 45 and over, or 30 years and over for Aboriginal and/or Torres Strait Islander Peoples, see your doctor for a Heart Health Check.

Find out more about blood pressure and how to look after your heart health at **heartfoundation.org.au**

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High blood pressure, or hypertension, is when blood pressure is consistently higher than normal. High blood pressure is one of the main risk factors for heart disease, especially heart attacks and strokes. It's possible to have high blood pressure without realising it, and that is why it's important to get heart health checked regularly by a health professional.

High blood pressure can be managed with some simple changes to lifestyle, such as eating a heart healthy diet, decreasing salt intake, stopping smoking and decreasing alcohol consumption, and exercising more regularly. There are also some medicationsv available to keep it under control.

There are many possible causes of hypertension and risk factors including:

- Family history
- Eating patterns (including salty foods)
- Alcohol intake
- Smoking and vaping
- Being overweight or obese
- Physical activity and exercise levels.
- High levels of stress and emotional states
- Some medications and drugs such as caffeine or methamphetamines

Checkpoint

State the average normal measurement for blood pressure and heart rate for an adult.

_____

State the name of the instrument that doctors use to measure blood pressure.

_____

List five risk factors for high blood pressure.

_____

_____

_____

_____

_____

Blood tests to check cardiovascular and liver health

In Chapter 1 you learned about the blood tests that can be used to diagnose various diseases. Here the focus will be on heart and liver disease diagnosis.

When the heart muscle has been damaged, which can happen during a heart attack, the body releases specific substances into the blood. Blood tests can measure the levels of these substances and show the heart has been damaged and to what extent the damage is.

The most common blood test after a heart attack will check levels of a protein called troponin. Blood tests are also done to measure the level of other substances, such as blood fats (e.g. cholesterol and triglycerides) and minerals. The blood test can also show how other body's organs are functioning, such as the kidneys, liver or endocrine (hormone-producing) glands. This information helps to guide treatment and diagnosis.

Liver function blood tests are used to help diagnose a number of diseases associated with the liver such as Diabetes Type 2, liver cancer, hepatitis and liver cirrhosis.

A Liver Function Test (LFT) is actually a group of blood tests. A liver function test can detect a range of substances in the blood including different proteins and enzymes that are produced by liver cells or released when these cells become damaged. It can be ordered if liver disease has been diagnosed or is suspected or to further investigate symptoms such as jaundice (yellowing of the skin), dark urine, fatigue or lethargy, nausea, loss of appetite or abdominal pain.

A Liver Function Test (LFT) can detect a range of substances in the blood including different proteins and enzymes that are produced by liver cells or released when these cells become damaged.

Checkpoint

List some of the substances that are checked when having blood tests to diagnose heart disease.

_____

_____

State the names of three disease associated with the liver that can be diagnosed with liver function tests.

_____

_____

Activity: Evidence of heartbeat and blood pressure

How many times in movies and on TV have you seen some one feel for heartbeat of an accident victim? It appears to be the first thing that rescuers do when they reach a victim.

"He's alive, but only just. His heartbeat is very weak."

Can you really tell that much about a person from their heart beat? Would you know if the heartbeat was weak or strong? Normal or abnormal? You will have the opportunity to experience a range of different heart beats when working with a group of people in this activity.

Activity purpose

- To observe the external changes of the body to infer internal functioning.

Materials

- Stopwatch or watch with seconds hand
- Stethoscope
- Digital sphymomanometer

Time required

- 80 minutes

Procedure

1. Locate three different places on your body surface where you can feel your pulse.
2. Try to count your pulse rate at each location.
3. Change the pressure you use on the pulse point when trying to count your pulse.

Questions

Describe the difference between a 'strong' and a 'weak' heartbeat:

_____

_____

_____

_____

State the location that had the strongest pulse? Suggest a reason for this.

_____

_____

Explain why the pressure you use have to be "just right" to easily count your pulse?

_____

_____

Use the stethoscope to listen to your pulse at each of the pulse point.

- Find the best location to listen to your heartbeat.
- Measure your heart rate for 1 minute and calculate your average heart rate.
- Draw a suitable table (below) in which to record your heart rate data and leave space for collecting rates from five other people and calculate their average heart rates.

Results table:

Give a reason for counting your heart rate more than twice.

Describe how you could reduce the error when counting your heart rate?

Was it easier to count your heart rate with the stethoscope or by using a pulse point?

How does the heart rate relate to your pulse?

Compare the heart rates of different people. Why would heart rate differ between people?

Listen to your heartbeat while feeling your pulse. How do they compare? Give a reason for any differences.

Use the digital sphygmomanometer to determine you blood pressure. Ask your teacher how to use the device properly.

- Learn how to position and use the sphygmomanometer.
- Measure your blood pressure after sitting down for 1 minute.
- Measure your blood pressure after lying down for 1 minute.
- Measure your blood pressure after standing for 1 minute.
- Draw a suitable table (below) in which to record your blood pressure data comparing blood pressure with different body positions and leave space for collecting BP from five other people and calculate their average blood pressure.

Results table:

State the differences between blood pressure results for sitting, standing and lying down.

Explain why there were differences in blood pressure with different postures.

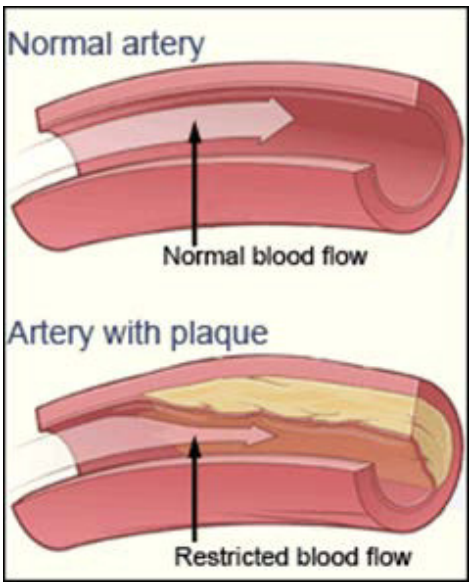
Cardiovascular disease

Cardiovascular diseases (CVDs) are a group of disorders of the heart and blood vessels and include:

- Coronary heart disease - disease of the blood vessels supplying the heart muscle.
- Cerebrovascular disease - disease of the blood vessels supplying the brain.
- Peripheral arterial disease - disease of blood vessels supplying the arms and legs.
- Congenital heart disease - malformations of heart structure existing at birth.
- Deep vein thrombosis and pulmonary embolism - blood clots in the leg veins, which can dislodge and move to the heart and lungs.

Heart attacks and **strokes** are usually acute events and are mainly caused by a blockage that prevents blood from flowing to the heart or brain. The most common reason for this is a build-up of fatty deposits on the inner walls of the blood vessels that supply the heart or brain. Strokes can also be caused by bleeding from a blood vessel in the brain or from blood clots.

The most common cause of CVD is the gradual clogging of blood vessels by fatty or fibrous material. Fatty material gradually builds up on the blood vessel walls, narrowing the arteries. This eventually prevents blood carrying vital oxygen from reaching the cells. As the deposits build up the arteries become less elastic. This condition is often referred to as **hardening of the arteries or atherosclerosis**. Any artery in the body can be affected. However, the arteries to the heart, brain or kidneys, or those to the eyes and legs are most commonly affected.



Certain groups in the population have significantly higher mortality from heart, stroke and vascular disease than other groups, particularly Indigenous Australians and those of lower socio-economic status.

It is now agreed that most of the **premature deaths** and much of the morbidity caused by heart disease, stroke and vascular disease are preventable. A number of major types of **cancer** (Australia's other main source of illness and premature death) **share important and preventable risk factors** with heart disease, stroke and vascular disease. These include tobacco smoking, physical inactivity, a diet high in fats and being overweight. The latter three are also important in the prevention and management of the most common form of **diabetes**, another leading cause of mortality and morbidity in Australia. This suggests that prevention can occur on a broad front and bring even wider gains than those relating only to **cardiovascular health**.

Checkpoint

Define each of the following:

Heart attack

_____

_____

Stroke

_____

_____

Deep vein thrombosis

_____

_____

Atherosclerosis

_____

_____

Cardiovascular disease

_____

_____

Suggest three ways that people can prevent or decrease the risk of cardiovascular disease.

1. _____

_____

2. _____

_____

3. _____

_____

Activity: Cardiovascular disease

The Heart Foundation collects the most up-to-date data and statistics on a range of cardiovascular diseases. This information covers the prevalence, deaths and hospitalisations of these diseases where data is available, as well as information regarding risk factors to developing cardiovascular diseases.

The statistics provided are drawn from a variety of sources including the Australian Bureau of Statistics (ABS) and the Australian Institute of Health and Welfare (AIHW). This information is combined with Heart Foundation survey data of the professional, patient and general populations.

Alongside providing the Heart Foundation with vital information regarding the burden of cardiovascular diseases in Australia and the challenge we face, this information provides a valuable resource for researchers, clinicians, healthcare policy makers, media professionals, the public and others who seek the best national data available on cardiovascular diseases in Australia.

Cardiovascular disease (CVD) is an umbrella term that includes heart, stroke and blood vessel diseases, and is one of Australia's largest health problems. It accounts for one in four of all deaths, claiming the life of one person every 12 minutes.

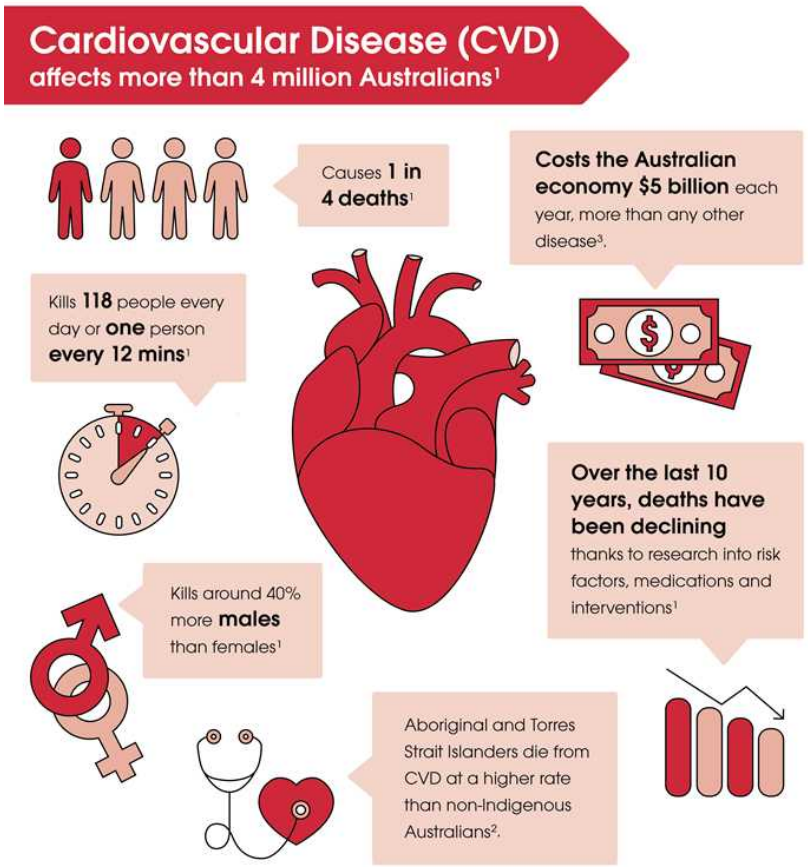
Activity purpose

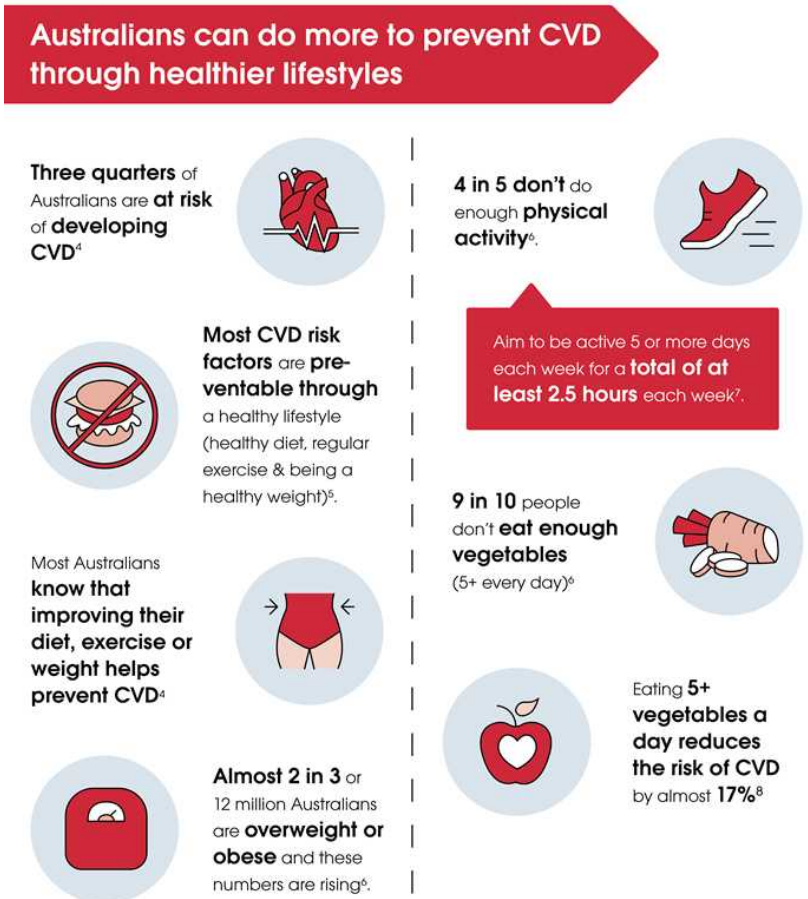
- To explain trends in data
- To explore ways of reducing the risks of CVDs

Time required

- 80 minutes

Explore the latest statistics relating to cardiovascular disease (CVD) below:





Prevalence[1]

- One in six Australians self-report as living with CVD, accounting for more than 4 million Australians.
- This represents 16.6% of the total Australian population living with CVD.
- Positively, the prevalence of CVD has been decreasing over time (declining approximately 80% since the 1980's), due to research into risk factors, medications and interventions.
- Regardless, CVD is still one of the most prevalent diseases in Australia.

