

# Solomon Islands Science

Year **8**

Teacher's Guide



Solomon Islands  
**Science**  
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# Introduction to this Teacher's Guide

This Teacher's Guide is designed to help you use the *Solomon Islands Science Year 8 Learner's Book*. The Teacher's Guide provides you with resources to help make your planning and teaching more effective.

Each chapter in the Teacher's Guide corresponds to a chapter in the Learner's Book and provides:

- the strand and sub-strand dealt with in the chapter
- advice on how much class time should be spent on the chapter
- the general and specific learning outcomes for the strand; that is, what the learners should achieve by studying that chapter
- answers to the challenge questions
- notes on each activity in the chapter, including resources needed, teacher's support notes and answers to questions about the activity
- answers to the questions at the end of each unit
- answers to the questions in the chapter review at the end of the chapter.

You may find some answers are different from your opinion—this is because some questions have more than one answer.

Each activity in the Learner's Book includes a list of resources needed to complete the activity. If the resources listed are not available, be creative in finding alternatives, ensuring that the fundamental principles of the activity are achieved. For example, if Bunsen burners are not available, use other safe ways for heating, such as a gas or kerosene stove or firewood to heat up a container of water. Hot water can be used to heat up the test tubes.

## The outcomes-based approach

This Teacher's Guide is written for a Learner's Book and a syllabus that follow the outcomes-based approach to learning. This has been adopted by the Ministry of Education and Human Resource Development through the Curriculum Development Division as part of the new curriculum for Basic Education from Years 1 to 9.

The basis of this approach is that learners should acquire knowledge, understanding, skills, values and attitudes that will be useful to them later in life. The approach is based on the needs of the learners rather than the needs of the subject. The emphasis is not on the traditional content of the subject, but on choosing those elements of the subject that will be useful and valuable to learners. The curriculum is learner-centred rather than subject-centred.

This learner-centred approach also contrasts with the teacher-centred approach of the past. The emphasis is on learners learning for themselves with the guidance of the teacher rather than being taught by the teacher. This means active learning in which learners do things that help them to find out for themselves, think about and draw on their own knowledge and experience, make observations, do experiments and carry out practical tasks. This can be called *learning by doing*.

Because of this approach, the syllabuses, Learner's Books and Teacher's Guides refer to *learners*, which suggests active participation in the process, rather than *students*, which suggests passive reception of knowledge.

One way to understand this approach is to think of the more traditional approach of our schools as banking education. In banking education, the teacher regards the learners as empty vessels to be filled with knowledge. The learners are tested by being asked to reproduce the knowledge that the teacher has given them. This method relies a lot on the learner listening to the teacher, copying notes from the board, learning them and reproducing them later. This can be done successfully without the learner even understanding fully what they are writing and reading.

The present approach can be called *problem-posing education*. This presumes that learners already have their own ideas, knowledge and skills based on previous experience in school or elsewhere. The job of the teacher is to build on these by posing problems to the learners that make them think about their own ideas and experiences, as well as adding new knowledge and skills to it. Learners are also exposed to experiences by being asked to observe reality outside the classroom, look at pictures or diagrams, examine statistics and read passages and thus find out knowledge and ideas for themselves. They are then expected to express these in their own words, not those of the teacher, to prove that they have really understood what they have learnt. Learners are encouraged to be responsible for their own learning, to think for themselves and form their own ideas and opinions. They are encouraged to become critical thinkers and to be able to face new challenges and situations for themselves. Learning becomes a cooperative effort between the learner and the teacher.

In addition, education is seen not just as a way of passing on knowledge and skills but a way of forming the kinds of values and attitudes that will make people good and responsible citizens in the future.

## The approach of the Learner's Book

The Learner's Book follows all these principles. It is not just a summary of the factual knowledge and concepts of the subject. There are activities for the learners to do and these activities form an essential part of the learning process. It is no longer good enough just to read the book. Learners must also do the activities in the book.

In the past, activities were often included only at the end of a chapter, and learners and teachers often ignored these and moved on to the next section. With this book, the activities are part of the text and must be completed in order to fully learn. Some units start with an activity that helps learners to find out information, think about their own experiences and knowledge, or practise skills for themselves.

Some of the activities are to be done in groups. This is to encourage interaction among the learners, because learners can often learn as much from each other as they can from the text book or the teacher.

## The Learner's Book and the syllabus

The Learner's Book is based on the strands and sub-strands of the syllabus. The chapters of the Learner's Book are based on one or more sub-strands of the syllabus, and the order of the chapters follows the order of the sub-strands of the syllabus.

Individual chapters, however, do not always follow the order of the outcomes in the sub-strand of the syllabus. Each sub-strand of the syllabus outlines the knowledge, understanding, skills and attitudes—that is, the outcomes—we want learners to achieve. The Learner's Book gives guidance about how the learners might best achieve those outcomes. The best way to do this is not always to follow the exact order of the outcomes in the syllabus. In teaching, therefore, you should usually follow the order of presentation in the Learner's Book rather than following the order of outcomes in the syllabus. As long as the outcomes are achieved, we have reached our goal.

The Learner's Book is full of illustrations, photos and diagrams. These are not just included for decoration. They should be used as an important part of your teaching. They are often just as important as the words of the book.

## **Timing: The syllabus and the yearly program planner**

The yearly program planner on page vii shows you the total amount of time that should be spent on teaching each of the topics covered by the Year 8 Learner's Book. This section shows the entire learning program for one year of Secondary Science course for Year 8. The suggested teaching times are based on 17 teaching weeks per semester and 34 teaching weeks per year in Years 7 and 8.

Try to spend the indicated number of weeks teaching each strand of the syllabus. Schools vary a great deal in the ability of their learners. This is partly due to the selective nature of our education system at present. After Year 6, most learners choose to go to National or Provincial Secondary Schools if they can. This means that the most able academic learners move to those schools, and many Community High Schools have learners who learn at a slower pace. It is impossible, therefore, to suggest that all schools should teach the strands and sub-strands in the same way or at the same speed. If you find you are unable to teach all the topics in a strand or sub-strand in the time suggested, try to choose the most important topics and leave some of the rest. Do not spend so long on one topic that you miss other topics altogether. Try to teach at least some of every chapter in the Learner's Book.

If you find you have extra time available, devise some activities to study the topic in more depth. If you have very quick learners, make up some extra activities that challenge them to think about the topic in greater depth.

## Year 8 program planner

Year 8 Semester 1									
Weeks	Week 1 (1 week)	Weeks 2–4 (3 weeks)	Weeks 5–7 (3 weeks)	Weeks 8–10 (3 weeks)	Weeks 11–12 (2 weeks)	Weeks 13–16 (4 weeks)	Weeks 17–18 (2 weeks)	Week 19 (1 week)	Week 20 (1 week)
Periods (68)	n/a	12	12	12	8	16	8	n/a	n/a
	Energy and change	Life and living	Natural and processed materials	Earth and beyond	Life and living	Energy and change	Revision program	Examination program	
	8.1 Simple machine structure and stability The ramp Levers Going for a spin: wheels, axles and gears Pulleys Structure and stability	8.2 Body systems Food Digestion Blood and circulation Excretion: getting rid of waste Respiratory systems	8.3 Chemical reactions and everyday uses What are chemical reactions? Reaction types Rate of chemical reactions and their importance in our daily lives	8.4 Atmosphere, climate and weather The atmosphere Weather	8.5 Plant processes and marine systems Plant transport systems Photosynthesis and respiration Marine systems	8.6 Heat and sound Heat Expansion of solids, liquids and gases Sound Hearing			

## Year 8 Semester 2

Year 8 Semester 2									
Weeks	Week 21 (1 week)	Weeks 22–24 (3 weeks)	Weeks 25–27 (3 weeks)	Weeks 28–31 (4 weeks)	Weeks 32–35 (4 weeks)	Weeks 36–38 (3 weeks)	Week 39 (1 week)	Week 40 (1 week)	
Periods (68)	n/a	12	12	16	16	12	n/a	n/a	
	Earth and beyond	Natural and processed materials	Life and living	Natural and processed materials	Energy and change	Revision program	Examination program		
	8.7 The fragile crust Plate tectonics At the edges Earthquakes Volcanoes Faults and folds Geological time	8.8 Small particles of matter Elements Inside atoms	8.9 Microbes What is a microbe? Reproduction of microbes Friend or foe?	8.10 The periodic table Atoms and the elements Arranging the elements Discovery of the elements The role of electrons	8.11 Electricity Static electricity Moving electricity Using electricity Electrical energy calculations				

## Teaching methods

It is important to plan and prepare before classes. The following are some teaching methods or approaches you can use to facilitate effective learning in your classrooms. To ensure effective applications of these methods, teacher planning and good preparation are important beforehand.

### Fieldwork and excursions

Fieldwork means any work outside the classroom. This helps learners to link classroom learning to real-world experience outside the classroom. Learners are instructed to apply skills such as observation, investigation and interviewing as a means of collecting information about the topic for themselves, thus achieving the outcomes of the syllabus in more practical and realistic ways. This is very important in Science, which teaches learners about the real world around them.

Fieldwork is particularly important in the outcomes approach, which aims to link the learning to the real needs of the learners. It should not be treated as an 'optional extra'.

To ensure an effective and successful outcome, you must consider important aspects of fieldwork, such as good classroom preparation and planning, the best way to carry out work in the field and follow-up work in the classroom.

This means you must go and look at the area you plan to do fieldwork in before you do it, and decide exactly what you want learners to observe and do when they go there.

The best way is often to provide a questionnaire to the learners before they go. A lot of the work can then be done by learners working in groups to answer the questions, without too much help from you. The activities in the Learner's Book will often give the basis for a questionnaire.

Fieldwork takes time and may have to be fitted in after the normal teaching time—on an afternoon or a weekend. Some fieldwork can be done by giving questionnaires for learners to fill in during their own time by looking at their own area—either after school or, in boarding schools, during the holidays.

Fieldwork is difficult in town schools but should not be ignored by those schools. You may have to rely on questionnaires to help learners to do the fieldwork in their own time, as described above. For instance, learners can be encouraged to go out and look at a river or stream, or the sea and coastline, or a farming area, on weekends. Assignments can also be given for learners to do in their home areas during holidays; this helps them to realise that what they are learning applies to their home area.

### Report writing

The report-writing process involves researching an issue thoroughly, often through fieldwork, collecting the information through one or more of the techniques explained in this section, and organising the information in a logical and clear manner.

Many of the units in the Year 8 English course teach learners about research and report writing. You should ask the English teachers what learners are doing and even get their cooperation in sharing an exercise to write up fieldwork or other information as part of their English course.

### Group work

Learners take a more active role and talk naturally when they are allowed to work in small groups. In this way they can express their ideas rather than listening passively to the teacher, as is often the case in the whole class. Group work encourages learners to talk or do things for themselves as part of the learning process. Learners discuss, share views and interact in their learning in small groups and present their collective work to the class. To ensure group work achieves effective learning, preparation and class management is important for teachers.

Group work must be properly organised and supervised. You must not use it as an excuse to sit back and let learners get on with it. On the other hand, learners will often not talk freely if they know the teacher is listening, so you must leave groups to talk on their own. Sometimes it is even effective to walk out of the classroom for a while to give groups a chance to get going without you listening.

The role of the teacher in group work should be:

- **Choose the topic:** Groups can only discuss topics that they know something about and for which it is possible to have different points of view or opinions. You cannot discuss a topic such as 'How are volcanoes formed?' because there is only one answer to the question and answers are right or wrong. However, you can discuss 'How can people who live near volcanoes prepare for what to do if the volcano erupts?' There are many different answers and each learner can suggest different ideas.
- **Set the objective:** Make sure each group knows exactly what to discuss and has a set of clear questions to answer. It is not enough just to say 'Discuss this topic'.
- **Organise the groups:** Groups should be small enough for everyone to be able to talk. They should usually be mixed—different island groups, not all *wantoks*. It is good to mix girls and boys but do not do this if it leads to some learners being too shy to talk. All-girl groups may sometimes be better.
- **Organise the seating:** Good discussion will only take place if learners face each other in a circle. You cannot talk to someone else's back! If possible, classrooms may be arranged by grouping desks in circles facing each other so group work is easy and no movement is necessary. In crowded classrooms you may allow some groups to go outside and work.
- **Circulate and listen to progress:** It is best to do this only after giving time for discussion to start. Try to make sure all learners are being given a chance to speak. If you see certain people dominating groups, intervene and ask others their ideas. If groups are having difficulty, give guidance by explaining the topic, giving some extra questions or asking individuals their ideas. If groups are doing well on their own, do not interfere.
- **Decide on the language to be used:** In Year 8 many will want to use Pijin. It is best to let them do so or they may say nothing. There is nothing wrong with a local language if everyone in the group speaks it. But try to get each group to report back their ideas at the end in English, either verbally or in writing. If groups are confident to use English throughout, allow them to do so.
- **Reporting back:** It is often a good idea to appoint a chairperson, who will report back to the whole class at the end, but this is not always necessary. Each member may write their own ideas, or groups may just learn from the process of discussion.

## Debate and discussions

Group work involves learners in debates and discussions, and these are active ways of engaging learners. Learners can collect information through research to use in debates about a particular topic or to share ideas with others in the classroom. They will learn a lot in this process.

Debates are good to encourage learners to form their own opinions about a topic. In Year 8 we should encourage this by using simple topics. At this level, debates should be informal.

## Photograph interpretation

Looking at photographs in the classroom helps learners to understand and remember the words they hear by seeing the real thing in photographs. This gives them the mental pictures to enable them to think about such things later. The skills needed include the ability to recognise what photographs show, see relationships within the photographs and explain certain features in the photographs—to interpret them. You can develop these skills in learners by encouraging them to look at all the photographs in the book and asking questions about what they show. Learners should analyse and interpret photographs of the topic they are learning about. Photographs are a valuable part of your teaching.

Many learners may not be used to looking at photographs, so things in the photographs that are obvious to us may puzzle some learners. Remember that photographs are just colours and lines on paper and we have to use these to decide what the photograph shows. If we are not used to doing this it may not be easy. There may be some small 'boxes' in one part of a photograph and we may know these are houses, but some learners may not recognise these as houses unless we point it out to them.

Be particularly careful of photographs of things some learners may have never seen. Even simple things, such as types of vehicles, may be unfamiliar to people in some rural areas. Learners will probably never have seen a wolf or a desert or an electron microscope, so we must point out what the photo shows, not just presume that learners see what we see.

Reality has three dimensions, while photographs only have two dimensions. Learners must get used to using perspective on photographs; that is, recognising that things that are close are large and things that are small are further away. This can sometimes cause confusion. Remember also that one of the differences between a photograph and a map is that photographs usually show things from the side and show perspective as we normally see them. Maps show things looking directly down from above and have a different perspective.

## **Graphs and statistics**

Representing information through graphs and statistics is an important and effective way of teaching and learning about some topics. Instead of providing a lot of information in words, representing it in a graphical or statistical way may make it easier for learners to understand the importance of the information. You should not expect learners to remember statistics. They are there to illustrate a point, not to be learnt.

## **Research interviews and questions**

There are different ways of using research interviews with people to collect information about a topic. This could include informal chats; questions for particular people prepared in advance; or standardised questionnaires by which learners work in small groups, ask the same questions to a large number of people and later convert the answers into statistical form.

Prepared questions are also useful for fieldwork and they can be used alone or with any of the above techniques to collect information.

## **Guest speakers**

Using people from outside the school with specialised knowledge and skills on a particular topic to speak to the learners is one way of altering the normal classroom teaching and learning. Through this process, learners will appreciate the importance of specialised knowledge other people in the community have.

## **Visits**

This links with fieldwork. If possible, try to visit areas similar to those discussed in the Learner's Book.

## **Case studies**

A case study is a detailed study of a particular area or topic. Presenting a case study helps learners to understand the reality of a particular topic. It helps to convert the abstract topics in the syllabus into concrete reality so learners will understand them better.

## Assessment, recording, monitoring and reporting

Assessment is a process in which teachers gather, analyse and interpret assessment information and data. You should use such information and data to develop and implement enrichment support and intervention strategies to improve the teaching and learning processes in the classroom.

It is important to assess the learners to know what standard they are at and the progress they are making in the classroom. It is an important ongoing process in teaching and learning and it should be used continuously, meaning it should not be done only at the end after completing a particular topic.

Assessment should include *formative assessment*, which takes place throughout every teaching topic and every chapter of the Learner's Book. Formative assessment emphasises continuous assessment as part of the teaching and learning process. 'Assessment *for* learning' focuses on using the assessment information to improve teaching and learning as an ongoing process. This helps you to monitor learners' progress on a continuous basis. You should constantly observe and evaluate learners' achievements, collecting data on areas of improvement and new skills that they acquire. In doing this, you should focus on the general and specific learning outcomes stated in the syllabus. Learners should also be aware of what is being assessed and the assessment techniques and criteria being used. Learners can then judge for themselves whether they are achieving the general and specific learning outcomes.

*Summative assessment*, for example a unit or chapter test, tells you what learners have learnt or can do after a whole section of teaching. This type of assessment focuses on 'assessment *of* learning' and is directed towards ranking learners from their performance on the learning outcomes. This will also help you to devise ways of improving the learners' performance in the classroom. These tests are important but assessment should not be done only by test. Assessment must cover skills as well as just knowledge. You should test whether learners can, for example, interpret a photograph or a graph, as well as test the factual knowledge they have learnt.

*Diagnostic assessment* is the type of assessment that you are encouraged to do in order to identify a learner's ability or achievement level in a specific learning outcome. This helps you to identify the learner's ability and, if necessary, devise remedial tasks as an intervention strategy. Learners who have achieved the specific learning outcome should be given enrichment support to encourage them to maintain their achievement level.

### Assessment techniques

#### Verbal assessment

- Answering questions
- Making a verbal report
- Interviewing

#### Written assessment

- Doing an activity (from textbooks or self-prepared)
- Doing an assignment
- Writing a report
- Sitting for a test or an examination

#### Practical assessment

- Participating in a field trip/excursion and collecting information
- Demonstrating a particular task
- Drawing, interpreting and using a map
- Analysing a photograph
- Basic library research and collecting information

## Group-work assessment

- Participating in a group task and discussion
- Participating in a role-play and drama

## Other

Other assessment techniques include:

- observation of what individual learners do
- consultation with individual learners by asking them questions
- focused analyses of learners' work such as portfolios, or a collection of work they have done, to determine how each individual learner is performing in their learning process.

## Assessment of individual specific learning outcomes using achievement levels

Learners' achievements in Science will be reported in levels instead of marks. These levels of achievement are derived from curriculum outcomes in the Year 8 Science syllabus. Six levels are used to describe learners' achievement of the learning outcomes, ranging from L5, the highest, through L4, L3, L2, L1, to L0, the lowest.

Learners achieving at L0, L1 and L2 are considered to be at a critical level (Lc) and need urgent assistance. Learners in this category must be given remedial work in order to reach the curriculum standard or benchmark. Learners achieving at L3+, which is a combination of L3 and L4, require assistance and must be given remedial work in order to acquire the curriculum standards or benchmark. Learners achieving at L5 are considered to have reached the curriculum benchmark and should be given enrichment support in order to maintain high excellence. Note the following:

- Learners achieving at L5 are considered to have achieved the curriculum benchmark and have full mastery of the learning outcome.
- Learners achieving at L1 to L4 are considered to have partially achieved the curriculum benchmark and have substantial, moderate, minor or minimal mastery of the learning outcome.
- Learners achieving at L0 are considered to have not achieved the curriculum benchmark and have no mastery of the learning outcome.

Level	Assessment criteria	Judgement criteria	Achievement award
L5	Statement to identify the fifth and highest level of achievement	Criteria for judging learners' achievement	Achieved (A) Full mastery of learning outcome
L4	Statement to identify the fourth level of achievement	Criteria for judging learners' achievement	Partially Achieved (PA4) Substantial mastery of learning outcome
L3	Statement to identify the third level of achievement	Criteria for judging learners' achievement	Partially Achieved (PA3) Moderate mastery of learning outcome
L2	Statement to identify the second level of achievement	Criteria for judging learners' achievement	Partially Achieved (PA2) Minor mastery of learning outcome
L1	Statement to identify the first level of achievement	Criteria for judging learners' achievement	Partially Achieved (PA1) Minimal mastery of learning outcome
L0	Statement to identify the lowest and last level of achievement	Criteria for judging learners' achievement	Not Achieved (NA) No mastery of learning outcome

## Assessment criteria as achievement levels

Following is an example of an assessment criteria framework for a specific learning outcome (SLO) in Year 8 Science. The SLO is the curriculum benchmark. The statements in the table are assessment criteria for the SLO 8.1.1.1 (Identify examples of simple machines in their community: levers, pulleys, wheels and axles, incline planes, gears). Each of the six levels describes the achievement of the learner.

Level	Assessment criteria	Judgement criteria	Achievement award
L5	Five examples of simple machines in their community	Describes five examples of simple machines in their community from all five categories (levers, pulleys, wheels and axles, incline planes, gears)	Achieved (A) Full mastery of learning outcomes
L4	Four examples of simple machines in their community	Describes four examples of simple machines in their community from four of the five categories (levers, pulleys, wheels and axles, incline planes, gears)	Partially Achieved (PA4) Substantial mastery of learning outcomes
L3	Three examples of simple machines in their community	Describes three examples of simple machines in their community from three of the five categories (levers, pulleys, wheels and axles, incline planes, gears)	Partially Achieved (PA3) Moderate mastery of learning outcomes
L2	Two examples of simple machines in their community	Describes two examples of simple machines in their community from two of the five categories (levers, pulleys, wheels and axles, incline planes, gears)	Partially Achieved (PA2) Minor mastery of learning outcomes
L1	One example of a simple machine in their community	Describes one example of a simple machine in their community from one of the five categories (levers, pulleys, wheels and axles, incline planes, gears)	Partially Achieved (PA1) Minimal mastery of learning outcomes
L0	No examples of simple machines in their community	Unable to describe any examples of simple machines in their community from any of the five categories (levers, pulleys, wheels and axles, incline planes, gears)	Not Achieved (NA) No mastery of learning outcomes

## Recording of learners' achievements

You are encouraged to keep accurate records of individual learners and the whole class. At the end of each assessment event, individual records of achievements must be recorded using the approved recording template (see Appendix 3, page 143). Indicate whether learners have: achieved an outcome (A), partially achieved an outcome (PA 1–4) or not achieved an outcome (NA).