Deaths[2]

- Cardiovascular disease (CVD) is a major cause of death in Australia, responsible for causing one in four (26%) of all deaths
- This means that on average, 118 Australians die from CVD each day, or one person every 12 minutes.
- Forty per cent more males die from CVD compared to females, while people in the lower socioeconomic groups, Aboriginal and Torres Strait Islander peoples and those living in regional and remote areas, generally have higher rates of death resulting from CVD than other Australians[4].
- Deaths from cardiovascular disease have decreased over the last 10 years, when adjusting for population growth and age distribution.

Hospitalisations[3]

- Someone is hospitalised for CVD every minute, equating to a total of 1619 hospitalisations per day.
- More men are admitted for CVD each year than women.
- Approximately $5 billion is spent on providing health care services to admitted patients with CVD each year, accounting for 11.1 percent of total admitted health expenditure – the largest share of health expenditure of any disease group[5].

References

1. Australian Bureau of Statistics 2018, National Health Survey 2017-18, Data customised using TableBuilder
2. Australian Bureau of Statistics 2020, Causes of Death 2019, cat. no. 3303.0, October
3. Australian Institute of Health and Welfare 2020, National Hospital Morbidity Database (NHMD) https://www.heartfoundation.org.au/health-professional-tools/Interactive-Heart-Map-Australia

Trends in data

Key statistics: Risk factors for cardiovascular disease

There are many different risk factors that increase your likelihood of developing a cardiovascular disease, such as heart disease.

Key risk factors that contribute to heart conditions, such as high blood pressure and high cholesterol, are largely preventable. Unfortunately, most people do not associate these key risk factors with their heart health.

Explore the latest statistics relating to cardiovascular disease risk factors below:

High blood pressure[2]

High blood pressure (or hypertension) is a common condition of the circulatory system and is widely recognised as the leading risk factor for CVD[1].

- One third of Australian adults have high blood pressure (33.7%), with almost 1.2 times as many males living with hypertension than females (36.2% compared to 31.3%).
- Prevalence of high blood pressure increases with age, with almost four out of five adults living with hypertension by the age of 75 years.
- Despite high prevalence, just 5% of adults nominate high blood pressure as a key risk factor for heart disease[3].

High cholesterol[2]

High blood cholesterol is a significant risk factor for developing CVD. Cholesterol is a fat-like substance necessary to make hormones and vitamin D, and to help you digest food. Your body produces cholesterol, and it's also in some foods.

- More than two in five (41.9%) Australian adults are living with high cholesterol.
- Prevalence of high cholesterol is highest amongst those aged 55 to 64 years of age.
- Unfortunately, only seven percent of adults nominate high cholesterol as a key risk factor for heart disease[3].

Being overweight or obese[2]

You're classified overweight if your body mass index (BMI) is 25 or over.

- Two in three (67%) Australian adults are overweight or obese, with the prevalence of overweight and obesity increasing over time.
- Prevalence of overweight and obesity is almost 25 percent higher in males (74.5%) than females (59.7%), with these proportions increasing for both males and females over time.
- Despite such large proportions of Australian adults being overweight or obese, just one in four adults believe that being overweight or obese is a key risk factor to developing heart disease[3].

Smoking[2]

The smoking statistics below are about 'current smokers', which is defined as a person that smokes daily, weekly, or less than weekly.

- Almost three million people over 15 years of age are current smokers, with the prevalence of smoking trending downwards.
- Smoking rates are higher for males over 15 years of age (17.6%) than females (11.7%), with the largest share of current smokers being males aged 25-44 years and females aged 45 to 64 years.
- One in three (31%) adults believe that smoking is a key risk factor to developing heart disease[3].

Physical inactivity[2]

Physical inactivity refers to people not getting the recommended level of regular physical activity, based on self-reported exercise and workplace activity.

- Four in every five (83%) adults do not meet national physical activity guidelines, with females being slightly more likely than males to fail to meet physical activity guidelines (84.2%) compared to males (81.2%).
- While the majority of people do not meet the physical activity guidelines, one in seven (14.5%) do no form of physical activity. Unfortunately, this proportion has been rising over time.
- Given such a large proportion of Australian adults do not meet physical activity guidelines, just one third of adults believe that a lack of exercise is a key risk factor to heart disease[3].

Alcohol consumption[2]

The National Health and Medical Research Council (NHMRC) Australian guidelines recommend healthy adults should drink no more than ten standard drinks a week, or a maximum of four standard drinks on any one day to reduce the risk of alcohol-related disease or injury.

- More than three million adults exceed alcohol consumption guidelines, with men being twice as likely as women to exceed these guidelines.
- Despite high rates of excessive alcohol consumption by adult males, this has been decreasing over time.

- Males aged 55 to 64 years and females aged 35-44 are most likely to exceed alcohol guidelines.
- Just one in ten Australian adults believe that alcohol consumption is a key risk factor to heart disease[3].

Diet[5,6]

Unhealthy diet is one of the leading risk factors for heart disease in Australia. Australians of all ages generally do not eat enough of the five food groups and eat too many junk foods high in salt, fat and sugar.

What you eat and drink impacts on several heart disease risk factors such as your blood pressure, cholesterol and weight.

- Ninety-two percent of Australian adults do not meet the recommended intake for vegetables (5+ servings of vegetables a day)[5], with this proportion increasing over the past two decades.
- The average Australian adult eats 2.4 serves of vegetables per day, which is less than half the recommended amount[5].
- Improving vegetable intake to meet the recommended five serves per day is estimated to reduce the risk of cardiovascular disease (CVD) by 16%[6].

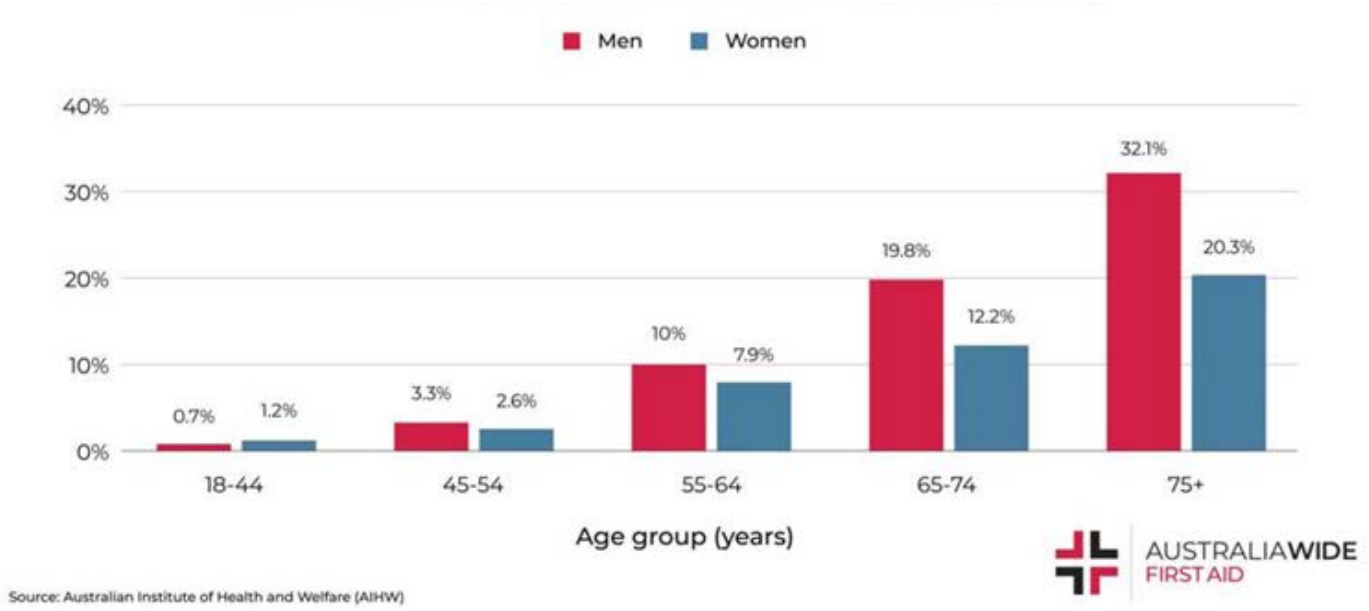
References

1. Institute for Health Metrics and Evaluation 2018, Global Burden of Disease Study 2017 (GBD 2017) Results, Global Burden of Disease collective Network, Seattle, available from http://ghdx.healthdata.org/gbd-results-tool
2. Australian Bureau of Statistics 2018, National Health Survey 2017-18, Data customised using TableBuilder.
3. Heart Foundation HeartWatch Survey, December 2020
4. Prevalence of high cholesterol is defined as all Australian adults that had high measured total cholesterol, and/or self-reported as having high cholesterol.
5. Apparent Consumption of Selected Foodstuffs, Australia, 2019–20, available from https://www.abs.gov.au/statistics/health/health-conditions-and-risks/apparent-consumption-selected-foodstuffs-australia/latest-release
6. Deloitte Access Economics, 2016. The impact of increasing vegetable consumption on health expenditure. Prepared for Horticulture Innovation Australia Limited. Available from https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-increasing-vegetable-consumption-health-expenditure-impact-040716.pdf

Use a table to compare all of the data for males and females outlined in the statistics provided in the previous text (your teacher may choose specific criteria for you to study).

Criteria	Males	Females

Figure 1: Self-reported prevalence of heart, stroke and vascular conditions in Australia 2017-2018

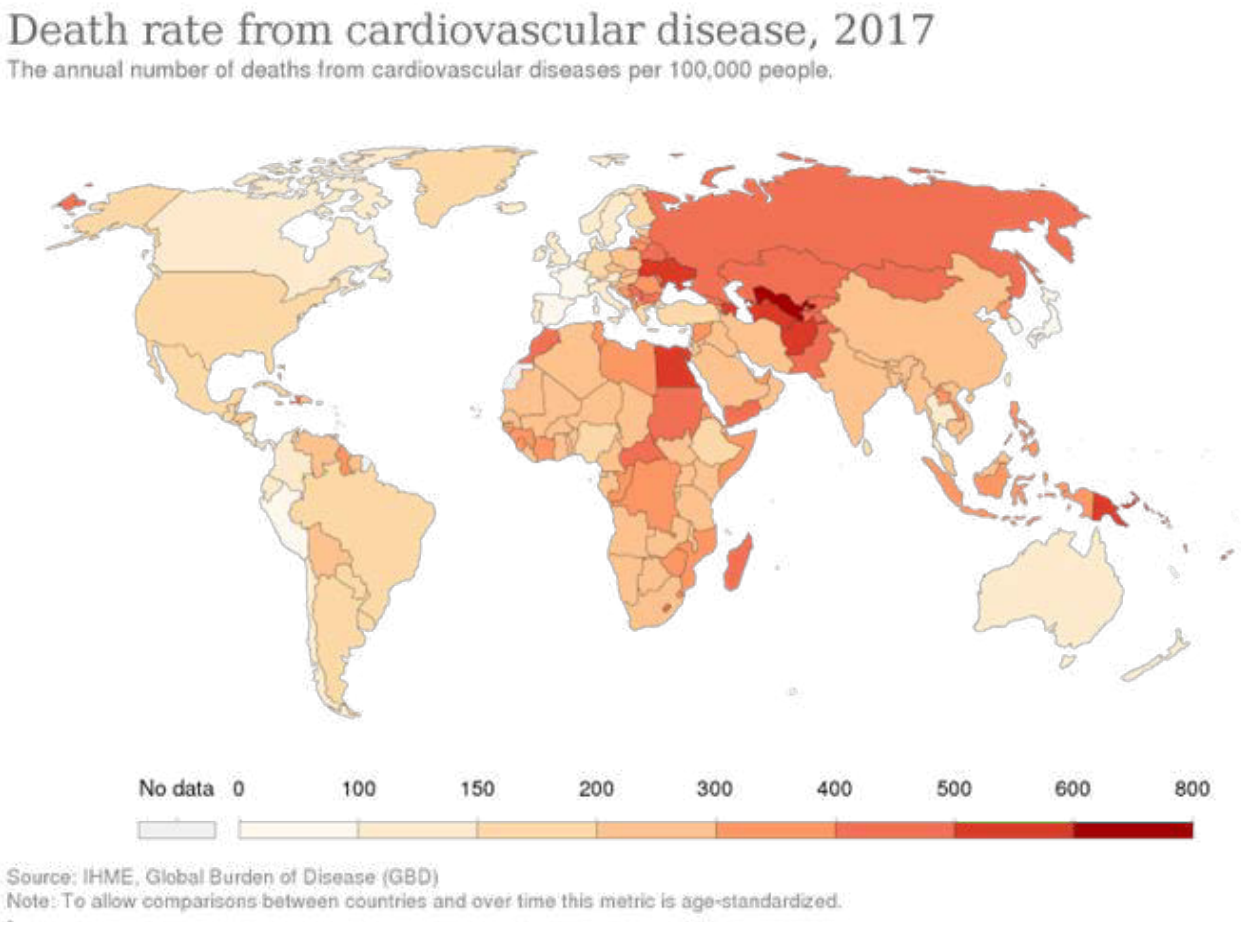


Describe the trend in the data for both males and females.

Suggest some reasons for men having much higher reports of CVD than women from ages 65-75+.

Describe how the data from 2017-2018 could be projected to change by 2086?

Figure 2: Death rate from cardiovascular disease



Describe the trends in the number of deaths from CVD that occurred in 2017 on each continent in the world.

_____

_____

_____

_____

_____

List some of the contributing factors causing differences in the rates of CVD in different countries.

_____

_____

_____

Use the information from the fact sheets at https://www.aihw.gov.au/reports/heart-stroke-vascular-diseases/hsvd-facts/contents/ explore-the-data to answer the following questions.

What is the general profile of people at most risk of CVD? Circle the correct answer:

- male / female
- indigenous / non-indigenous
- non-smoker / smoker
- active / inactive
- urban / rural / remote
- lower SES / higher SES
- young / older

How does the profile compare with your circumstances?

Suggest the role of each of the following in the development of the profile:

Education

Availability of medical facilities

Diet

Availability of recreational facilities

Family lifestyle

Television and use of devices such as computers and mobile phones

Liver disease and alcohol

The liver is an important organ in the body that helps to filter out toxins, produce bile, and metabolize carbohydrates, fats, and proteins. The liver can be damaged by many different chemicals that can be ingested such as alcohol and paracetamol, as well as viruses such as hepatitis.

Alcoholic drinks contain ethanol, a type of alcohol that is produced by fermentation of fruits, grains and other sugar sources. Ethanol acts as a drug and has many effects on the body. In Australia, alcohol plays an important role in social culture. Alcohol is the most widely used drug in Australia, with approximately 40% of the population drinking at least once per week. Alcohol consumption is regarded as acceptable in Australian culture and is consumed in most social situations such as weddings, sport events, baby showers and funerals. The consumption of alcohol is a major cause of preventable disease, injury and accidents.

Alcohol can damage the liver in several ways, including:

- Fatty liver: This is the most common type of alcohol-related liver damage. It occurs when fat builds up in the liver. Fatty liver is usually reversible if you stop drinking alcohol.
- Alcoholic hepatitis: This is inflammation of the liver caused by alcohol. It can be mild or severe. Severe alcoholic hepatitis can be fatal.
- Fibrosis: This is scarring of the liver. It occurs when the liver tries to repair damage caused by alcohol. Fibrosis is usually irreversible.
- Cirrhosis: This is the most severe form of alcohol-related liver damage. It occurs when the liver is so scarred that it can no longer function properly. Cirrhosis can lead to liver failure and death.

Many young people drink alcohol at parties and in other social situations. The liver is still developing in 16-18 year olds. This means that it is more susceptible to damage from alcohol. Even moderate drinking can increase the risk of liver damage in young people.

The symptoms of alcohol-related liver damage can vary depending on the severity of the damage. Some common symptoms include:

- Fatigue
- Nausea and vomiting
- Abdominal pain
- Loss of appetite
- Jaundice (yellowing of the skin and eyes)
- Dark urine
- Itching

- Swelling in the legs and feet
- Confusion

The best way to protect the liver from alcohol damage is to avoid drinking alcohol. If people choose to drink, it is important to do so in moderation. This means no more than one standard drink per day for women and two standard drinks per day for men.

Other things people can do to protect their liver include:

- Eating a healthy diet
- Exercising regularly
- Maintaining a healthy weight
- Getting enough sleep
- Avoiding other drugs that can damage the liver, such as paracetamol (common pain medication) and ibuprofen (common anti-inflammatory medication)

There are some additional things that 16-18 year olds should know about alcohol and liver damage:

- Alcohol is a toxic substance. Even small amounts of alcohol can damage the liver.
- The younger you start drinking, the more likely you are to develop alcohol-related liver damage later in life.
- There is no safe level of drinking for young people. The best way to protect your liver is to avoid drinking alcohol altogether.
- If you do choose to drink, it is important to do so in moderation. This means no more than one drink per day for women and two drinks per day for men.
- If you are concerned about alcohol-related liver damage, talk to your doctor. They can assess your risk and recommend ways to protect your liver.

NOTE: Please remember that your health is more important than anything else. If people are struggling with alcohol use, they should reach out for help. There are many resources available to help, including the person's doctor/GP, psychologist, or a local support group.

Checkpoint

Describe how alcohol is produced.

_____

_____

_____

Suggest a reason for Australians being some of the heaviest alcohol consumers in the world.

List four liver diseases that may result from excessive alcohol consumption.

Explain why cirrhosis of the liver is so dangerous to humans.

Describe four symptoms of liver damage or disease.

Explain why young people 16-18 years of age are more susceptible to liver disease if they consume alcohol.

Describe five ways that people can prevent liver disease.

_____

_____

_____

_____

_____

_____

How many drinks of alcohol per day are considered safe for men and women?

_____

_____

_____

Chapter review questions

- Compare and contrast the structure and function of the heart and blood vessels (arteries, capillaries and veins).
- Using annotated diagrams, describe the major structures of the heart.
- Name and describe the role of the valves within the heart.
- Explain how the structure of the blood vessels is related to their function.
- Describe the components of blood including red blood cells, white blood cells, platelets, and plasma.
- Describe the various roles of blood.
- Describe the functions of the liver described in this chapter.
- Explain why the functions of the liver are so important to our health.
- Describe ways to measure the health of the cardiovascular system.
- Name the diseases associated with the circulatory system.
- Describe how cardiovascular diseases decrease the efficiency of the transport of substances around the body.
- Describe how people can help prevent circulatory system diseases from occurring.
- Describe the risks to healthy liver function of excessive alcohol consumption.

Extras for experts

- Explain the differences in structure and pressure differences of the right and left ventricles.
- Explain why exchange of materials by diffusion occurs only via the capillaries due to structure of the walls of the blood vessels.
- Compare and contrast the solid components of blood, relating the structure of the blood components to their function.
- Explain how liver disease can adversely affect other organ systems in the body.

CHAPTER 3
Respiratory System

Syllabus dot points

- Exchange of gases between the external environment and the blood is facilitated by the structures of the respiratory system.
- The mechanics of breathing help to maintain the efficient exchange of gases in the lungs.
- Spirometry, pulse oximetry and the use of stethoscopes provide information about respiratory system health.
- The function of the respiratory system can be compromised by diseases and conditions that reduce the efficiency of gas exchange.

The Learning intentions and Success criteria are included as a guide to understanding expectations of students as outlined in the syllabus. Students could use them to review their understanding of the syllabus prior to assessments.

Learning intentions

1. Understand the functions of the structure of the respiratory system and how they work to facilitate the exchange of carbon dioxide and oxygen.
2. Understand how the structures of the respiratory system allow for efficient exchange of gases.
3. Understand the mechanics of breathing that enables air to flow from the external environment to inside the lungs.
4. Understand that lung function can be measured using various tests.
5. Understand that respiratory dysfunction can be due to poor lifestyle choices, genetics or diseases.

Success criteria

- Label a diagram of the respiratory system.
- Describe the function of all the parts of the respiratory system.
- Explain the difference between breathing and respiration.
- Describe the sequence of events that occur for air to move in and out of the lungs.
- Outline the pathway of air into the lungs.
- Describe how oxygen enters the blood at the lungs (gas exchange).
- Describe how carbon dioxide leaves the blood at the lungs (gas exchange).
- Describe how the structures of the respiratory system allows for fast and efficient gas exchange.
- Describe the tests available to determine lung function and to check for respiratory disease.
- Describe diseases that reduce the efficiency of the exchange of oxygen and carbon dioxide.

Key terms

Identify and fill in the definitions for the following key terms:

Key term	Definition
Alveoli	
Asthma	
Breathing	
Bronchi	
Bronchioles	
Concentration gradient	
Diffusion	
Emphysema	
Intercostal muscles	
Larynx	
Lung cancer	
Pharynx	
Pneumonia	
Pulmonary	
Pulse oximetry	
Respiration	

Key term	Definition
Ribcage	
Spirometry	
Stethoscope	
Trachea	
Tuberculosis	
Ventilation	

Respiration

Introduction

Our body requires energy to carry out our daily activities. **Respiration** occurs in the cells through a series of chemical reactions. During respiration cells use oxygen to break down glucose to release energy that the cells require to carry out their activities. Carbon dioxide and water are the waste products of respiration.

$$\text{oxygen} + \text{glucose} \rightarrow \text{carbon dioxide} + \text{water} + \text{energy}$$

When we breathe in, air enters the lungs and oxygen from the air is transported by diffusion into the bloodstream. The bloodstream distributes the oxygen to the cells in the body for the process of respiration. The respiratory system works to ensure that cells have a constant supply of oxygen, and that carbon dioxide is continually removed.

The circulatory system works in conjunction with the respiratory system to ensure this occurs.

It is important to understand that breathing and respiration are different processes. **Breathing** is the mechanical process of bringing air in and out of the lungs, where respiration is the chemical reaction that occurs in cells to release energy.

Checkpoint

The main purpose of the respiratory system to:

1. _____

2. _____

The process of bring air in and out of the lungs is called:

_____

The process of breaking down oxygen and glucose in the cell to release energy is called:

_____

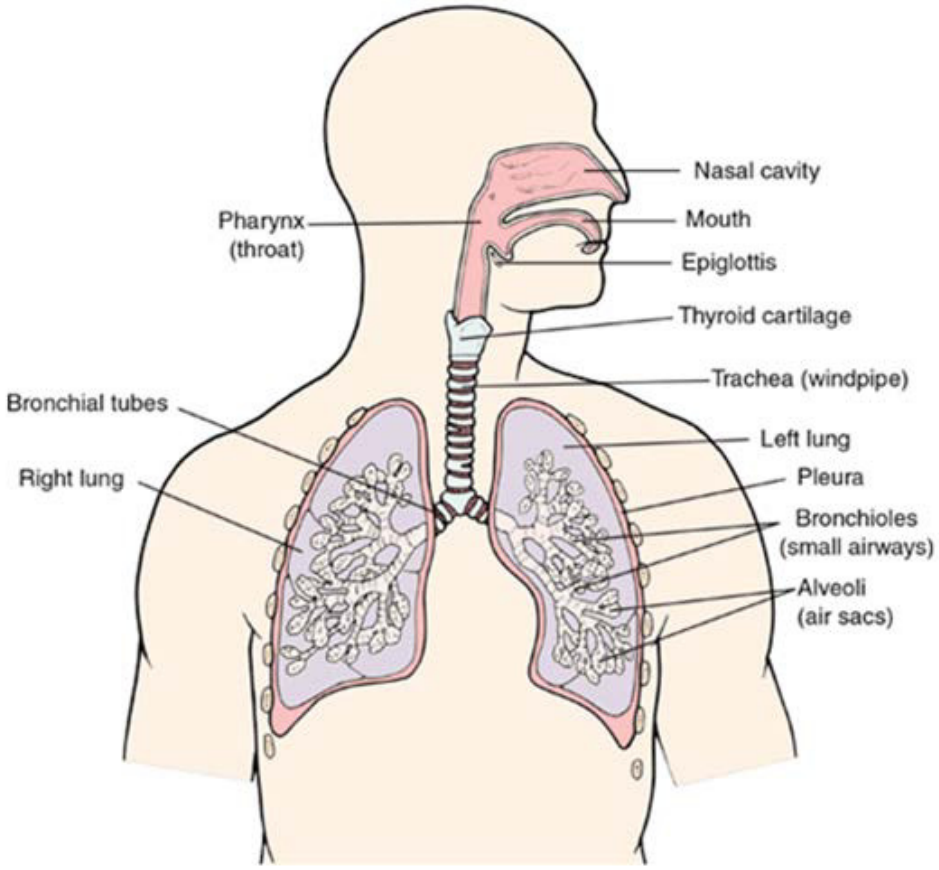
Structures of the respiratory system

Air enters the nasal cavity when we breathe in. The air is warmed and the nasal cavity is lined with tiny hairs that trap dust and other foreign particles entering our airway. The air then passes the **pharynx**, also known as the throat behind the nose and the mouth and continues down past the **larynx** where the vocal chords are located.

The air continues it travels down the **trachea**, also known as the windpipe. It is made of a series of cartilage rings that provide strength and flexibility. The trachea branches off into bronchi both left and right, then these separate into smaller branches called **bronchioles**. At the end of the bronchioles are microscopic bunches of air sacs called the **alveoli**, this is the site at which gas exchange occurs.

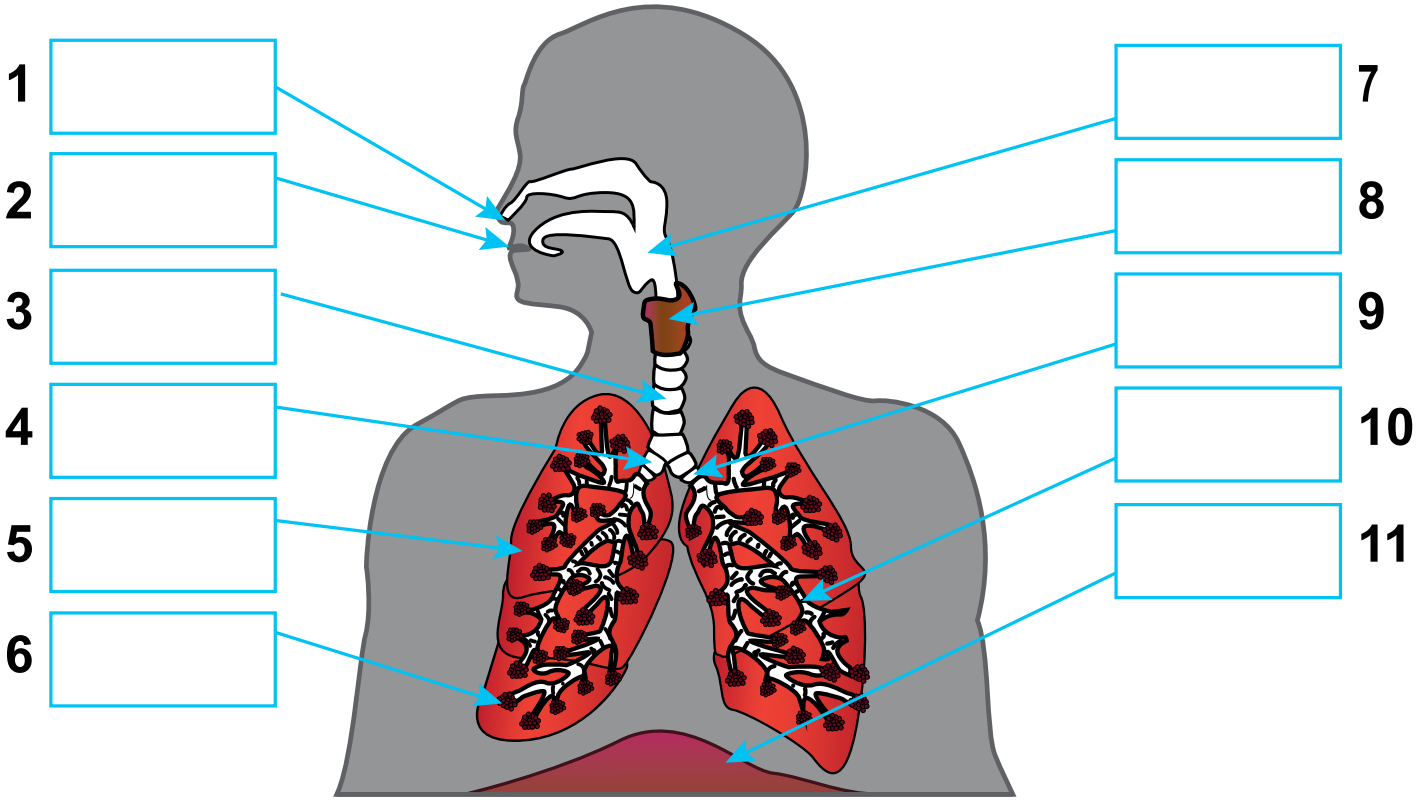
The **ribcage** surrounds the lungs and protects them. The **intercostal muscles** are found between the ribs and assist with raising the ribcage up and down when breathing in and out. The **diaphragm**, muscle that separates the lungs from the abdomen, also works by contracting to increase volume in the chest cavity when breathing in.