Keeping up-to-date and accurate records is very important for monitoring and reporting the performance, progress and achievements of learners. It is also useful to show the records during meetings with parents, the learner and other key stakeholders.

## Monitoring individual learner and class achievements

With accurate records, teachers are able to monitor the learning performance, progress and achievement of individual learners and the whole class. You should monitor individual learners' performance, progress and achievements at end of each assessment event. As you continue to assess more outcomes, the learning pathway of each learner can be mapped and tracked during a term or semester in any one year. This information is useful for providing advice to the parents, the learner and other key stakeholders.

In order to identify strengths and weaknesses of individual learners, you need to keep accurate records of the performance of all learners in the class against the performance of an assessed outcome at the end of assessment event. In this way you can identify whether individual learners have achieved, partially achieved or not achieved the outcome for a particular assessment event. Using this simple monitoring technique, you can identify learners who need enrichment support and those who need remedial work to help them achieve the standards required by the national curriculum. The recommended monitoring template is shown in Appendix 4 (page 144).

## Reporting individual learners' achievements

With accurate records and effective monitoring systems, teachers are able to compile and make a balanced, accurate and fair report on the learners' performance, progress and achievements in a given assessment period. The type of reporting system recommended by the Ministry of Education requires more description of the learners' performance. This means that the report must also give a descriptive account of the learners' achievements.

The reporting system will no longer use marks or grades; instead you need to specify whether a learner has achieved, partially achieved or not achieved the assessed outcome. You should indicate this with A, PA (1–4) or NA on the approved reporting form. At the end of each assessment period, you need to give an overall achievement level for the learner. This is essential for the calculation of the overall award. The overall achievement level is calculated as a gross point average, whereby the total value of each of the outcomes assessed are added and divided by the number of outcomes assessed. The value of each overall achievement level is equivalent to an award of attainment for the learner. The recommended reporting template is shown in Appendix 7 (page 147).

## Calculating progressive achievement levels for formative and summative assessment

To calculate the progressive achievement level for formative assessment, add the values of achievement levels for all outcomes assessed during the formative component of the assessment and divide by the number of outcomes assessed. The number you get is the progressive achievement level for the learner for formative assessment. Similarly, to calculate the progressive level for summative assessment, add the value of achievement levels for all outcomes assessed in the summative component of the assessment and divide by the number of outcomes assessed. The number you get is the progressive achievement level for the learner for summative assessment.

## Calculating overall achievement levels using formative and summative assessments

To calculate the overall achievement for each individual learner, add progressive achievement levels for formative and summative assessment and divide by 2. The number you get is the overall achievement level for the learner for that specific assessment period. The overall achievement level attained corresponds to an overall award for the learner (you should round off the calculated values to the nearest whole number). The award will be issued to the learner in the form of a coloured certificate in recognition of the learner's achievement.

## Reporting the learners' overall performance and achievements

Teachers will prepare two types of reports. The first is a detailed report using the internal reporting template for learners and teachers. The second is the overall reporting template using the letter grades for parents, guardians and other key stakeholders. Teachers must issue certificates in recognition of the achievements made by the learner for each subject learnt at school, with appropriate school reports at the end of each assessment period. The letter grading reporting framework is used to give parents a clear understanding of the report. Such a reporting system is similar to the current and traditional reporting framework (see Appendix 9, page 150). However, detailed reports will be used for parent–teacher meetings at the school level (see Appendix 8, page 148). This report should be kept in the learner's folio as a record of his or her learning record to show the learner's performance, progress and achievements.

### The National Achievement Standards

The table below contains statements that describe the National Achievement Standards that teachers and instructors must use for measuring a learner's performance or achievements in all registered schools and TVET Centres throughout Solomon Islands. The achievement standards are based on the learner's overall achievement of learning outcomes prescribed in the National Curriculum of Solomon Islands. The achievement standard sets the benchmark for determining the learner's overall achievement level, grade, award and certification at the end of an assessment period.

Overall achievement level	Achievement standard	Achievement award	Certificate position	Colour code	Grade
Level 5 Mastery Level	The learner has an extensive knowledge and understanding of the content and can readily apply this knowledge. The learner has achieved a very high level of competence in the processes and skills and can apply these skills to newer situations.	Achieved With Excellence	Gold	Yellow	A
Level 4 Progressive Level	The learner has a thorough knowledge and understanding of the content and can apply this knowledge. The learner has achieved a high level of competence in the processes and skills and can apply these skills to most situations.	Achieved With Merit	Silver	Green	B
Level 3 Progressive Level	The learner has a basic knowledge and understanding of the content and has achieved an adequate level of competence in the processes and skills and can apply these skills in some situations.	Achieved	Bronze	Blue	C
Level 2 Critical Level	The learner has inadequate knowledge and understanding of the content and has achieved a limited level of competence in the processes and skills.	Not Achieved	Critical Level	No award	D
Level 1 Critical Level	The learner has inadequate knowledge and understanding of the content and has achieved a very limited level of competence in the processes and skills.	Not Achieved	Critical Level	No award	E
Level 0 Critical Level	The learner has no knowledge and understanding of the content. The learner has not achieved outcomes assessed and is not competent.	Not Achieved	Critical Level	No award	F

Teachers may award bonus grades to learners at the end of each assessment period. Teachers must consider the standardised range of percentages for awarding the overall grade. A bonus grade of C+, B+ or A+ must correctly reflect the difference between a C, B and A grade respectively, according to the overall percentage awarded to each learner. For example, a learner scoring 95% can be awarded an A grade, while a learner scoring 99% would be awarded an A+ grade. Teachers must ensure that the awarding of bonus grades is carefully administered according to their professional judgement and as such, reflects the learning progress and achievement of learners within a specific assessment period.

### **Meetings with parents, learners and other stakeholders**

Teachers and the school administration are encouraged to consult parents, learners and other stakeholders to discuss the performance, progress and achievements of learners and suggest ways that learners can improve. This is a very important process because it involves giving proper feedback to both the learner and the parents. The school can organise consultative meetings between teacher and parents, as well as teacher, parent and learner. If you have kept accurate records of the learner's performance, progress and achievements, you will be able to identify the learning progress and pathway of the learner and therefore determine appropriate remedial work for each learner. You will also then need to provide results after each remedial work has been carried out with the learner. Conducting such very important meetings will give parents and key stakeholders the confidence for their children to be educated in our schools. These meetings will make important links with the parents and other key stakeholders.

### **Links between Science and other subjects**

Many other subjects teach topics or skills that are similar to or related to the topics and skills we teach in Science. It is important that you are aware of these—when you teach a topic or use a skill, remind learners that they have also learnt about this or will learn about this in another subject. On the next page is a list of some of the topics or skills in other subjects that you should be aware of.

## Links with other subjects

Subject	Link description
Agriculture	The study of living things and how they interact with the surrounding environment is fundamental in understanding soil properties, animal systems and plant systems, studied in Agriculture.
Social Studies	The study of climate, weather and rock types is fundamental in understanding the environment and geological forces that explain causes of earthquakes, tsunamis and volcanoes, studied in Social Studies.
Technology	An understanding of material technology is fundamental to the appreciation of local materials in the environment, including solar power, studied in Technology.
Business Studies	The study of plants and animals as our important natural resources helps us to appreciate them being key players in our national economy, studied in Business Studies.
Home Economics	An understanding of human systems, including digestive systems and nutrition, is fundamental in understanding related sub-strands, studied in Home Economics.
Physical Education	An understanding of first aid and human skeletal, circulatory and respiratory systems is fundamental in understanding safety, health, fitness and human anatomy, studied in Physical Education.
Health Education	An understanding of human systems and diseases is fundamental in understanding good habits and a healthy lifestyle, studied in Health Education.
Arts and Culture	An understanding of culture is fundamental in understanding and applying existing indigenous scientific knowledge in everyday life.
Mathematics	An understanding of and the ability to use mathematical skills is fundamental in understanding and applying scientific knowledge, skills, attitudes and values.
English	An understanding of and the ability to use English is fundamental in understanding and applying scientific knowledge, skills, attitudes and values.



# Chapter 1: Simple machine structure and stability

## Strand: Energy and change

**Suggested class time: 12 periods**

### Sub-strand statement

This sub-strand deals with simple machine technology. The structure of an object determines its stability. An object is in stable equilibrium (balanced) when its centre of gravity is above its base. A small machine allows a small force (effort) to overcome a large force (load). This is the principle of the machine. A machine that increases force gives a mechanical advantage. A machine that increases movement gives an advantage called velocity ratio. Complex machines are made up of many simple machines joined together. Machines transfer energy and do work.

## General learning outcomes

Learners should:

- 8.1.1** know that a simple machine transfers energy and does work
- 8.1.2** understand work done by levers
- 8.1.3** be able to show the turning force in a lever
- 8.1.4** understand the ratio of effort to load gives a machine its mechanical advantage
- 8.1.5** be able to show that a simple machine helps us to reduce effort to do many everyday jobs
- 8.1.6** be able to show the stability of an object
- 8.1.7** know that building structures are designed carefully so that they are stable.

## Specific learning outcomes

Learners should be able to:

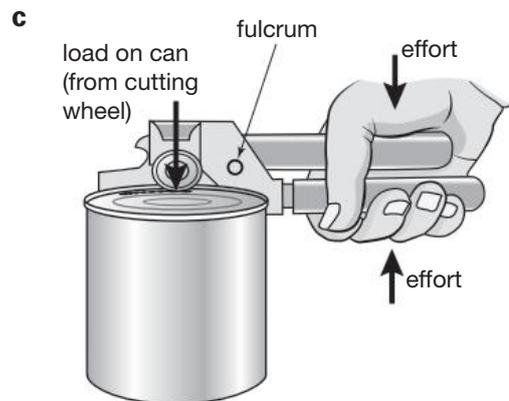
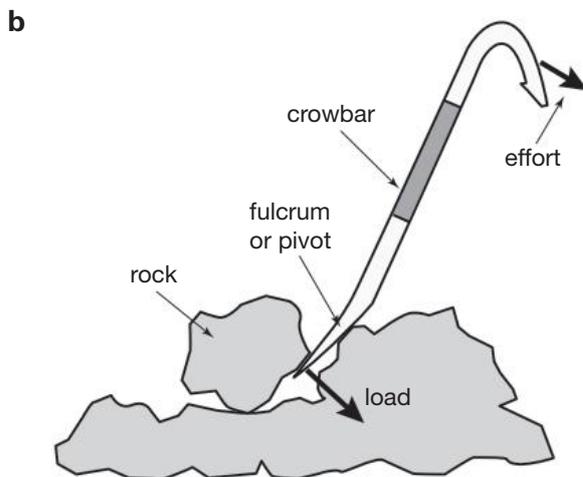
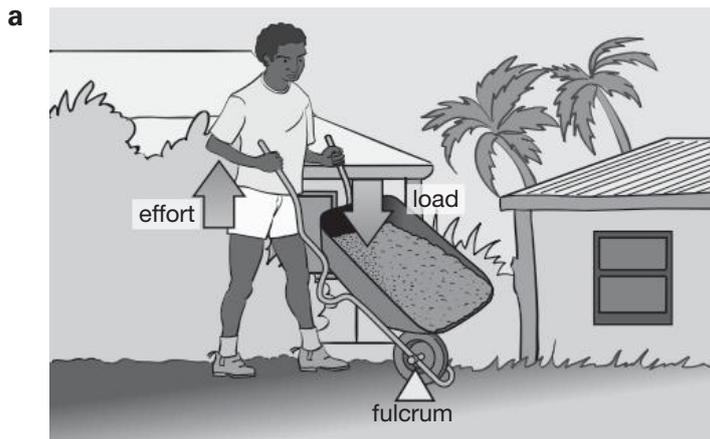
- 8.1.1.1** identify examples of simple machines in their community: levers, pulleys, wheels and axles, incline planes, gears
- 8.1.2.1** explain that the transfer of energy does the work in simple machines, for example a lever (eg a crowbar lifting a rock)
- 8.1.2.2** list three classes of lever systems and identify the effort, load and pivot positions in each system
- 8.1.3.1** demonstrate that the turning forces in a lever are the forces applied times the distance from the pivot
- 8.1.3.2** use a seesaw arrangement to demonstrate the turning force effects in levers
- 8.1.4.1** calculate the mechanical advantage by dividing the load by the effort for different simple machines
- 8.1.4.2** calculate the velocity of a pulley system by dividing the distance moved by the load by distance moved by the lever
- 8.1.5.1** perform the following tasks to demonstrate the use of a simple machine:
  - i** remove the nail from timber using a hammer (lever)
  - ii** carry stones in a wheelbarrow (lever)
  - iii** dig potatoes using sticks
  - iv** open a soft drink bottle