Structures of the respiratory system



Checkpoint

Label the structures of the respiratory system:



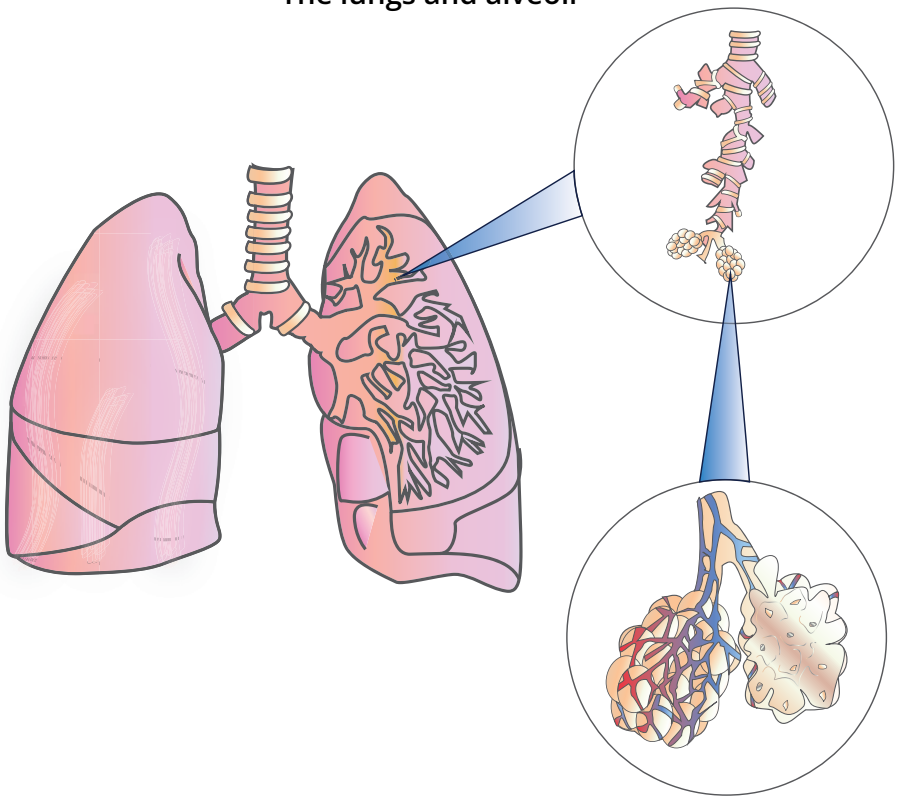
Complete the table by writing the correct structure of the respiratory system next to its function (job).

Structure	Function
	Passageway for air into the body. Prepares the air.
	Tube that extends down the neck from the nasal cavity. Otherwise known as the wind-pipe.
	The voice box where we can make speech sounds.
	The organ where oxygen and carbon diox-ide are exchanged.
	Tube that air moves through from the throat to the lungs.
	Tube that air moves through into the left and right lung.
	Large, dome-shaped sheet of muscle that has a role in breathing.
	Fine tubes that carry air to the air sacs.
	Tiny air sacs where carbon dioxide is re-moved from the blood and oxygen moves into the blood (gas exchange).
	Muscles between the ribs that have a role in breathing.
	Cavity that lies behind the mouth and nose.

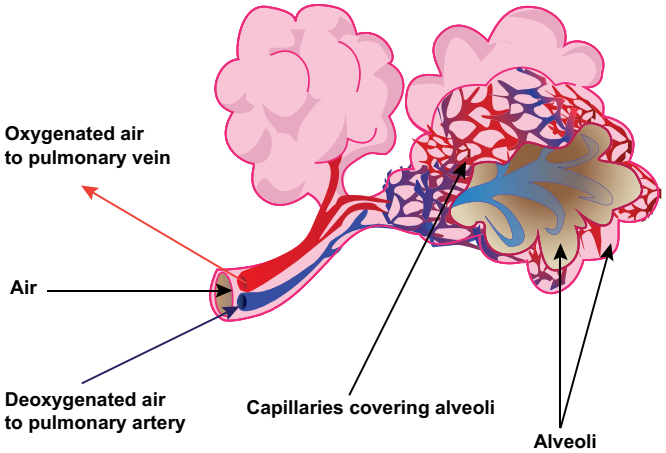
Gas exchange

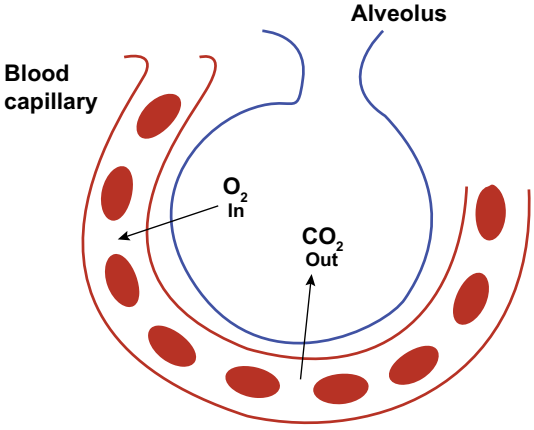
The lungs are made of millions of microscopic bunches of air sacs called **alveoli**, that are attached to the end of the **bronchioles**. This is the place where gas exchange between oxygen and carbon dioxide in the blood and lungs occurs. The air in the lungs contains a higher concentration of oxygen than in the blood and the blood contains a higher concentration of carbon dioxide than in the lungs.
The gases enter and leave the blood by **diffusion**. Oxygen is taken into the blood and carbon dioxide leaves the blood.

The lungs and alveoli



Capillaries and alveoli structure





The alveoli are well designed for gas exchange:

- Being microscopic there are millions of them providing a massive surface area for gas exchange, allowing a large amount of gas to be exchanged very quickly.
- The membrane that covers the alveoli is very thin, one cell layer thick, this allows gas molecules to move in and out of blood easily.
- Each alveolus is surrounded by a capillary network that maintains the concentration gradient, which aids in diffusion of gases.
- The alveoli have a moistened surface allowing gases to dissolve for faster exchange by diffusion

Maintenance of a **concentration gradient** for oxygen and carbon dioxide is essential if the gases are to diffuse in/out of the blood/alveoli. The blood that is entering the capillaries surrounding the alveoli has come from the pulmonary artery and contains blood that has been through the body where the oxygen has been taken up by the body cells, it contains a lower concentration of oxygen than inside the alveoli. The oxygen dissolves into the moist surface of the alveoli and diffuses easily into the blood to be carried by the pulmonary vein back to the heart which will pump the freshly oxygenated blood around the body. Similarly, this blood will have a higher concentration of carbon dioxide from cellular respiration than inside the alveoli, the carbon dioxide will diffuse out of the blood into the alveoli which will be breathed out of the lungs. This continuous process of blood being pumped to the lungs and breathing air in and out in the lungs keeps a favourable concentration gradient for diffusion of gases to occur.

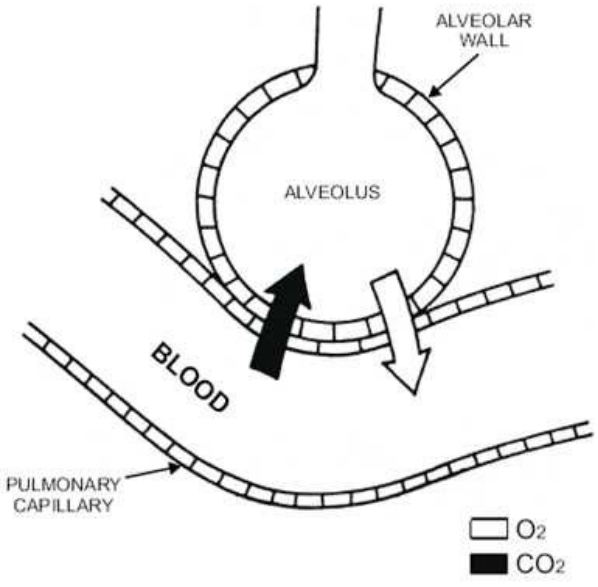
Checkpoint

Oxygen diffuses out of the alveoli and into the blood because there is a _____ concentration of oxygen inside the alveoli and a _____ concentration of oxygen in the blood.

Carbon dioxide diffuses out of the blood and into the alveoli because there is a _____ concentration of carbon dioxide in the blood and a _____ concentration of carbon dioxide in the alveoli.

On the diagram, use a **red pen/pencil** to show the movement of inspired air into the alveolus and the diffusion of **OXYGEN** into the blood capillary. Don't forget to show the concentration gradient.

On the diagram, use a **blue pen/pencil** to show the diffusion of **CARBON DIOXIDE** out of the blood capillary and the movement of expired air out of the alveolus. Don't forget to show the concentration gradient.



The alveoli are well designed for gas exchange. There are millions of them, they have walls that are one cell thick, each is surrounded by a capillary network and their surfaces are moistened.

Outline how each of these features helps with gas exchange.

Feature	How this helps with gas exchange
millions of alveoli	
one cell thick walls	
surrounded by capillary network	
surfaces are moistened	

Activity: Lung dissection

Your lungs are pair of large sponge-like organs that almost fill your thoracic cavity. They are responsible for supplying the body with oxygen and removing carbon dioxide.

They have two main roles:

1. Breathing – this is the process of moving air in and out of the lungs.
2. Gas exchange – this is where oxygen and carbon dioxide is exchanged between the lungs and the blood.

Activity purpose

To identify the features of the lungs that aid efficient gas exchange.

Materials

- 1 x safety glasses
- 1 x sheep pluck (heart and lungs combination))
- 1 x scalpel
- 1 x blunt probe
- 1 x dissecting scissors
- 1 x dissecting board or tray
- 1 x dissecting or stereo microscope
- 1 x microscope slide and cover slip
- 1 x rubber tube
- 1 x bicycle pump
- 1 x 50 cm string or 20 cm garden tie
- 1 x rule
- gloves

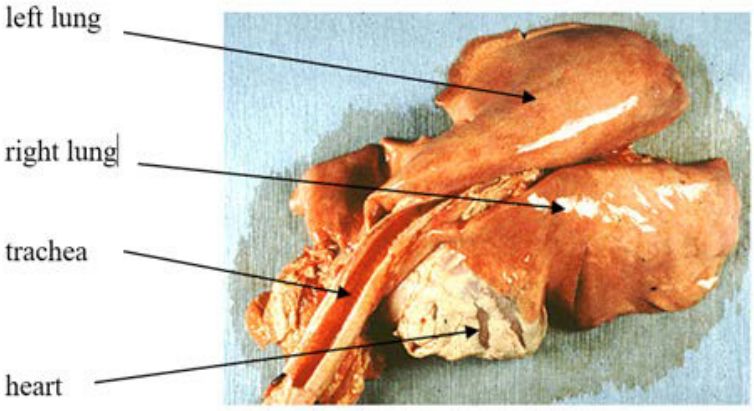
Time required

- 60 minutes

Procedure

1. Arrange the pluck so that the heart is beneath the lungs. This is the ventral view i.e., the view of the heart and lungs from the front as shown below.
2. Identify the structures shown Figure 1 on the pluck you are looking at.

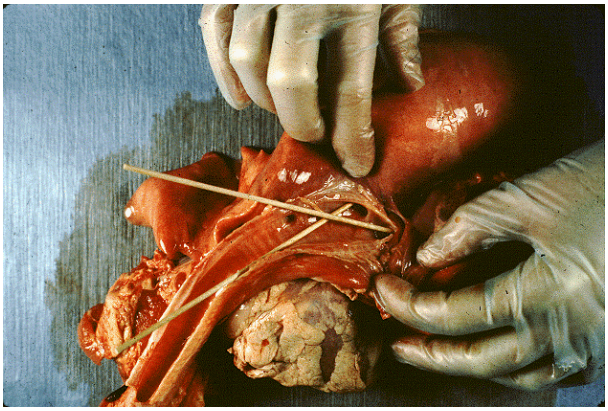
Figure 1: The pluck of a sheep



How many lobes are in each lung? _____

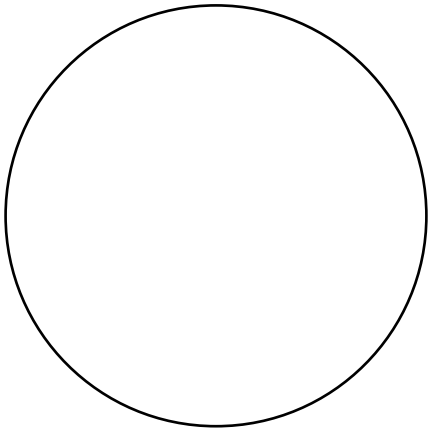
3. Answer Question 1 on page 106.
4. Find the opening of the trachea and insert the rubber tube.
5. Seal the tubing into the trachea using the piece of string or garden tie.
6. Use the bicycle pump to inflate the lungs.
7. Answer Questions 2-4 on pages 106-107.
8. Remove the tube from the trachea.
9. Feel around the trachea to find the place where there is no cartilage.
10. Use the scissors to cut along the trachea along this line until you reach the branches to each lung.
11. Answer Question 5 on page 107.