- 8.1.5.2** identify simple machines that:
- i** multiply (increase) force (eg tap knob, door knob)
  - ii** multiply (increase) speed (eg bicycle gears, fanbelt in a vehicle)
- 8.1.6.1** locate the centre of gravity of a hanging object
- 8.1.6.2** demonstrate that changing the centre of gravity of an object affects its stability
- 8.1.7.1** identify examples of building structures or large objects that are stable or unstable in their local community or school.

## Answers

### Suggested assessment events

*Solomon Islands Years 7–9 Science Syllabus*



## Challenge questions

*Learner's Book page 1*

- 1** This is an open-ended question. Some likely responses are: wheelbarrow; knife; axe; truck; car. Note that there is no wrong answer for this question; however, you should guide learners to explore the concept of the simple machine.
- 2** This is an open-ended question. Learners should be able to list many different things that can be done now that could not be done 100 years ago. Some examples are: flying an aeroplane; driving a car; watching a soccer match on TV.
- 3** This is an open-ended question. Learners will give lots of different answers based on their experiences. Some examples are: car; truck; aeroplane; TV; radio; mobile phone.
- 4** This is an open-ended question. Answers could include stone tools, stone fish traps and a range of weapons. Some tools would be used to make other tools.

## Unit 1.1: The ramp

### Activity 1: Ramps for disabled people

Learner's Book page 2

Processes and skills	Resources	Teacher's support notes	Answers to questions
To test commonly used ramps to determine whether they comply with the requirements of the disabled	<ul style="list-style-type: none"> <li>a range of ramps</li> <li>rulers and tape measures</li> </ul>	<p>Support learners to develop an understanding of the concept of ramps as they work through this activity.</p> <p>Learners may need help about what to measure on the ramp. They will need to be able to measure the length along the ground horizontally and the height of the ramp. Help learners to understand that the ratio 1:8 means that for every 1 cm the ramp goes up it has to take 8 cm across. Provide learners with a diagram showing what to measure and how to calculate.</p>	<p><b>1</b> The distance to travel is shorter. For walking or rolling, it doesn't take as much effort or force to go up a shorter ramp compared with a longer one, so the ramp can be steeper.</p> <p><b>2</b> Learners' responses will be based on their calculations.</p>

## Answers

### Unit questions

Learner's Book page 4

- In science, work is the energy needed to move something over a certain distance.
- Work is energy output. The more energy you produce, the more work is done. Force is equal to mass multiplied by acceleration.
- The unit normally used for work is the joule.
- A ramp reduces effort by increasing *distance*.
- Five examples of ramps making a job easier are:
  - a piece of timber placed so that one end is attached to the back of a truck and the other on the ground makes it easier to load or unload items on or off the truck
  - a woodscrew inserted in a piece of timber
  - a wheelchair access ramp next to stairs
  - a ramp for loading luggage onto a jumbo jet
  - a road winding up a mountain.
- A ramp uses the principle of  $\text{work} = \text{effort} \times \text{distance}$ .  
For the same amount of work to be done you either increase effort and decrease distance; or increase distance and decrease effort.
- Mechanical advantage is the effectiveness of a machine or technology.
- A machine with a high mechanical advantage is very efficient. Less effort force is used to do the work.
- Five uses of wedges are: knives; drills; screws; axes; nails.
- A screw is really a ramp because turning the screw provides a large distance, but little effort is needed to turn the screw. As the screw goes into the wood, it provides a mechanical advantage.

- 11 Three uses of screws are: to hold pieces of timber together; to join pieces of metal to wood; to hold pieces of metal together.
- 12 A path that zigzags up the mountain is easier to walk than a path straight up the mountain because when you zigzag you increase the distance and reduce the effort.
- 13 a 2; b 3; c 0.17; d 5
- 14 The machine in d has the highest mechanical advantage.
- 15 Here are just two examples of the many uses of ramps such as screws or wedges.

Simple machine	How it does the job
Screwing a woodscrew into timber	Effort is applied in a circular motion, which increases the distance of the force.
Cutting a melon with a kitchen knife	The sharp knife cuts through the melon easily, using less effort than if you break the melon in half with your hands.

- 16 24 joules of work = object's weight (24 N); therefore, the load that Sarah is trying to lift is about 2.4 kg.

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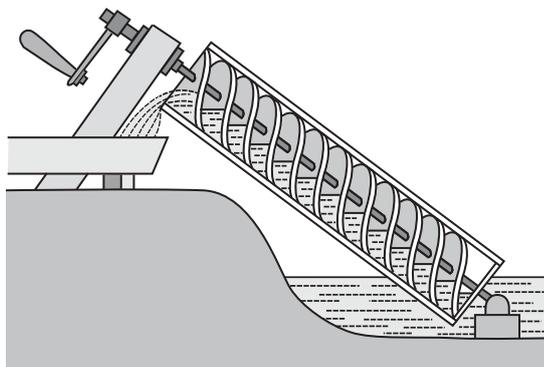
Work (J)	Ramp length (m)	Effort needed (N)	Proof that this will do the job	Mechanical advantage
24	1	24	$1 \times 24 = 24$	$24/24 = 1$
24	2	12	$2 \times 12 = 24$	$24/12 = 2$
24	3	8	$3 \times 8 = 24$	$24/8 = 3$
24	4	6	$4 \times 6 = 24$	$24/6 = 4$
24	6	4	$6 \times 4 = 24$	$24/4 = 6$
24	8	3	$8 \times 3 = 24$	$24/3 = 8$
24	12	2	$12 \times 2 = 24$	$24/2 = 12$
24	24	1	$24 \times 1 = 24$	$24/1 = 24$

- 18 The ramp that would make the job easier for Sarah is the one with the highest mechanical advantage. The ramp that was 24 m long would make the job the easiest, only needing an effort force of 1 N. Its mechanical advantage was 24.

### Extension questions

*Learner's Book page 5*

- 1 Learners' responses will vary but could include a ramp in place of stairs to help furniture removalists.
- 2 Learners' responses will vary. Archimedes' water screw is a machine use to transfer water from low-lying ground to higher up. A handle is used to turn a big screw-shaped surface contained in a hollow pipe.



## Activity 2: Ramps

Learner's Book page 5

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the relationship between the slope of a ramp and effort	<ul style="list-style-type: none"> <li>• spring balance</li> <li>• ramp</li> <li>• dynamics cart or trolley and wooden block</li> <li>• small masses</li> <li>• sticky tape</li> <li>• books</li> <li>• protractor</li> </ul>	Ensure that learners use appropriate apparatus. Learners can do this activity in groups, but should do their own write-ups.	<ol style="list-style-type: none"> <li><b>1</b> The work required to drag the cart and the block up was the same because they had the same mass and distance.</li> <li><b>2</b> As the ramp got longer the effort force needed decreased.</li> <li><b>3</b> The better ramp in each case (no matter if the block or the cart/trolley) is the least steep ramp, as means less effort is required. However the work done is the same. The cart/trolley will travel uphill more easily, so this makes a better overall system.</li> <li><b>4</b> The effort force depends on the mass of the wooden block used, although the learners should bear in mind that the cart involves less friction than the block.</li> </ol>

## Unit 1.2: Levers

### Activity 3: The seesaw

Learner's Book page 6

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the seesaw as a lever	<ul style="list-style-type: none"> <li>• 7 small masses such as 5-cent coins</li> <li>• ruler</li> <li>• fulcrum or pivot</li> <li>• elastic band</li> </ul>	<p>This relationship is important to note:</p> $\text{Effort} \times \text{distance} = \text{load} \times \text{distance}$	<ol style="list-style-type: none"> <li><b>1</b> As the mass increases, the distance from the pivot decreases.</li> <li><b>2</b> Load <math>\times</math> distance = effort <math>\times</math> distance             <ol style="list-style-type: none"> <li><b>a</b> <math>2 \times 4 [8] = 2 \times 4 [8]</math>, ie 4 cm from the pivot</li> <li><b>b</b> <math>10 \times 2 [20] = 2 \times 10 [20]</math>, ie 10 cm from the pivot</li> <li><b>c</b> <math>6 \times 6 [36] = 2 \times 18 [36]</math>, ie 18 cm from the pivot</li> <li><b>d</b> <math>1 \times 2 [2] = 2 \times 1 [2]</math>, ie 1 cm from the pivot</li> </ol> </li> </ol>

## Activity 4: Lifting books

*Learner's Book page 8*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the relationship between fulcrum position and effort on a class 1 lever	<ul style="list-style-type: none"> <li>• 1-metre ruler</li> <li>• rubber stopper</li> <li>• textbook</li> </ul>	<p>Support learners to develop an understanding of the relationship between the position and the effort required as they work through this activity. For example, if the position of the book is closer to the fulcrum, the effort will be less, and vice versa. Learners can do the activity in groups, but do their own write-ups.</p> <p>Ask questions while the learners are working through the lever positions. For example: How does this position affect the lever? Does it work better? Which is the best?</p>	<ol style="list-style-type: none"> <li>1 Check learners' work—they should copy from their Learner's Book.</li> <li>2 Using the class 1 lever, the force needed to lift the book increased as the stopper was moved away from the load. This is because: <math>\text{effort} \times \text{distance} = \text{load} \times \text{distance}</math> When the stopper was moved away from the load, the distance increased, while the distance of the effort decreased. This is to balance the forces on both sides of the fulcrum.</li> <li>3 If the fulcrum is close to the load, and the effort is far away from the fulcrum then you would need less effort. This is called principle of force multiplier.</li> <li>4 It was most difficult to lift the book using the class 3 lever.</li> </ol>

## Activity 5: Class 3 levers

*Learner's Book pages 9–10*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate a class 3 lever	<ul style="list-style-type: none"> <li>• 1 metre ruler</li> <li>• 1 kg mass</li> <li>• spring balance</li> <li>• brick or block to act as the fulcrum</li> </ul>	<p>Support learners to develop an understanding of the following relationship as they work through this activity:</p> <p>Mechanical advantage = <math>\text{load/effort} = \text{distance of effort to fulcrum/ distance of load to fulcrum}</math></p> <p>Encourage learners to practise working out the kilograms from the newton force given on the spring balance. Explain why they need to divide by 10 for gravity.</p>	<ol style="list-style-type: none"> <li>1 Check learners' responses and relate their answers to the relationship: <math>\text{Load} \times \text{distance} = \text{effort} \times \text{distance}</math> In Figure 1.2.11: Load = 1 kg or 10 N Distance = 100 cm <math>1 \text{ kg} \times 100 = 100 \text{ N.cm} = ? \times 50</math> <math>? = 100/50 = 2 \text{ kg}</math>, which is equal to 20 N. Thus the effort need to lift the load is 20 N.</li> <li>2 The most effective lever is the lever that requires the least effort to lift a load. Therefore the class 1 lever is the best.</li> </ol>

**Activity 6: Class 3 levers at work***Learner's Book page 10*

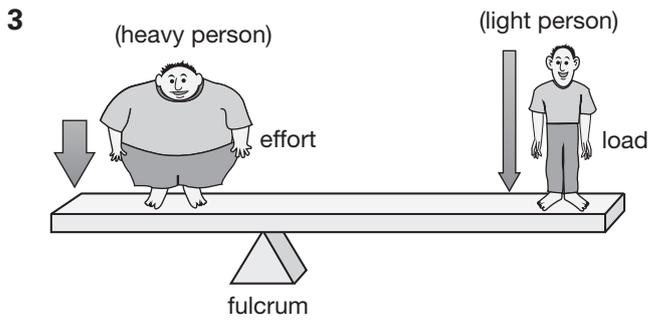
Processes and skills	Resources	Teacher's support notes	Answers to questions
To examine various common implements to determine which class of lever is being used	<ul style="list-style-type: none"> <li>• stapler</li> <li>• nail clippers</li> <li>• scissors</li> <li>• pruning shears</li> <li>• nutcracker or bulldog clip</li> </ul>	<p>Support learners to understand class 3 levers and know that they are speed multipliers as they work through this activity.</p> <p>Encourage learners to consider each aspect of the lever.</p> <p>Some of the levers listed in the Resources column are actually compound levers (eg the nail clippers)—they have a section of Class 2 and a section of Class 3. Explain to learners that real implements sometimes include aspects of more than one type of lever. Items that are class 3 levers only include a broom, a pair of tweezers or a pair of kitchen tongs.</p>	<p><b>1</b> Stapler—class 2; Nail clippers—class 2 and class 3; Scissors—class 1; Pruning shears—class 1; Nutcracker or bulldog clip—class 2</p> <p><b>2</b> Stapler—force multiplier; Nail clippers—force and speed multiplier; Scissors—force multiplier; Pruning shears—force multiplier; Nutcracker or bulldog clip—force multiplier</p>

**Activity 7: Making body parts***Learner's Book pages 10–11*

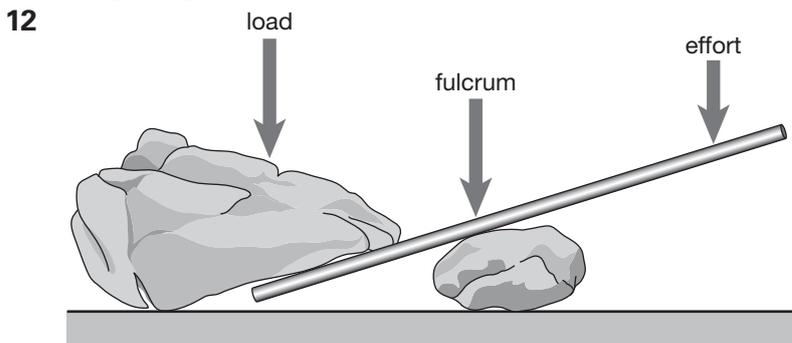
Processes and skills	Resources	Teacher's support notes
To investigate two body parts that act as levers: the jaw and the arm	<p><b>Part 1</b></p> <ul style="list-style-type: none"> <li>• cardboard</li> <li>• paperclip</li> <li>• balloon</li> </ul> <p><b>Part 2</b></p> <ul style="list-style-type: none"> <li>• 2 pieces of wood approx. 10 cm × 20 cm</li> <li>• 2 balloons</li> <li>• metal hinge and screws</li> <li>• length of string</li> </ul>	Many body parts are actually levers at work. Encourage learners to think about what parts of the body are levers before they complete the activity. While performing the activity ask learners what type of lever they are exploring and discuss. Learners could also draw diagrams to explain where the fulcrum, effort and load are for each case.

**Answers****Unit questions***Learner's Book pages 11–12*

- 1** A force multiplier is a machine or something that produces a large force as a result of only a little effort. An example is a wheelbarrow.
- 2** A fulcrum is any object that is placed between a load and an effort. The fulcrums act as a force multiplier. Using a fulcrum you need to apply only a small effort to lift a big load.



- 4 For levers, mechanical advantage can be calculated in two ways: mechanical advantage = load over effort; mechanical advantage = distance of effort from fulcrum.
- 5 For a lever, the greatest advantage is achieved when the effort is at a distance from the fulcrum and the load is close to it.
- 6 A class 3 lever acts as a speed multiplier by having the fulcrum at one end and the load (often a light ball) at the other end. The effort force is high, movement is small and slow, and is close to the fulcrum. This translates to a low force, but with high speed at the far end of the lever. Speed has been multiplied.
- 7 The advantage of using a class 3 lever in most ball sports is that most ball sports require high speed of light balls. A class 3 lever will ensure the ball travels at a high speed.
- 8 A brush knife is a class 3 lever because the fulcrum and the load are at either end, and the effort is in the middle, between the fulcrum and the load.
- 9 Three examples of a lever in action are: a person carrying a load of gravel in a wheelbarrow; children playing on a seesaw; a person opening the lid of a tin of milk with a spoon.
- 10 **a** Some levers are force multipliers.  
**b** The fulcrum of a lever is *in the middle or at the end*.  
**c** A bat is an example of a *speed* multiplier.  
**d** A pivot is the same as a fulcrum.  
**e** A speed multiplier is needed in *all* ball games.
- 11 The principle of levers: effort × distance = load × distance



- 13 A class 1 lever is the most effective in lifting a load.
- 14 **a** Class 1 lever; **b** Class 2 lever; **c** Class 1 lever; **d** Class 2 lever
- 15 **a**  $10/5 = 2$ ; **b**  $15/5 = 3$ ; **c**  $5/25 = 0.2$

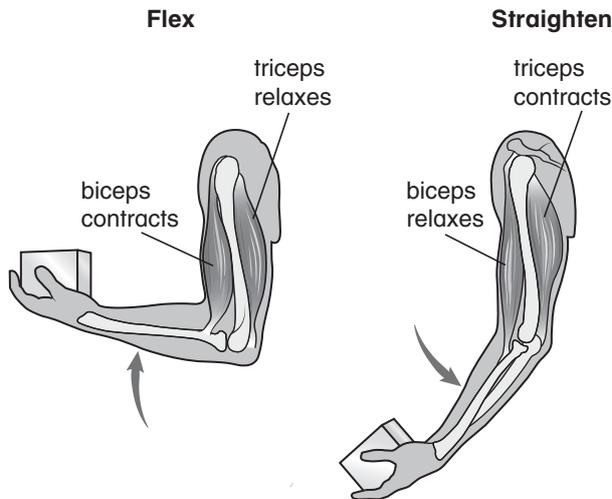
16

Mass #1 (g)	Distance of mass #1 from pivot (cm)	Mass #2 (g)	Distance of mass #2 from pivot (cm)
6	4	8	3
6	4	2	12
1	24	12	2
10	1	5	2
3	6	2	9
8	2	1	16

Extension questions

Learner's Book page 12

- 1 a Learners' responses will vary; b Learners' responses will vary.
- 2 Learners' responses will vary.
- 3



Unit 1.3: Going for a spin: wheels, axles and gears

Activity 8: A simple wheel and axle

Learner's Book page 13

Processes and skills	Resources	Teacher's support notes	Answers to questions
To construct a simple wheel and axle	<ul style="list-style-type: none"> <li>• 250 mL beaker or tin can</li> <li>• 100 g mass</li> <li>• 2 paperclips</li> <li>• flexible drinking straw or satay stick</li> <li>• cotton thread</li> <li>• sticky tape</li> </ul>	<p>Support learners to understand the relationship between the axle and the wheel, and why the wheel turns around, as they work through this activity.</p> <p>Learners may need help to understand how to lift the mass. Twisting the straw or satay stick in one direction, wind up the cotton and lift the mass. It should be easier with the stick or straw bent because this provides a handle that is easier to spin.</p> <p>Ask learners to think about what part is performing as a wheel or an axle.</p>	<ol style="list-style-type: none"> <li>1 Learners' responses will vary.</li> <li>2 The job would be easier if the load was moved closer to the beaker. As the effort is further away from the fulcrum, the effort required is smaller.</li> </ol>

**Activity 9: Roping them together***Learner's Book page 15*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate speed changes by connecting different-sized wheels	<ul style="list-style-type: none"> <li>• different-size lids, such as from coffee, peanut butter and jam containers</li> <li>• elastic bands</li> <li>• piece of wood</li> <li>• small sheet of thin cardboard</li> <li>• pins</li> <li>• small nails, or tacks (they must have a circular cross-section)</li> <li>• marking pen</li> <li>• hammer</li> </ul>	Ask other teachers in your school for empty bottles and jars with the kind of lids you need for the activity. Collect the items well beforehand.	<ol style="list-style-type: none"> <li>1 The rpm of the small wheel will be higher than the rpm of the larger wheel.</li> <li>2 The bigger the wheel, the lower the rpm.</li> <li>3 The wheels should spin in opposite directions.</li> <li>4 Learners should describe what happened in their own words.</li> </ol>

**Activity 10: Geared machines***Learner's Book page 17*

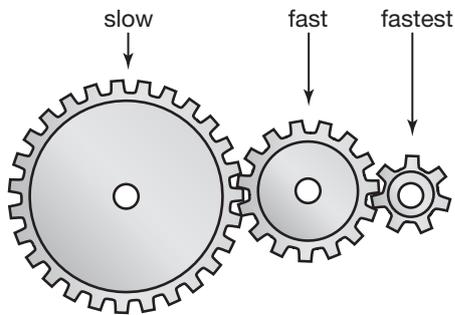
Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate common implements that use gears	<ul style="list-style-type: none"> <li>• eggbeater</li> <li>• hand drill</li> <li>• corkscrew</li> <li>• adjustable spanner</li> </ul>	Reminder: A force multiplier reduces the effort needed to do work, whereas a speed multiplier increases the speed of wheels, axles.	<ol style="list-style-type: none"> <li>1 The driving gear should be the larger.</li> <li>2 Learners' responses will vary, depending on the kind of implements available.</li> <li>3 Learners' responses will vary, depending on the kind of implements available.</li> <li>4 Learners' responses depend on the number of teeth in each gear. For example, if the larger one has 10 teeth and the smaller has 5, divide 10 by 5.</li> <li>5 Learners' responses depend on the size of the gears. For example, if you chose 10 and there were 5 turns on the other gear, divide 10 by 5.</li> <li>6 These ratios should be the same.</li> </ol>

## Answers

### Unit questions

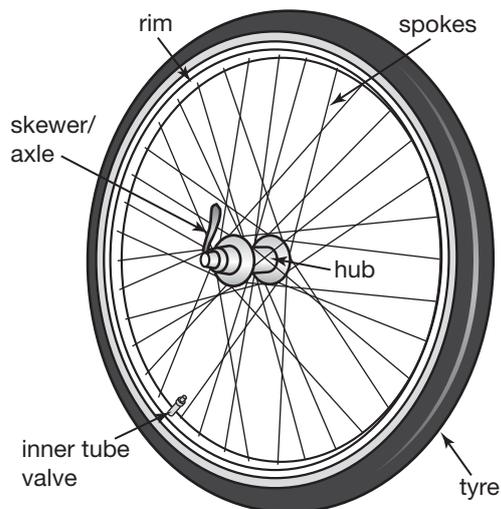
Learner's Book pages 17–18

- 1 A wheel is like a lever because it is a force multiplier. The wheel reduces the force that is needed to carry out a task.
- 2 Another name for a fulcrum of a wheel is 'axle'.
- 3 Another name for the axle of a door knob or tap is 'simple wheel'.