Figure 2: Opening the trachea



What is the diameter of the last airway with cartilage rings? _____

12. Use the scalpel to keep cutting, following one airway as far as possible.
13. When you can't see the airway anymore, carefully cut a thin slice of lung tissue using the scalpel.
14. Place the slice of tissue on a microscope slide and cover with a cover slip.
15. View the slice under a dissecting or stereo-microscope.
16. Draw a diagram of the view of part of your lung section. If possible, identify the airway, alveoli and blood vessels.



17. Look at the tissue sample under the microscope. Identify any blood vessels present.
18. Answer Questions 6-9 on page 107.

Questions

1. Why are the left and right lungs different shapes?

_____

_____

_____

2. What changes occurred to the lungs when they were inflated?

_____

_____

_____

3. What happens when the pump is removed from the tube? Why does this happen?

_____

_____

_____

4. What would happen if you made an incision in the lungs while they were still inflated and before removing the pump? Explain why.

_____

_____

_____

5. When the trachea is cut it springs open and lies almost flat. What is the function of the cartilage rings in the intact living trachea?

_____

_____

6. Alveoli are structured as shown in the image on the right. Explain why this is more efficient for gas exchange than a smooth sphere?

_____

_____

_____

7. How close are the blood vessels to the wall of the alveoli? Why is this important?

_____

_____

8. The air moving in and out of the lungs travels the same path. Explain why this is inefficient, yet sufficient for human requirements.

_____

_____

_____

9. Explain how air is continually being replenished in the alveoli?

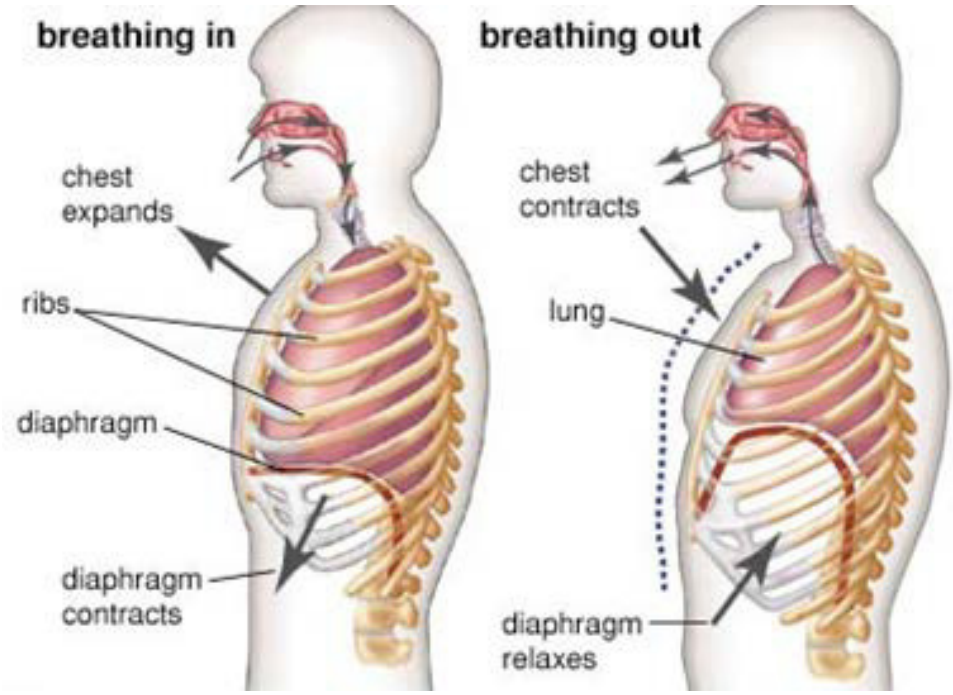
_____

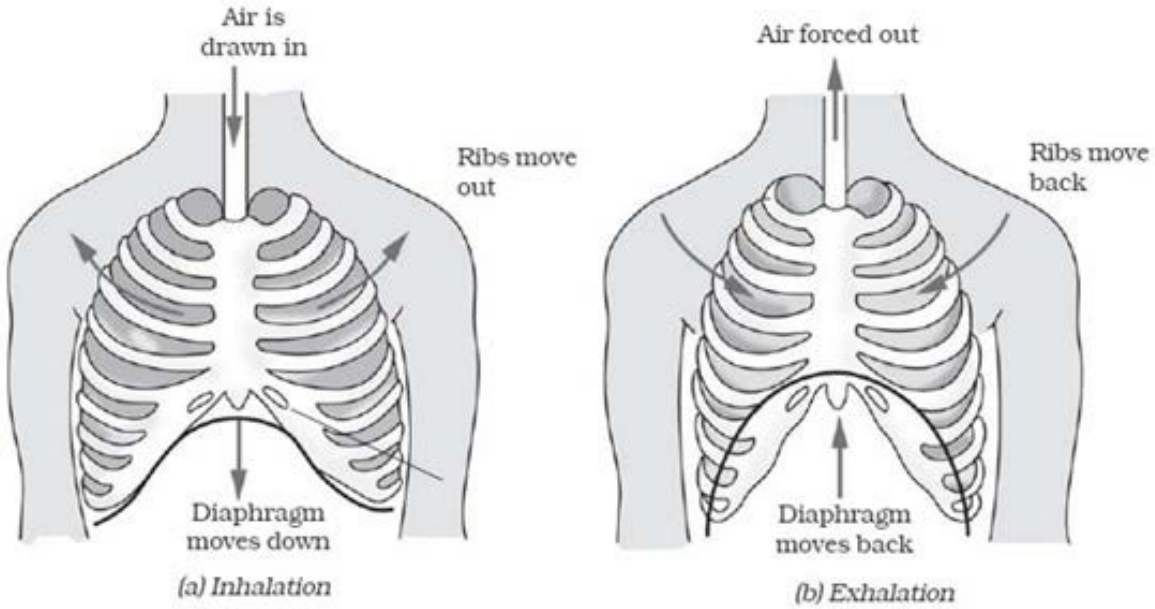
_____

_____

The mechanics of breathing

Breathing or ventilation involves air moving in and out of the lungs. This allows for a constant supply of oxygen rich air to enter the alveoli and the removal of carbon dioxide from the blood. Air moves from places of high pressure to low pressure. Air moves in and out of the lungs due to a difference in pressure caused by a series of muscle contractions that occur during breathing.





Inhalation, or breathing in, is the process of air moving into the lungs. For this to occur the diaphragm and the intercostal muscles contract, this moves the ribcage down and outwards. The volume of the chest cavity increases which decreases the air pressure in the lungs, causing air to move into the lungs.

Exhalation, or breathing out, is the process of moving air out of the lungs. The diaphragm and the intercostal muscle relax, this moves the ribcage up and inwards. The volume of the chest cavity decreases which increases the air pressure in the lungs causing air to move out of the lungs.

Breathing is an involuntary process; it occurs without thinking about it. Breathing can be controlled voluntarily for tasks like speaking, singing or when you need to hold your breath under water.

Checkpoint

Highlight the correct term for each stage of breathing in and out.

	Inhalation	Exhalation
Diaphragm	relax / contract	relax / contract
Intercostal muscles	relax / contract	relax / contract
Ribcage	outwards and upwards / inwards and upwards	outwards and upwards / inwards and upwards
Chest cavity	volume increases / decreases	volume increases / decreases
Air pressure inside lungs	increases	decreases

Summarise each process in a few sentences below.

Inhalation (breathing in)

_____

_____

_____

Exhalation (breathing out)

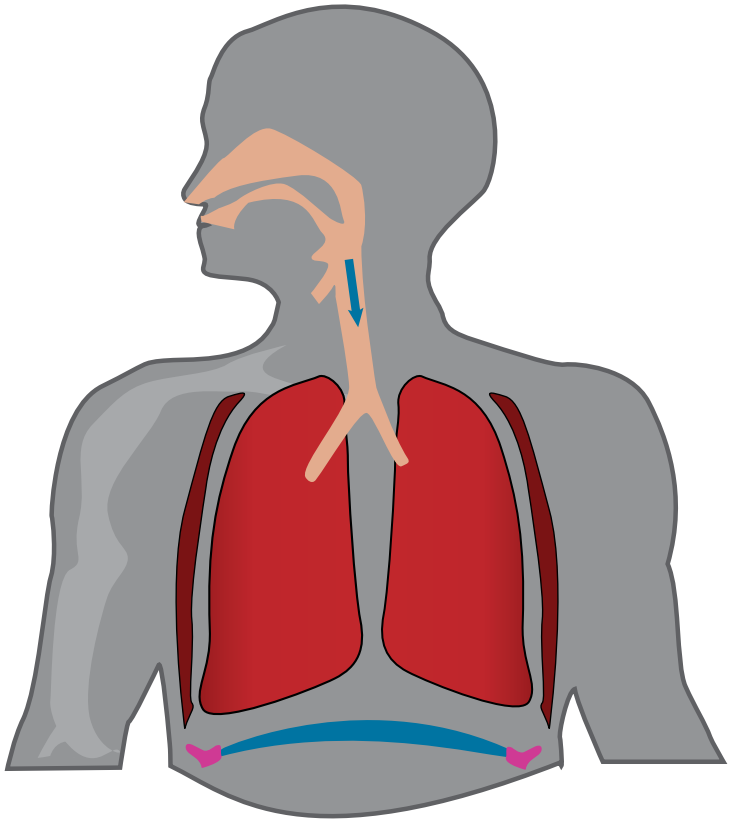
_____

_____

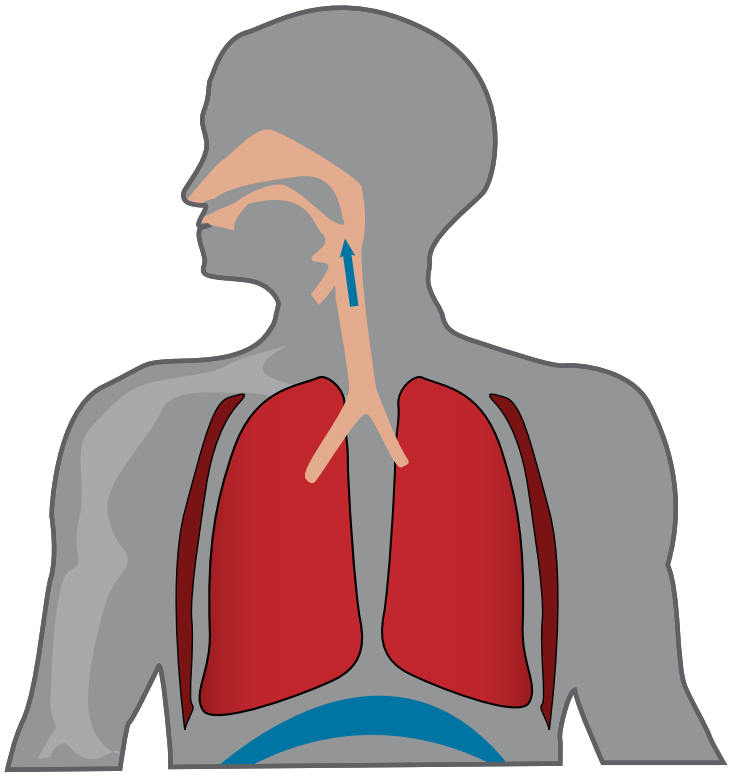
_____

Annotate the diagrams below labelling the processes occurring during ventilation:

Inhalation



Exhalation



Questions

Write the word equation for cellular respiration.

Name the waste products of respiration. How are they removed?

Name the body system that works closely with the respiratory system.

Distinguish between breathing and respiration.

Describe the pathway that air takes as you breath in.

Describe how the structures of the respiratory system enable the exchange of gases quickly and efficiently.

The gases being exchanged are **OXYGEN** and **CARBON DIOXIDE**. These are not the only gases in the air that we breathe in and out. The table below shows the makeup of the gases of inhaled air and exhaled air.

Constituent	Inhaled air	Exhaled air
Oxygen	20.9%	16%
Carbon dioxide	0.03%	4.0%
Water vapour	Variable	Variable but more than in inhaled air
Nitrogen	78.1%	78.1%
Noble gases	0.94%	0.94%

Compare the amount of OXYGEN in inspired air and expired air. Why is there a difference?

_____

_____

Compare the amount of CARBON DIOXIDE in inspired air and expired air. Why is there a difference?

_____

_____

Explain why there is no change in the amounts of NITROGEN and INERT GASES in inspired air and expired air.

_____

_____

_____

Describe the sequence of events that occur during breathing in and out.

_____

_____

_____

Activity: Making a model of the lung

Use the instructions on the following website to make a model of the lung to help explain the mechanics of breathing.

https://www.instructables.com/Make-a-Human-Lung-Model/

Assessing respiratory health

Spirometry, pulse oximetry, and the use of stethoscopes are all important tools that doctors use to assess respiratory system health.

Spirometry is a test that measures how much air you can breathe in and out of your lungs and how quickly you can breathe it out. It is used to diagnose and monitor a variety of respiratory conditions, including asthma, chronic obstructive pulmonary disease (COPD), and cystic fibrosis.

Spirometry is performed by blowing into a mouthpiece connected to a spirometer, a machine that measures lung volume and airflow. The spirometer records the following data:

- Forced vital capacity (FVC): The total volume of air that you can exhale in one forced breath.
- Forced expiratory volume in one second (FEV1): The volume of air that you can exhale in the first second of a forced breath.
- FEV1/FVC ratio: A measure of how quickly you can exhale air from your lungs.

Doctors use this data to diagnose and monitor a variety of respiratory conditions. For example, a low FEV1/FVC ratio may indicate asthma or COPD.

Pulse oximetry is a test that measures the amount of oxygen in the blood. It is a quick and easy way to assess how well the respiratory system is working. Pulse oximetry is often used to monitor patients with respiratory conditions, such as asthma and COPD, as well as patients who are under anaesthesia or in critical care.

Pulse oximetry is performed by placing a small sensor on the fingertip or earlobe. The sensor measures the amount of oxygen in the blood by measuring the absorption of light by the blood cells.

A normal oxygen saturation level is 95% or higher. A lower oxygen saturation level may indicate a respiratory problem, such as asthma, COPD, or pneumonia.

Stethoscopes are used to listen to the sounds of the heart, lungs, and other organs. Doctors use stethoscopes to detect abnormalities in the lungs, such as wheezing, crackling, and diminished breath sounds. Stethoscopes are also used to monitor the effectiveness of respiratory treatments. The stethoscope amplifies the sounds of the body, making it easier for the doctor to hear them.

When listening to the lungs, doctors pay attention to the following:

- Breath sounds: Breath sounds should be clear and even. Wheezing, crackling, and diminished breath sounds may indicate a respiratory problem.
- Rhonchi: Rhonchi are low-pitched, rumbling sounds that can be heard when there is obstruction in the airways.
- Wheezes: Wheezes are high-pitched, whistling sounds that can be heard when the airways are narrowed.
- Crackles: Crackles are high-pitched, popping sounds that can be heard when there is fluid in the airways.

Doctors use this information to diagnose and monitor a variety of respiratory conditions.

In addition to spirometry, pulse oximetry, and the use of stethoscopes, doctors may also use other tests to assess respiratory system health, such as chest X-rays and lung function tests.

Checkpoint

Name three respiratory diseases that can be monitored by the use of a stethoscope.

_____

_____

_____

_____

Describe how a sprirometer works.

_____

_____

_____

_____

_____

Describe the purpose of the pulse oximeter.

_____

_____

_____

_____

Explain the significance of the sound of wheezing when listening to the airways.

_____

_____

_____

_____

Activity: Measuring respiratory volume

The lungs are the main part of the respiratory system. They are located in the chest cavity and are like big sponge-filled balloons.

There are three main volume measurements to do with the lungs:

- **vital capacity** is the largest volume of air that can be exhaled following a deep breath
- **tidal volume** is the amount of air inhaled during normal breathing
- **expiratory reserve** is the air that is left in the lungs following normal exhalation

Each of these is useful to know because they can be used to give information about the functioning and efficiency of your respiratory system. Asthmatics will have their vital capacity measured and the rate at which they can exhale that volume of air.

Activity purpose

- **Determining vital capacity** by making a measuring instrument from a 5 L plastic container to measure the amount of air you blow out of your lungs.

Materials

- 5 L plastic container
- permanent marker
- large bucket/trough
- plastic tubing
- 1 x balloon per person
- 250 mL measuring cylinder
- water at body temperature
- scissors

Time required

- 60 minutes

Hint : You may want to do this activity outside of the classroom as there will be plenty of water spillage.

Procedure

Make a measuring instrument from a 5 L plastic container to measure the amount of air you blow out of your lungs.

1. Measure 250 mL of water using the measuring cylinder and pour it into an empty 5 L plastic container.
2. Use a permanent marker to mark the water level and write '250 mL' at this line on the container.
3. Measure out and add another 250 mL of water to the plastic container.
4. Mark the water level and write '500 mL' at the water line on the container.
5. Continue this process until the plastic container is full of water and you have marked a series of water levels on the outside of the container.

Use your instrument to measure your lung capacity. *Beware: This could be a very messy procedure. Have mops and buckets ready to clean up the spilt water.*

1. Fill the bucket/trough approximately half full with water.
2. Fill the plastic container, turn it upside down in the bucket and remove your hand once the top is under the water level making sure that there are no air bubbles in the container.
3. Place one end of a clear plastic tube through the submerged opening of the plastic bottle.
4. Work with a partner to place a clean mouth piece into the tube end that is out of the water and pinch the tube so no air enters. A mouth piece can be made by cutting the blowing end for a balloon.
5. Hold the bottle up so that it does not tip over.
6. Hold your nose closed and exhale as deeply as possible into the container through the tube.
7. Measure the volume (mL) of air in the plastic container.

Results

Draw up a suitable table in which to record your data.

Questions

Why is it important to know your vital capacity?

Does vital capacity change with the size of the person? How does it change and why?

How are respiratory volume values affected by respiratory conditions such as asthma or emphysema?

Diseases of the respiratory system

The primary function of the respiratory system is to exchange oxygen and carbon dioxide between the air and the blood. This process takes place in the alveoli, which are tiny air sacs at the end of the bronchioles in the lungs.

Gas exchange is a passive process, meaning that it does not require energy. Oxygen diffuses from the alveoli into the blood, and carbon dioxide diffuses from the blood into the alveoli. This diffusion is driven by the difference in concentration of oxygen and carbon dioxide between the air and the blood.

Diseases and conditions that reduce the efficiency of gas exchange can do so in a number of ways. For example, they can:

- Damage the alveoli, reducing the surface area available for gas exchange
- Narrow or obstruct the airways, making it difficult for air to reach the alveoli
- Reduce the amount of oxygen in the blood
- Increase the amount of carbon dioxide in the blood

When gas exchange is impaired, the body cannot get enough oxygen and cannot remove enough carbon dioxide. This can lead to a number of symptoms, including:

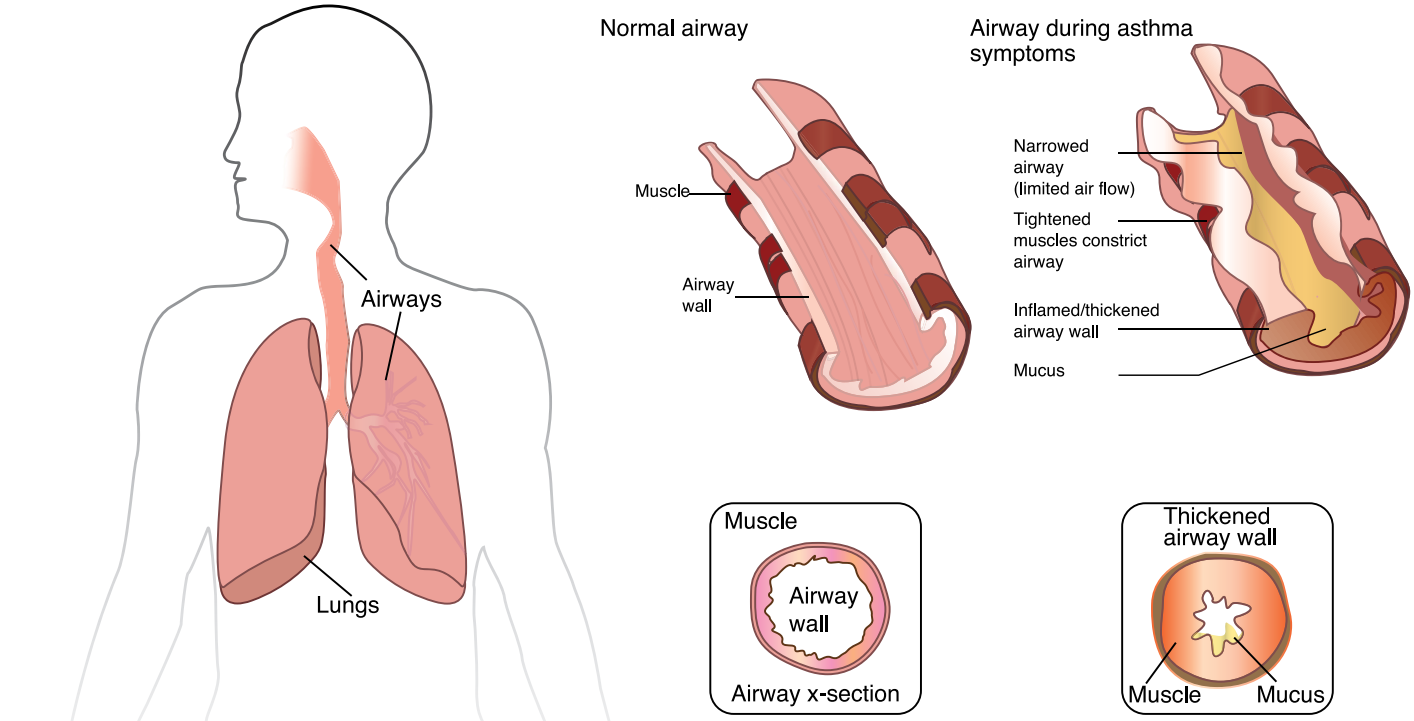
- Shortness of breath
- Wheezing
- Coughing
- Chest tightness
- Cyanosis (a bluish tint to the skin and lips)
- Fatigue
- Confusion
- Headache

In severe cases, impaired gas exchange can lead to respiratory failure, which can be life-threatening.

Some specific examples of diseases and conditions that can reduce the efficiency of gas exchange include:

- Asthma: Asthma is a chronic inflammatory condition of the airways. The inflammation causes the airways to narrow, making it difficult for air to flow through.
- Chronic obstructive pulmonary disease (COPD): COPD is a group of chronic lung diseases that cause inflammation and obstruction of the airways. COPD includes chronic bronchitis and emphysema.

- Pneumonia: Pneumonia is an infection of the lungs that causes inflammation and fluid accumulation in the alveoli.
- Pulmonary oedema: Pulmonary oedema is a condition in which fluid accumulates in the lungs. This fluid can come from the heart, the blood vessels, or the lungs themselves.
- Cystic fibrosis: Cystic fibrosis is a genetic disorder that causes thick, sticky mucous to build up in the lungs and other organs. This mucous can clog the airways and interfere with gas exchange.



Activity: Research diseases of the respiratory system

Use the internet to complete the table about into the following respiratory diseases.

Disease	Cause	Effect on body	Treatment
Asthma			
Chronic Obstructive Pulmonary Disease			
Emphysema			
Lung Cancer			
Lung Infection, Pneumonia			

Chapter review

- Describe the function of the respiratory system.
- List the structures of the respiratory system in the order through which the air travels from the outside to the alveoli.
- Explain the process of breathing.
- Describe how oxygen is exchanged for carbon dioxide in the alveoli.
- Describe the function of the cartilage rings in the trachea.
- List three ways that respiratory function can be measured.
- Describe the purpose of spirometry.
- State what a pulse oximeter measures.
- Describe the symptoms of asthma and the physical changes that occur in the airways when someone is experiencing an asthma attack.

Extras for experts

- Mouth to mouth resuscitation involves rescuers breathing their exhaled breath into the patients lungs. Explain how this can keep the patient alive? (refer to table of percentage make up of gases in exhaled breath above)
- Find out what hypoxia is. Describe a situation you may be in to suffer from this condition and how may it affect you.
- Describe what might occur if someone has a collapsed lung?
  - Is it possible for such a person to function in a fairly normal way. If so how?

CHAPTER 4
Urinary System

Syllabus dot points

- The removal of excess water, metabolic wastes and toxins from the blood is facilitated by the structures of the urinary system (details of filtration, reabsorption and secretion processes not required).
- Urinalysis is a set of screening tests that help diagnose conditions such as urinary tract infections, kidney disorders and diabetes.
- Dysfunction of the kidneys may result in serious illness due to accumulation of toxic substances in the blood.

The Learning intentions and Success criteria are included as a guide to understanding expectations of students as outlined in the syllabus. Students could use them to review their understanding of the syllabus prior to assessments.

Learning intentions

1. Understand that body cells produce wastes and they must be removed to maintain optimum performance.
2. Understand that there are several tests that can be performed on urine to diagnose disease.
3. Understand that the dysfunction of vital organs such as the kidney may result in disease.

Success criteria

- Describe the structure and function of the urinary system.
- Label diagrams of the urinary system.
- Name the major nitrogenous wastes that are toxic to the human body and state their origins.
- Give reasons for the need to remove excess water from the blood.
- Describe the consequences of the build-up of toxic wastes in the body.
- Describe the urinalysis tests available for diagnosis of disease associated with the urinary system.
- Explain how urinalysis can diagnose disease.
- Describe some common diseases associated with kidney dysfunction.
- Describe ways of maintaining kidney health.
- Describe how dialysis machines work to remove toxic wastes and preserve life.
- Describe how kidney transplants work to preserve life.

Key terms

Identify and fill in the definitions for the following key terms:

Key term	Definition
Bladder	
Dialysis	
Excretion	
Homeostasis	
Kidney	
Kidney transplant	
Large intestine	
Metabolic wastes	
Nephron	
Nitrogenous wastes	
Sweat glands	
Ureters	
Urethra	
Urine	
Water balance	

Organs of the excretory system

In humans, the excretory system is comprised of the kidney, skin, lungs and the digestive system.

All systems in nature produce wastes. If wastes are allowed to accumulate many problems can arise, including the potential for diseases to be suffered by living parts of the system. In humans, **wastes** are produced when chemical reactions take place in cells. Cellular respiration, for example, produces carbon dioxide, water and heat as wastes. More complex reactions cause more toxic wastes to be produced. For example, the liver produces **nitrogenous wastes**, such as urea, when it metabolises or breaks down proteins to make new products.