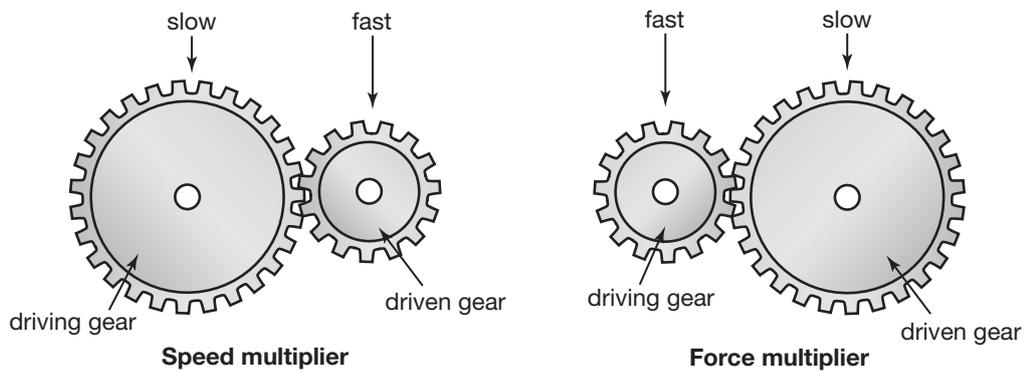


- 5 Other examples of wheels being used as speed multipliers are: propeller and a house fan.
- 6 The direction of a spinning wheel can be changed by connecting wheels of different diameters together with belts.
- 7 Gears can be used to change *speed*, *effort* (force) or the direction of *rotation*.
- 8 The driven gear is smaller than the driving gear.
- 9 Gearing up is used when a car is speeding, while gearing down is used when a car is slowing down.
- 10 A gear train is a series of two or more gears.
- 11 Learners can trace the gears shown in Figure 1.3.11 of their Learner's Book.
- 12
  - a Rotary motion is *spinning or turning motion that takes place around an axis*.
  - b The axle and rim of a wheel are the same thing.
  - c The driving wheel of the bicycle is an example of a speed multiplier.
  - d Parallel gears turn in *opposite directions*.
  - e The steering wheel of a car is an example of a speed multiplier.
  - f Gearing up is used when high-speed rotation is needed.
  - g Gearing down is used in drills and kitchen blenders.

13



14 a & b



15 a Anticlockwise direction and speeding up; b Anticlockwise and gearing down; c Clockwise with no change of speed

### Extension questions

*Learner's Book page 18*

- 1 a Bicycle gears are called sprockets.
  - b i Ten-speed bicycles have five speeds on the back (at the wheel) and two speeds in the centre (where the pedals are).  
 ii This may vary. One option is: 52 42 for the front and 14 16 18 21 24 for the back.  
 iii They do not mesh together. Instead they are held together with a chain.
  - c Diagrams will vary depending on the bicycle that learners look at.  
 i Learners' responses will vary — the requirements for travelling at high speed vary depending on the condition (downhill, uphill etc).  
 ii To climb a steep hill you would use the first gear. This is the largest sprocket on the rear wheel and the smallest sprocket on the chain wheel.  
 iii To ride downhill you would use a high gear.
  - d i Learners' responses will vary depending on the number of gears in the bicycle considered. Check working for gear ratio calculation.  
 ii Gear ratios will be lower numbers for the steep climb than the higher ratios for travelling flat or going down a hill.
- 2 Learners' responses will vary. They should construct a trap racer from available resources.

## Unit 1.4: Pulleys

### Activity 11: Fixed and moveable pulleys

*Learner's Book page 19*

Processes and skills	Resources	Teacher's support notes	Answer to questions
To investigate the mechanical advantage of various pulley configurations	<ul style="list-style-type: none"> <li>• 100 g mass</li> <li>• spring balance</li> <li>• retort stand</li> <li>• strong cotton thread</li> </ul>	<p>Learners do this activity before reading the text about pulleys. To help learners answer the questions before they read the text, ask questions such as: Can you see a difference between these systems? What makes lifting the weight easier? What does this look like (for example, where have you seen something like a pulley in real life or on TV)?</p> <p>Help learners to understand that a pulley reduces effort force.</p>	The moveable pulley required less effort because the distance moved was greater and therefore less effort was required.

### Activity 12: Paperclip pulleys

*Learner's Book page 20*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To compare single and double pulleys made from paperclips	<ul style="list-style-type: none"> <li>• 100 g mass</li> <li>• spring balance</li> <li>• retort stand</li> <li>• strong cotton thread</li> <li>• paperclips</li> </ul>	<p>Point out to learners that paperclips can behave like pulleys; that is, they can reduce effort force.</p> <p>Prepare some paperclips in the way demonstrated in Figure 1.4.4 to demonstrate to learners how to separate them.</p> <p>In order to answer the questions, learners will need to compare their results in this activity with the single pulley shown in Figure 1.4.2.</p>	<ol style="list-style-type: none"> <li>1 The double pulley made the jobs of holding and lifting easier.</li> <li>2 The paperclip pulleys have more friction than those with moving wheels.</li> <li>3 Learners' responses will vary: Mechanical advantage = effort × distance moved</li> </ol>

**Activity 13: Using pulleys***Learner's Book page 21*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To construct pulley systems to lift various masses	<ul style="list-style-type: none"> <li>• 2 single pulleys</li> <li>• 2 double pulleys</li> <li>• 1 m string</li> <li>• a set of 50 g masses</li> <li>• spring balance</li> <li>• ruler</li> </ul>	<p>Make sure that learners are familiar with a range of pulley systems before performing this activity. This activity could be done as a self-directed investigation in which learners experiment with different aspects of the pulley systems within a group.</p> <p>Discuss with learners the importance of pulleys in real-life situations.</p>	<ol style="list-style-type: none"> <li>1 When you use the spring balance upside down it will also include the weight of the body of the balance itself. This means the weight of the balance needs to be subtracted when considering the real mass.</li> <li>2 A single pulley reduces effort force; that is, less work is required.</li> <li>3 The effort force decreases as more pulleys are added.</li> <li>4 Learners' responses will vary.</li> <li>5 Learners' responses will vary.</li> </ol>

**Activity 14: Rope sections***Learner's Book page 22*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To construct a pulley system using common materials	<ul style="list-style-type: none"> <li>• strong wire that can be bent (coat hangers are ideal)</li> <li>• retort and clamp with ring</li> <li>• strong cotton thread or string</li> <li>• 100 g mass</li> </ul>	<p>Ensure that learners understand that ropes can behave like pulleys.</p> <p>Encourage learners to find the resources for this activity themselves. Help them to consider how everyday items might be able to be used to set up pulley systems, and how that could be useful. Where have they seen ropes and pulley systems in use? Some boats would use pulleys in different forms to lift up sails or lift up equipment.</p>	<ol style="list-style-type: none"> <li>1 When the number of threads increased, the distance the hand moved was greater.</li> <li>2 The effort required was less.</li> <li>3 Work done depends on two factors: effort and distance. The same amount of work is done with less effort and more distance, or less distance and more effort. For those two factors, if one decreases, the other will increase.</li> </ol>

**Answers****Unit questions***Learner's Book pages 22–23*

- 1 Humans find that pulling an object down is much easier than lifting an object up because of the extra force of gravity that is acting downwards.
- 2 Less rope is needed in the pulley system.
- 3 The mechanical advantage is the number of pulleys used.
- 4 A block and tackle is a multiple pulley system.
- 5 A pulley reduces effort by changing the direction of the effort, therefore changing the distance of the effort required to do the same job.

- 6 When two pulleys are used, less effort but more distance is needed.
- 7 A pulley is a force multiplier, while a gear is a speed multiplier.
- 8 Friction is a nuisance in a pulley, because it reduces the efficiency of the machine.
- 9 The advantage of using a clamp with a pulley is that it prevents the pulley from moving.
- 10 A hoist is a machine to lift a load.
- 11 Pulleys are force multipliers because they reduce the effort force in the system.

12

Advantage	Disadvantage
1 Less effort required	1 More friction
2 Can lift heavy loads	2 More pulleys required
	3 Longer rope required

- 13 Number of pulleys: **a** 1; **b** 11
- 14 Force multiplication: **a**  $\times 4$ ; **b**  $\times 10$

**Extension questions**

*Learner's Book page 23*

1–3 Learners' responses will vary.

**Unit 1.5: Structure and stability**

**Activity 15: The centre of gravity**

*Learner's Book page 24*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To find the centre of gravity of a hanging object using a plumb-line	<ul style="list-style-type: none"> <li>• cardboard</li> <li>• cotton thread</li> <li>• 2-inch nail</li> <li>• small stone or weight</li> </ul>	<p>Support learners to understand the concept of the centre of gravity as they work through this activity. Learners need to know how the centre of gravity affects the stability of objects.</p> <p>Provide learners with other examples of centre of gravity. The activity does not need to be done with just a piece of cardboard. Other items can be used to demonstrate gravity.</p>	<p>1 The centre of gravity. 2 The stability of the cardboard is greatest at the point of intersection, which is the centre of gravity.</p>

**Activity 16: Stability and structure**

*Learner's Book page 25*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To construct a stable structure from a deck of cards	<ul style="list-style-type: none"> <li>• deck of playing cards</li> </ul>	<p>Support learners to understand the relationship between stability and structure as they work through this activity.</p> <p>Some of the ways you can build a card castle make it more stable than others. Try several methods. Learners might come up with different ideas. As they do, discuss what it is about the stability of each design that makes it work better or not work at all. Ask them to consider where the centre of gravity is in each design.</p>	<p>The broader the base, the higher the structure can go. The lower the centre of gravity, the more stable the object, which means it can be built up higher.</p>

## Answers

### Unit questions

*Learner's Book page 25*

- 1 The 'centre of gravity' is the balance point of an object.
- 2 The location of the centre of gravity depends on the shape and mass of the object.
- 3 When the canoe has a high load its centre of gravity is raised, and so it becomes less stable.
- 4 An object with a low centre of gravity is more stable than an object with a high centre of gravity.
- 5 Most tall buildings have a broad base and a narrow top because it is important to have a low centre of gravity.
- 6 One way to lower the centre of gravity is to load the hull of the ship with metals or sand.
- 7 You would need to ensure that the load was low and wide rather than high, so that the centre of gravity of the truck or ship was not raised to an unstable level.

### Extension question

*Learner's Book page 25*

Learners' responses will vary, depending on where their community or school is located.

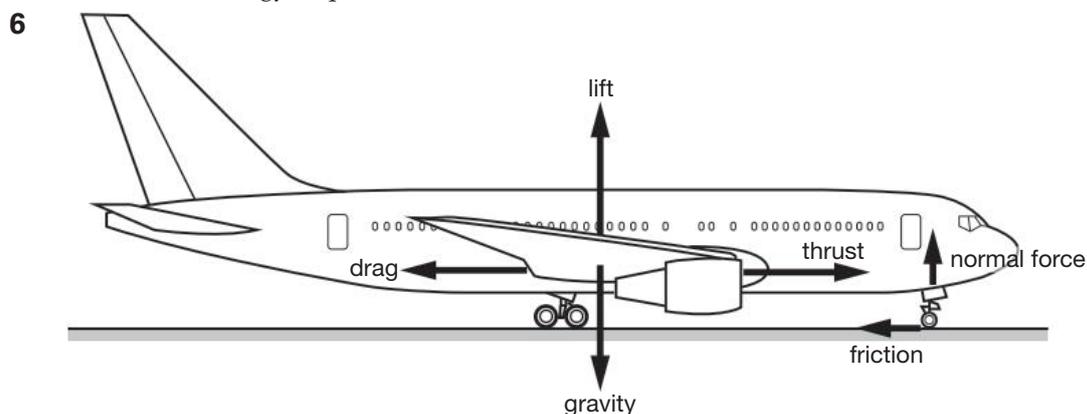
Sample answers: a church building, a bridge, a wharf.

## Chapter review

### Answers

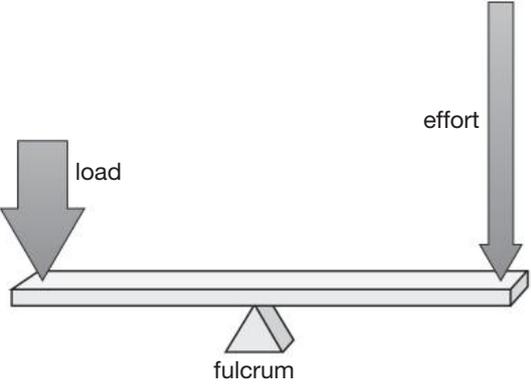
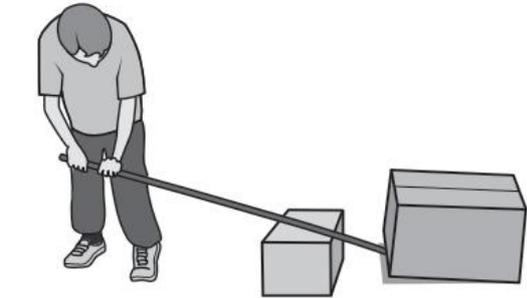
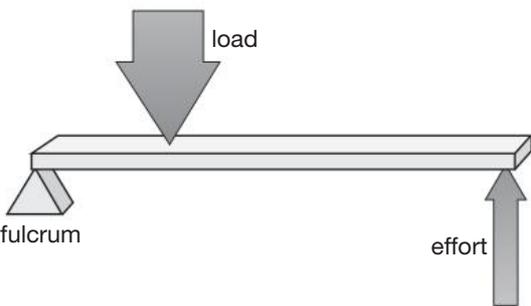
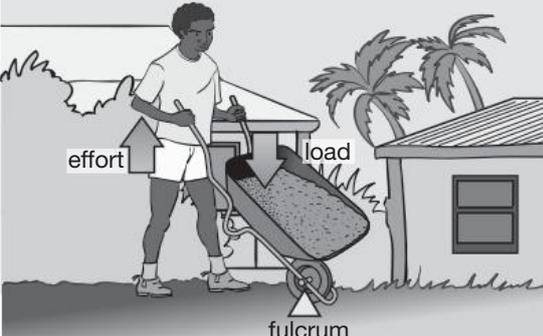
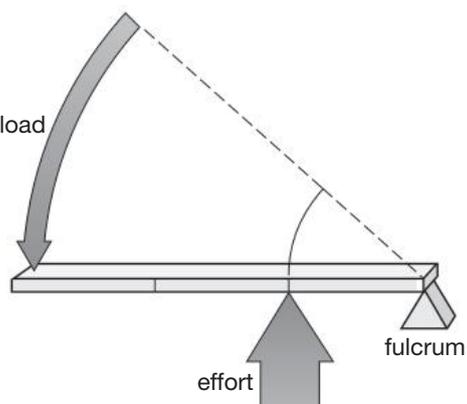
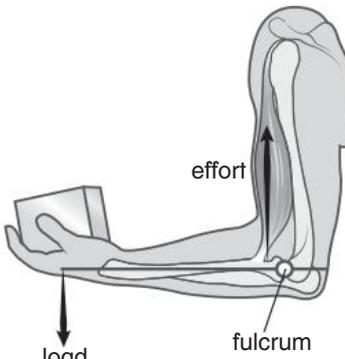
*Learner's Book pages 26–27*

- 1 **a** True; **b** True; **c** True; **d** False; **e** True; **f** True; **g** False; **h** True; **i** False; **j** True; **k** True; **l** True
- 2 A simple machine reduces the effort required to do work.
- 3 Six examples of machines are: ramps, wedges, pulleys, wheels, axles and gears.
- 4  $\text{Work} = \text{effort force} \times \text{distance}$
- 5 Effort is the energy required to do the work on the load.



- 7 **a** Mechanical advantage is load/effort.  
**b** Mechanical advantage should be high. The higher the mechanical advantage, the better the machine.
- 8 Ramps reduce effort by increasing the distance an object moves. This is because work done on the load depends on the effort and distance. Increasing the distance reduces the effort required for the same load.

9

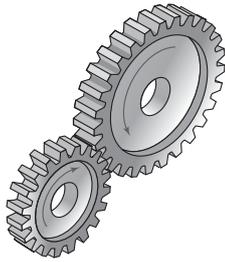
Class	Example
<p>Class 1 lever</p> 	
<p>Class 2 lever</p> 	
<p>Class 3 lever</p> 	

- 10** Spur, worm and bevel are examples of gears.
- 11** Parallel gears are the same size as each other but move (rotate) in opposite directions.
- 12** Advantage of a single pulley: the weight acts in the same direction as the effort, so it will be easier to do the job. Disadvantage: the effort will be the same as or more than the load.
- 13** The rope must also be pulled double the distance or length from the pulley.
- 14** The more pulleys in a system, *the higher the mechanical advantage*. Other acceptable answers are:
- The more pulleys in a system, *the lower the effort needed*.
  - The more pulleys in a system, *the greater the friction*.
- 15** **a** 5 cm; **b** 10 cm
- 16** The mechanical advantage is calculated by dividing the load by the effort.
- 17** **a** Zero; **b** Zero
- 18** **a** Opposite and slow; **b** Same direction but faster; **c** Opposite direction but slower

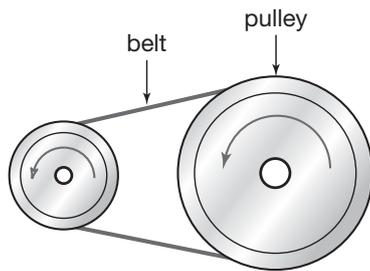
19 a A wheel acts as a force multiplier in a pulley system.

b A wheel acts as a speed multiplier in gears.

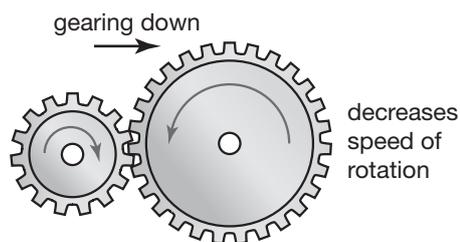
20 a Gearing down



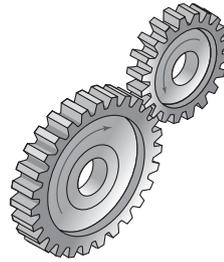
c Rotating in the same direction



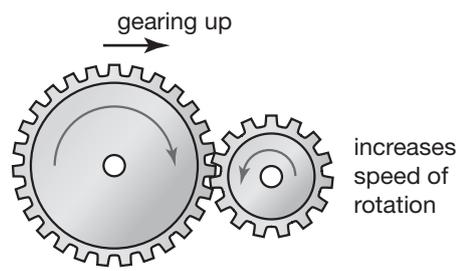
e Decreasing the speed of rotation



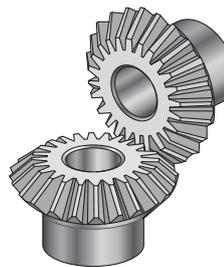
b Gearing up



d Increasing the speed of rotation



f Changing the direction of rotation by 90°



21 a Pizza cutter: wheel, reduces effort

b Whisk: gear, increases speed

c Waffle iron: lever, reduces effort

d Tongs: lever, reduces effort

e Garlic crusher: lever wedge reduces effort

f Corkscrew: ramp, reduces effort

# Chapter 2: Body systems

## Strand: Life and living

**Suggested class time: 12 periods**

### Sub-strand statement

This sub-strand deals with the digestive, circulatory, excretory and respiratory systems. The digestive system breaks down food. The circulatory system carries food and oxygen to the body cells. The urinary (excretory) system removes waste fluids. The respiratory system transfers oxygen to the blood and removes carbon dioxide from the body.

## General learning outcomes

Learners should:

- 8.2.1** know that food provides the body with different types of nutrients
- 8.2.2** know that the digestive system breaks down food and absorbs food nutrients
- 8.2.3** know that the circulatory system consists of the heart, blood and blood vessels
- 8.2.4** know the main functions of the heart
- 8.2.5** know the different components of the blood
- 8.2.6** know that excretion is the removal of waste material from the body
- 8.2.7** know the human respiratory system
- 8.2.8** be able to show that the respiratory system involves movement of air in and out of the body
- 8.2.9** understand the mechanics of inhalation and exhalation
- 8.2.10** know that energy is released from food during the process of cellular respiration
- 8.2.11** know the health problems associated with the body systems
- 8.2.12** appreciate both local and modern medicines used to treat the disease.