Excretion is the term used to describe the removal by the body of these metabolic wastes such as urea and carbon dioxide.
There are various excretory organs in the human body that act as excretory organs.
Note that elimination is the term used for the removal of non-metabolic wastes such as undigested food.

Checkpoint

Excretion is the removal of:

_____

such as:

_____

Excretion is important because:

_____

Recall: EXCRETION is not the same as ELIMINATION.

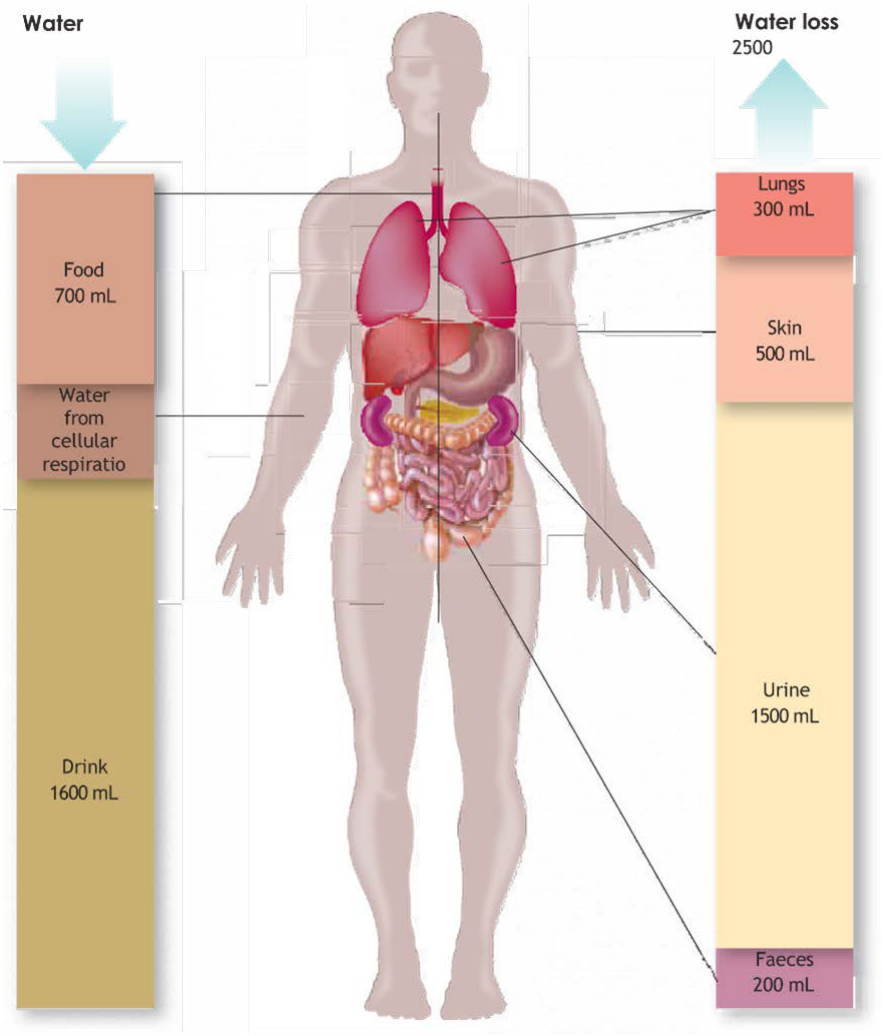
Elimination is the removal of:

_____

The importance of water balance

The cells of our bodies function best if their surrounding environment is kept constant at a level where they work efficiently. This is called homeostasis. The composition of the fluids in the body is regulated and the concentration of substances normally stays fairly constant. Water makes up around 55% to 70% of the mass of the human body. The water, together with important dissolved substances, forms the various fluids of the body. Fluid contained inside the cells is called intracellular fluid. Fluid outside the cells is extracellular fluid. The extracellular fluid is found in two places, the plasma of the blood and the tissue fluid.

The body fluids need to be constantly regulated to ensure the survival of the cells. Substances used by the cells, such as oxygen and glucose for respiration, must be continually replaced. At the same time, the chemical activity within the cell produces wastes. These wastes must be removed because if they accumulate the cells may die. The concentration of body fluids depends on the amount of water in the fluid. To keep the concentration of body fluids constant, the amount of water taken into the body must balance the amount of water that is lost. If there is not enough water, the cells may shrink. If there is too much water the cells will swell. Water is taken into the body by drinking and eating. Food has more water in it than you might realise. The cells also make water, through respiration. This is called metabolic water. Water is lost through urine, sweat, breathing and eliminating faeces.



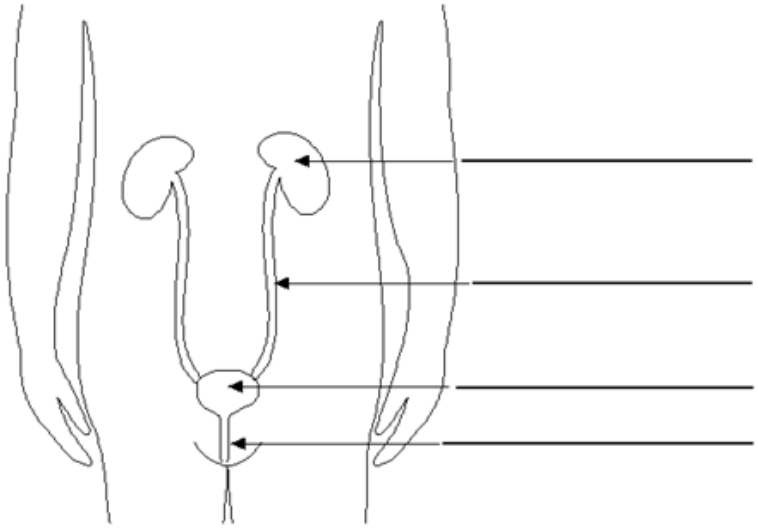
Functions of the urinary system

The urinary system is made up of the kidneys, ureters, bladder and urethra. The two kidneys are bean shaped and are located in the rear abdomen and are partially protected by the lower ribs. Blood is delivered to the kidneys directly from the aorta to be filtered. Once the filtration takes place in the nephrons, the structural and functional units of the kidney, the substances required by the body are reabsorbed back into the blood. The wastes and excess water are collected as urine in the nephrons. The urine is removed via the ureters. The ureters lead to the bladder where the urine is stored. Once the bladder fills, sensory receptors detect the stretch and send messages to the brain. The urine is then eliminated via the urethra.

Checkpoint

The **KIDNEYS** are the major excretory organs of the body. They form part of the **URINARY SYSTEM**.

Label the diagram below to show the position of the kidneys and the other organs/structures that work with the kidneys to remove wastes in the form of urine from the body.



Complete the following table on the function of each of the structures of the urinary system:

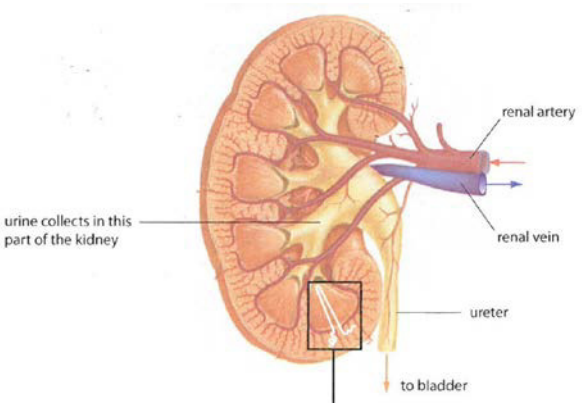
Structure	Function
Kidneys	
Ureter	
Bladder	
Urethra	

Kidney structures

Each kidney is made up of tiny units called _____.

There are over a _____ of them in each kidney.

The nephrons _____ water and dissolved substances from the _____.



Activity: The kidneys

Your kidneys are bean-shaped organs, each about the size of your fist, located either side of your spine at about the level of your waist.

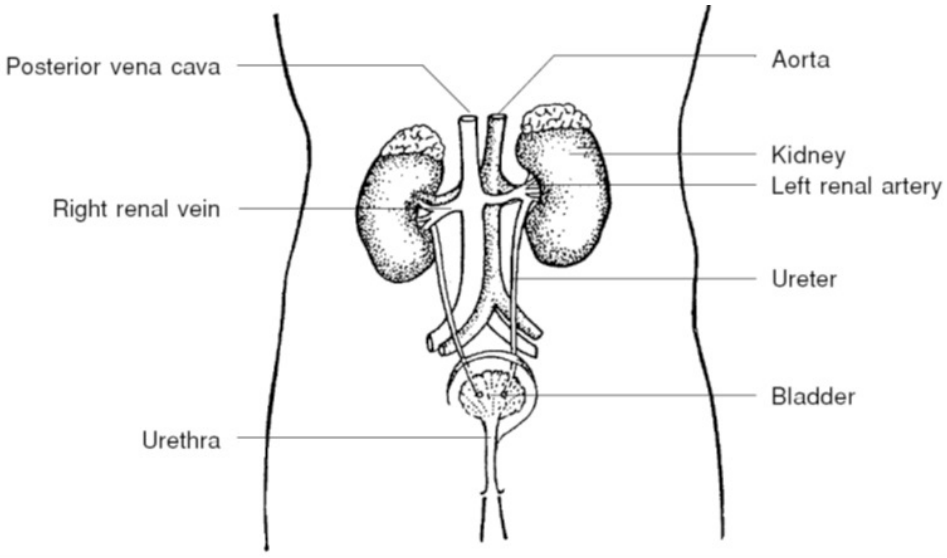
Your kidneys filter blood. The filtering occurs in tiny units inside your kidneys called **nephrons**. One kidney has about a million nephrons. They remove waste products and extra water, which become urine. The urine flows through tubes called **ureters** to your **bladder**, which stores the urine until you go to the toilet.

Metabolic reactions in the cells produce wastes which are removed from tissues by the blood. If your kidneys did not remove these wastes, they would build up in the blood and detrimentally effect the functioning of cells.

Normal urine contents are:

- water
- urea
- sodium
- potassium
- phosphate
- sulfate ions
- creatinine
- uric acid
- calcium, magnesium and hydrogen carbonate ions

Use red - for oxygenated blood, blue - for deoxygenated and yellow - for urine to show the differences between the content of the tubes shown in the diagram below:



Activity purpose

- To observe the structure of the kidney.
- To understand the role of the kidney in maintaining metabolism.

Materials

- sheep's kidney, preferably with some ureter
- scalpel
- hand lens
- forceps, fine
- blunt seeker
- scissors, fine point
- dissecting dish

Time required

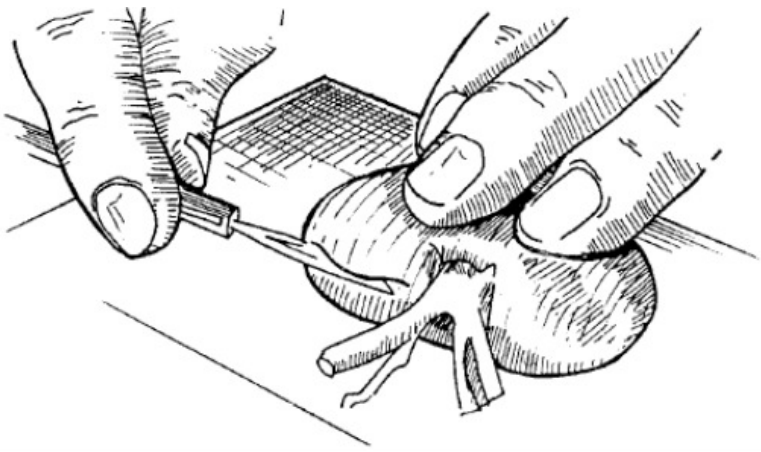
- 45 minutes

Safety

- Scalpel blades are extremely sharp. When cutting, make sure your fingers are distanced from the blade and cut away from your body. When you are not using the scalpel, place it on the dissecting tray. DO NOT use it to probe the heart. DO NOT wash the scalpel.
- Wear gloves at all times. Remove them by pulling the glove from your wrist over your hand, avoiding contact with any blood or tissue.
- Wash your hands following the activity.
- Dispose of all animal matter and gloves according to the teacher's instructions.

Procedure

1. Remove any fatty tissue from around the kidney, taking care not to damage any of the tubes emerging from the concave surface.
2. The kidney may be covered by a transparent layer, the renal capsule. This layer is continuous with the outer coat of the ureter.
   Leave the renal capsule intact.
3. Start cutting the kidney in the vertical section as shown in the diagram (right). Make the incision around the kidney the about the same distance from the attached tubes. Do not cut through the tubes.



4. Cut halfway through the body of the kidney, opening the incision to look for the changes in colour of the layers and the pelvis.
5. The kidney should almost be cut in half with the tube section joining the halves. Lay the halves out flat.
6. Poke a blunt seeker down the pelvis to observe which tube is the ureter.
7. Observe the internal appearance of the kidney. The cortex of the kidney contains the renal capsules and the convoluted tubules, while the medulla contains the loops and collecting ducts. Identify the cortex, medulla, pelvis of ureter, pyramids, and calyces (singular = calyx).
8. You may be able to detect fine radial striations in the lighter pink area. These are due to the loops and collecting ducts, which are aligned parallel to each other.

Results

Draw and label a diagram of your dissection:

Questions

Describe an observed difference between the ureter and the blood vessels attached to the kidney.

Compare the colour of the cortex and medulla of the kidney. State a reason for the difference.

Name the filtering unit of the kidney.

Name the part of the filtering unit found mainly in the cortex.

Name the part of the filtering unit found mainly in the medulla.

Human urine is sterile, unless the person has an urinary tract/genital infection. Explain why there are no bacteria or viruses in urine.

Suggest why we tend to urinate more frequently in cold weather than in hot weather.

Suggest why urine is often darker coloured in hot weather than in cold weather.

Urinalysis to diagnose disease

Urinalysis is a group of tests that examine the physical, chemical, and microscopic properties of urine. It is a simple and non-invasive test that can be used to screen for a variety of medical conditions, including urinary tract infections (UTIs), kidney disorders, and diabetes. Most urine tests can be performed in a doctors surgery or even at home. Proteins and glucose can be detected easily using test sticks that change colour according to the substances present.

Urinary tract infections

A UTI is an infection of the urinary tract, which includes the bladder, kidneys, ureters, and urethra. UTIs are most common in women, but they can occur in men and children as well. The most common cause of UTIs is bacteria, which can enter the urinary tract through the urethra and travel up to the bladder. UTIs can also be caused by viruses or fungi, but this is less common.

Symptoms of a UTI can vary depending on the part of the urinary tract that is infected. However, common symptoms include:

- Pain or burning when urinating
- Frequent urination
- Urgent urination
- Cloudy or bloody urine
- Strong-smelling urine
- Lower abdominal pain
- Back pain
- Fever

UTIs can usually be treated with antibiotics, but if left untreated, they can lead to serious health complications, such as kidney damage.

Some ways to help prevent UTIs include:

- Drink plenty of fluids, especially water.
- Urinate frequently, especially after sexual intercourse.
- Wipe from front to back after using the toilet.

- Shower instead of taking baths

Urinalysis can be used to detect signs of a UTI, such as the presence of bacteria, white blood cells, and red blood cells in the urine. A positive urinalysis for a UTI does not necessarily mean that antibiotics are needed, but it does require further evaluation by a doctor.

Kidney disorders

Kidney disorders are a group of conditions that affect the kidneys. The kidneys are responsible for filtering waste products from the blood and producing urine. Kidney disorders can be caused by a variety of factors, including diabetes, high blood pressure, and autoimmune diseases.

Urinalysis can be used to detect signs of kidney disorders, such as the presence of protein, blood cells, and casts (tiny particles that can be made up of kidney cells, white blood cells, proteins or fats) in the urine. A positive urinalysis for kidney disease does not necessarily mean that the kidneys are failing, but further investigation is necessary.

Diabetes

Diabetes is a chronic disease that affects the body's ability to regulate blood sugar levels. High blood sugar levels can damage the kidneys and other organs over time.

Urinalysis can be used to detect signs of diabetes, such as the presence of glucose (sugar) in the urine. A positive urinalysis for glucose does not necessarily mean diabetes, but further tests by a doctor should occur.

Urinalysis is a valuable screening tool for a variety of medical conditions, including UTIs, kidney disorders, and diabetes. It is a simple and non-invasive test that can be performed in a doctor's office or at home.

If people have any of the following symptoms, they may need a urinalysis:

- Pain or burning when you urinate
- Frequent urination
- Urgent urination
- Cloudy or bloody urine
- Back pain
- Fever
- Fatigue
- Increased thirst

Urinalysis is also recommended for pregnant women, people with diabetes, and people with other chronic medical conditions.

Checkpoint

Describe the purpose of urinalysis.

Describe the common features of a urinary tract infection.

List the substances found in urine that could suggest that someone has a UTI.

List two causes of kidney disease.

Describe the features of diabetes.

Explain how diabetes can be diagnosed using urinalysis.

List 5 symptoms that may indicate kidney disease.

Kidney health

As with most vital organs, a healthy diet and general lifestyle decreases the risk of kidney disease. A balanced diet with limited salt intake, plenty of fruit and vegetables, and drinking water regularly will enable the kidneys to function properly.

Dysfunction of the kidneys can result in serious illness due to the accumulation of toxic substances in the blood. This condition is known as uraemia.

The kidneys are responsible for filtering waste products from the blood and producing urine. When the kidneys are not functioning properly, these waste products can build up in the blood and cause a variety of health problems.

Uraemia can cause a wide range of symptoms, including:

- Fatigue
- Weakness
- Nausea and vomiting
- Loss of appetite
- Itching
- Muscle cramps
- Swelling in the legs and feet
- Shortness of breath
- High blood pressure
- Seizures
- Coma

If uraemia is not treated, it can lead to death.

Uraemia can be caused by a variety of factors, including:

- Chronic kidney disease (CKD)
- Acute kidney injury (AKI)
- Kidney failure
- Kidney stones
- Urinary tract infections
- Certain medications
- Diabetes
- High blood pressure

Treatment for uraemia depends on the underlying cause.

Some ways to prevent kidney dysfunction include:

- Control blood sugar levels if diabetes is present.
- Control blood pressure.
- Maintain a healthy weight.
- Eat a healthy diet low in salt and processed foods.
- Exercise regularly.
- Drink plenty of fluids.
- Avoid smoking.
- Decreasing alcohol consumption/stop drinking alcohol

People who suffer from other diseases such as diabetes mellitus and high blood pressure, tend to have a higher risk of developing kidney disease, as do those who consume large amounts of alcohol on a regular basis.

What is chronic kidney disease?

- The gradual loss of kidney function.
- Symptoms include difficulty urinating, dizziness and swelling.
- It's commonly cause by diabetes, high blood pressure and glomerulonephritis.
- Treatment focuses on the underlying cause of kidney impairment and any complications.
- If the kidneys are still functioning, treatment may involve dialysis or a kidney transplant. If the kidneys have failed, the only treatment option is a kidney transplant.

Kidney disease research

Use the internet to find out about kidney disease. Use Australian sites such as Kidney Health Australia.

Kidney disease is:

_____

_____

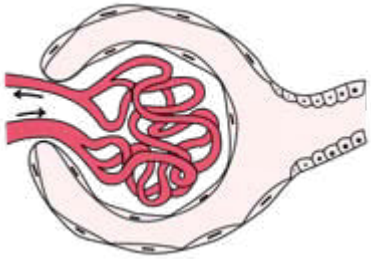
Symptoms of kidney disease include:

_____

_____

_____

How does kidney disease affect the nephron?

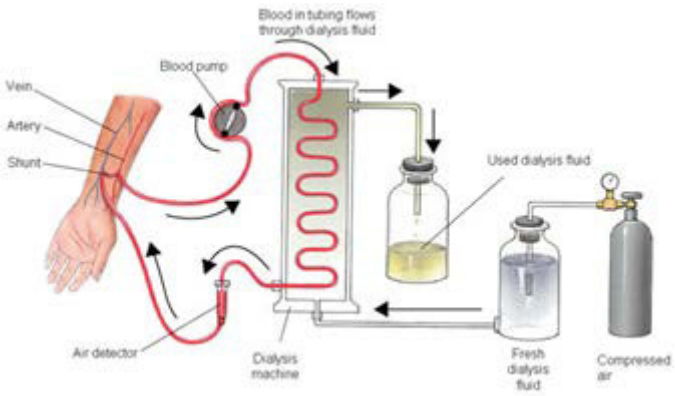


Lifestyle factors that can contribute to the development of kidney disease:

Kidney FAILURE is:

Dialysis is:

Haemodialysis is:



Wastes are removed from the blood but the 'good stuff' stays in during dialysis because:

_____

_____

_____

_____

_____

Chapter review questions

- Describe the structure and function of the urinary system.
- Name the major nitrogenous wastes that are toxic to the human body and state their origins.
- Give reasons for the need to remove excess water from the blood.
- Describe the role of the excretory organs in maintaining the correct water balance within the body.
- Describe the consequences of the build-up of toxic wastes in the body.
- Describe how kidney disease can be detected by testing urine samples.
- Describe ways of maintaining kidney health.
- Describe how dialysis machines work to remove toxic wastes and preserve life.

Extras for experts

- Explain how the liver produces nitrogenous wastes to be excreted from the kidney.
- Explain why water balance is so important to cells.
- Explain why diabetes and high blood pressure are the main causes of kidney disease.

Notes

Image References

Pg 1 Cover Artwork by David Keigwin

Pg 9 Chapter 1 Cover Image: Blood Tests - Image by Karolina Grabowska: https://www.pexels.com/de-de/foto/verwischen-professionell-klinik-krankenhaus-4226925/

Pg 15 Close up Hand of nurse, doctor or Medical technologist in blue gloves taking blood sample from a patient in the hospital https://stock.adobe.com/au/216086445

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Pg 18 Cancer council - free home test kit https://cancerwa.asn.au/news/do-the-test/

Pg 19 A doctor using a sphygmomanometer to measure blood pressure https://www.pxfuel.com/en/search?q=cardiac

Pg 20 Closeup view of an ECG EKG monitor on a operating room https://stock.adobe.com/au/306576515

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Pg 21 "MRI scan" http://www.srht.nhs.uk/sah/images/MRI_Scan.gif

Pg 21 "X-Ray" https://www.wallpaperflare.com/black-and-white-hand-bones-x-ray-xray-human-hand-human-body-part-wallpaper-uipkt

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Pg 24 Girl checking vision with tonometer at eye clinic https://stock.adobe.com/au/100726377

Pg 29 Snellen Eye Chart https://commons.wikimedia.org/wiki/File:1606_Snellen_Chart-02.jpg

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Pg 40 City highway https://www.rawpixel.com/image/3343089/free-photo-image-view-shanghai-city-highway

Pg 43 "External anatomy of the heart" http://www.nku.edu/~dempseyd/HEART_1.htm

Pg 43 "Interior view of the heart" http://www.ohsu.edu/health/health-topics/topic.cfm?id=8485&parent=12326

Pg 44 Heart label https://www.biologycorner.com/anatomy/circulatory/heart_internal.html

Pg 45 "Heart anatomy (interior view)" https://www.enchantedlearning.com/subjects/anatomy/heart/labelinterior/label.shtml

Pg 48 "External anatomy of the heart" Illustration by David Keigwin

Pg 52 "Interior view of the heart" http://www.ohsu.edu/health/health-topics/topic.cfm?id=8485&parent=12326

Pg 55 "Blood vessels" Illustration by David Keigwin

Pg 64 "Spot on: A blood-type test shows four blood-type reactions to antibody serums" http://www.dailymail.co.uk/health/article-1028274/Are-A-B-O--Duffy-Why-know-blood-type.html

Pg 65 Digestive system organs - Illustration by David Keigwin

Pg 73 Man check blood pressure monitor and heart rate monitor with digital pressure gauge https://stock.adobe.com/au/images/man-check-blood-pressure-monitor-and-heart-rate-monitor-with-digital-pressure-gauge-health-care-and-medical-concept/214413535

Pg 78 Cardiovascular Disease statistics https://www.heartfoundation.org.au/bundles/for-professionals/key-stats-cardiovascular-disease

Pg 93 Chapter 3 Cover Image: Photo by Kindel Media: https://www.pexels.com/photo/kid-sitting-under-a-swimming-pool-9044074/

Pg 98 "Structures of the respiratory system" diagrams from Shenton College, Yr11 Workbook 2

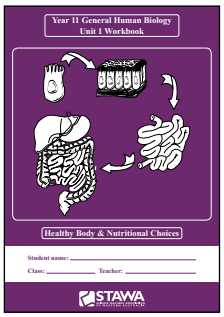
Pg 99 Structures of the respiratory system - Illustration by David Keigwin

Pg 101 "The lungs and alveoli" Illustration by David Keigwin

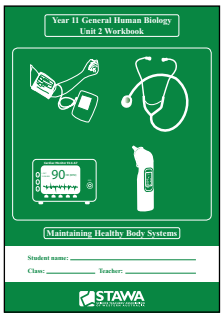
Pg 101 “Capillaries and alveoli structure” Illustration by David Keigwin
Pg 102 Oxygen movement - Diagram from Shenton College, Workbook 2
Pg 105 “Figure 1: The pluck of a sheep” and “Figure 2: Opening the trachea” http://www.ndsu.nodak.edu/instruct/tcolvill/135/r_structure.htm
Pg 108 Mechanics of breathing - Diagrams from Shenton College, Workbook 2
Pg 110 “Inhalation” + “Exhalation” Illustration by David Keigwin
Pg 114 Spirometry - BruceBlaus, CC BY-SA 4.0, via Wikimedia Commons https://creativecommons.org/licenses/by-sa/4.0
Pg 114 OxyWatch C20 Pulse Oximeter - Thinkpaul, CC BY-SA 3.0, via Wikimedia Commons https://creativecommons.org/licenses/by-sa/3.0
Pg 121 Asthma airway - Illustration by David Keigwin
Pg 124 Chapter 4 Cover Image: Photo by Ray Piedra: https://www.pexels.com/photo/clear-liquid-in-drinking-glass-1556381/
Pg 127 Polluted stream https://commons.wikimedia.org/wiki/File:Mixing_of_raw_wastewater_with_a_stream_running_to_LacTanganyika_%286908382775%29.jpg
Pg 128 Water balance - from Human Perspectives 1A1B, Newton and Joyce
Pg 135 PPI drug testing https://www.flickr.com/photos/magnumppi/39362224991

General Human Biology Resources

Year 11 General Human Biology Unit 1 Workbook Healthy Body & Nutritional Choices



Year 11 General Human Biology Unit 2 Workbook Maintaining Healthy Body Systems



Year 12 General Human Biology Unit 3 & Unit 4 Workbook

The STAWA General Human Biology resources support teachers and students of the Western Australian General Human Biology Courses.

Chapters correspond to the topics outlined in the Science Understanding strand of the syllabus. Science Inquiry and Science as a Human Endeavour have been incorporated where appropriate. *Syllabus Dot Points, Learning Intentions* and *Success Criteria* are provided to help support teaching and learning programs.

Practical activities: Experiments, dissections, and interpretation of second-hand data are included, with safety considerations highlighted where applicable. Practical activities provide opportunities for students to further develop science inquiry skills including to formulate tables for data collection and presentation, to practice graphing skills, to draw labelled scientific diagrams and to communicate findings.

Learning support structures: Students are encouraged to define key terms in the glossary and to write their own notes guided by the *'Checkpoints'* as they work through the resources. Checkpoints enable students to consolidate their understanding and to summarise key concepts. *Chapter Review Questions* support revision, while *'Extras for Experts'* enable students to extend their depth of understanding of concepts.

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