## Specific learning outcomes

Learners should be able to:

- 8.2.1.1** identify common local foods that provide the following nutrients:
  - i** carbohydrate—potato, taro, corn
  - ii** protein—fish, chicken, beans
  - iii** fat and oil—nuts, coconut
  - iv** vitamins—vegetables, fruits
  - v** minerals—salt, eggs, nuts
- 8.2.1.2** describe the functions of these nutrients
- 8.2.2.1** draw and identify the parts of the human digestive system: mouth, oesophagus, stomach, liver/gall bladder, pancreas, small intestine (consisting of duodenum and ileum), colon, rectum and anal canal
- 8.2.2.2** describe the main processes in the digestive system:
  - i** physical/mechanical breakdown of large food
  - ii** chemical breakdown of food
  - iii** absorption of food
  - iv** assimilation of food nutrients
  - v** elimination of unused food materials

- 8.2.3.1 identify from a diagram:
  - i the heart
  - ii blood vessels (arteries, veins and capillaries)
- 8.2.4.1 describe the two main functions of the heart:
  - i to pump deoxygenated blood to the lungs to collect oxygen
  - ii to pump oxygenated blood to all body parts
- 8.2.5.1 name the four components of blood: red blood cells, white blood cells, blood platelets, blood plasma
- 8.2.5.2 describe the main functions of the components of blood: red blood cells, white blood cells, blood platelets, blood plasma
- 8.2.6.1 identify from a diagram the main parts of the excretory system: kidney, ureter, bladder and urethra
- 8.2.6.2 state that urea is the main waste product of the body
- 8.2.7.1 explain how the respiratory system takes in oxygen gas from the air through the nose and mouth and removes carbon dioxide gas from the body, also through the nose and mouth
- 8.2.7.2 identify from a diagram the main parts of the respiratory system
- 8.2.8.1 perform inhalation (breathing in) and exhalation (breathing out)
- 8.2.9.1 explain the process of breathing: **i** inhalation—diaphragm and intercostals muscles contract; volume of the thoracic cavity increases; increased volume means decreased pressure; air rushes in; **ii** exhalation—diaphragm and the intercostals muscle relax; volume of the thorax cavity decreases; decreased volume means increased pressure; air rushes out
- 8.2.10.1 describe cellular respiration and write the chemical equation for the reaction
- 8.2.11.1 list the common health problem associated with:
  - i digestive system—diarrhoea, constipation
  - ii circulatory system—heart attack, high blood pressure
  - iii excretory system—kidney failure
  - iv respiratory system—asthma, cough and tuberculosis (TB)
- 8.2.11.2 list local medicines used to treat diseases
- 8.2.11.3 list modern medicines used to treat diseases

## Answers

### Suggested assessment events

*Solomon Islands Years 7–9 Science Syllabus*

- 1 Water and fibre (roughage)
- 2 **a** Small intestine; **b** Large intestine; **c** Stomach; **d** Large intestine; **e** Small intestine

3

Blood vessels	Description
Veins	Return blood to heart
Arteries	High pressure
Capillaries	Fine tubes near cells

- 4 **a** Carbon dioxide: chemical reactions in the cells
- b** Water: chemical reactions in the cells, extraction of water from food by the large intestine, filtering of some water out of the blood by the kidneys
- c** Urea: produced by the liver and filtered out of the blood by the kidneys

5	Body parts	Functions
	Heart	Pumps blood around the body
	Kidneys	Filter blood
	Ureters	Allow urine to reach storage area
	Bladder	Urine storage
	Urethra	Tube which allows urine to leave the body

## Challenge questions

*Learner's Book page 28*

- 1 A car needs petrol to operate. Food is the fuel that your body needs to operate. It provides energy for movement and the production of heat.
- 2 A mucous lining protects the stomach from enzymes and acid; otherwise the stomach would digest itself.
- 3 The alimentary canal, also known as the digestive tract or sometimes simply the gut, runs from the mouth to the anus.
- 4 Veins are blue because they contain blood without oxygen and are more blue-red in colour.
- 5 The heart pumps blood around the body, beating at about 90 to 120 beats per minute for children and 70 beats per minute for adults, though super-fit athletes may have resting pulse rates below 30.
- 6 The bladder has a maximum capacity of about 1 litre. It only takes about 300 millilitres (less than a can of soft drink) to trigger nerve sensors in its walls.

## Unit 2.1: Food

### Activity 1: Nutrition

*Learner's Book page 30*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate nutrients provided by common food types	<ul style="list-style-type: none"> <li>• breakfast or lunch pack</li> <li>• plate</li> <li>• spoon</li> <li>• water bottle</li> </ul>	In this activity, learners make observations and interpret recorded data. The teacher must supply samples of foods or pictures of different types of food for learners to study and classify into the food groups.	<ol style="list-style-type: none"> <li>1 Learners' responses will vary. Sample answers: eggs, bread, butter, tomatoes, rice, chicken, water, cabbage etc.</li> <li>2 Learners' responses will vary, depending on what they ate, but should include carbohydrates, protein, fat and oil, water.</li> <li>3 Food provides body cells with the nutrients needed for normal body functioning.</li> <li>4 Learners' responses will vary.</li> <li>5 Learners' responses will vary.</li> </ol>

**Activity 2: Basic food tests***Learner's Book pages 31–32*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To test for the presence of starch, glucose, lipids and protein in food	<ul style="list-style-type: none"> <li>• starch (or a dry biscuit)</li> <li>• iodine solution</li> <li>• white tile</li> <li>• glucose solution</li> <li>• Testape</li> <li>• margarine</li> <li>• vegetable oil</li> <li>• brown paper</li> <li>• protein solution</li> <li>• 2 test tubes</li> <li>• eye dropper</li> <li>• spatula</li> <li>• Benedict's solution</li> <li>• 1% copper sulfate solution</li> <li>• 5% sodium hydroxide solution</li> <li>• beaker</li> <li>• Bunsen burner or kerosene stove</li> <li>• pestle and mortar</li> <li>• water</li> <li>• heat-proof mat</li> <li>• tripod</li> <li>• gauze mat</li> <li>• matches</li> <li>• safety glasses</li> </ul>	<p>In this activity, learners make observations and interpret recorded data.</p> <p>Learners justify their choice of instruments and the accuracy of their measurements, commenting on the reliability of the procedures, the measurement used, and the conclusions drawn against the prediction or hypothesis investigated.</p> <p>The teacher must ensure that learners use clean equipment for each food test.</p> <p>Learners test freshly prepared samples of food, study the reactions in each test and record their data, and interpret their results by identifying the nutrients contained in the sample tested.</p>	<p><b>1 a</b> Solution turns blue-black when iodine is added if starch is present.</p> <p><b>b</b> Brown paper becomes transparent if lipids are present.</p> <p><b>c</b> Yellow-green-red/orange precipitate forms if glucose is present. Testape changes colour to green if glucose is present.</p> <p><b>d</b> The solution changes to purple if protein is present, depending on the amount.</p> <p><b>2</b> Mashing the food increases the surface area and therefore causes the reaction to occur more quickly. There is further information on this in Chapter 3.</p> <p><b>3</b> Fats and oils are very similar in chemical structure. However, oils tend to be liquids at room temperature and have fewer saturated fatty acids. Fats tend to be solid at room temperature and have more saturated fatty acids. In addition, animals tend to store fats, and plants tend to store oils.</p>

### Activity 3: Energy input

Learner's Book page 34

Processes and skills	Teacher's support notes	Answers to questions
To calculate the energy supplied by different foods	<p>In this activity, learners make systemic observations and interpret recorded data.</p> <p>Learners study the table showing the amount of energy in some common foods used in Solomon Islands meals and use it to interpret and calculate the energy input of some foods.</p> <p>You can give learners additional questions to practise calculating the energy input of foods.</p>	<p><b>1</b> Kumara (orange flesh) 100 g = 280 kJ</p> <p>During the feast 120 kg of kumara was baked = 120 000 g</p> $120\,000\text{ g}/100\text{ g} = 1200$ <p>Therefore, the energy value of 120 000 g of baked kumara is <math>1200 \times 280\text{ kJ} = 336\,000\text{ kJ}</math>.</p> <p>Rice 80 g = 390 kJ</p> <p>Total mass of 10 bags of rice is <math>10 \times 20\text{ kg} = 200\text{ kg}</math></p> $200\text{ kg} = 200\,000\text{ g}$ $200\,000\text{ g}/80\text{ g} = 2500$ <p>Therefore, the energy value of 200 000 g of rice is <math>2500 \times 390\text{ kJ} = 975\,000\text{ kJ}</math></p> <p><b>2</b> Four slices of white bread = 250 kJ per slice = 1000 kJ</p> <p>Boiled egg (large) = 340 kJ</p> <p>Soft drink (240 g) = 450 kJ</p> <p>Total = 1790 kJ</p> <p><b>3</b> 390 kJ for half a cup, therefore 780 kJ for one cup</p> <p>Fish (100 g) = 800 kJ</p> <p>Green vegetables (100 g) = 100 kJ</p> <p>Total = 1680 kJ</p>

### Activity 4: Energy requirements

Learner's Book page 35

Processes and skills	Teacher's support notes	Answers to questions
To calculate the energy requirements for various people in the community	<p>In this activity, learners make observations, interpret recorded data and calculate energy needs.</p> <p>Learners study a table of information about children's and adolescents' daily energy needs and use it to calculate the energy requirement for these age groups.</p>	<p><b>1</b> a 2880 J or 2.88 kJ b 508 590 J or 508.59 kJ c 483 450 J or 483.50 kJ</p> <p><b>2</b> The energy intake for each age group varies because these groups differ in:</p> <ul style="list-style-type: none"> <li>• their growth rates</li> <li>• their activity levels</li> <li>• their size and mass.</li> </ul> <p><b>3</b> Girls between the ages of 15 and 18 years require less energy than boys because they are generally less active. Boys of the same age require more energy because their muscles are growing.</p>

**Activity 5: Energy in a peanut***Learner's Book page 35*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To determine the chemical potential energy stored in a peanut	<ul style="list-style-type: none"> <li>• peanut</li> <li>• cork</li> <li>• pin</li> <li>• test tube</li> <li>• heat-proof mat</li> <li>• retort stand</li> <li>• boss head and clamp</li> <li>• thermometer</li> <li>• electronic balance</li> <li>• matches</li> </ul>	<p>In this activity, learners make observations and interpret recorded data.</p> <p>If peanuts are not available, other food samples can be used, such as dry coconut meat etc.</p> <p>Learners may use other instruments if the required ones are not available and justify their choice of instruments and the accuracy of their measurements.</p> <p>Learners comment on the reliability of the procedures, the measurement used and the conclusions drawn against the prediction or hypothesis investigated.</p>	<p><b>1</b> Learners' responses will vary, but the water can actually boil, going to 100°C.</p> <p><b>2</b> The answer will depend on the temperature rise. If there is a 10°C rise, it will be <math>10 \times 42 = 420</math> J. If there is a 60°C rise, it will be <math>60 \times 42 = 2520</math>.</p> <p><b>3</b> The peanut contains more energy than the calculated figure, but energy is lost as the flame heats the pin and test tube, and radiates into the air.</p> <p><b>4</b> Energy in 1 g = energy released by peanut in experiment (J) + mass of peanut in experiment (g)</p> <p><b>5</b> This experiment could be more accurate if it were performed in a container that would trap all or more of the heat.</p>

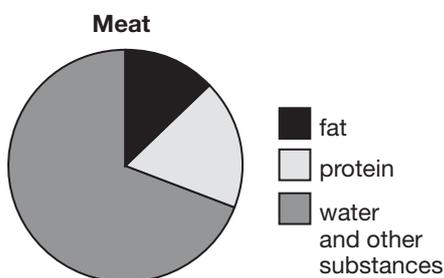
**Answers****Unit questions***Learner's Book page 36*

- 1** Food is the fuel that your body needs to operate. It provides energy for movement and the production of heat.
- 2** Water and fibre (roughage)
- 3** Dietary fibre is the fibre/roughage found in the cell wall of plants such as cereals, vegetables, fruits, nuts and seeds. It provides bulk to speed up the movement of matter through the intestine.
- 4** Cereals, vegetables, fruit, nuts and seeds
- 5** Carbohydrates include starches and sugars, and are our main source of energy. Examples of foods that contain carbohydrates are: rice, bread, fruit, pasta, potatoes.  
Lipids are fats and oils. They are a rich source of energy and contain twice the energy of carbohydrates. Examples of foods that contain lipids are: chips, butter, cooking oils.  
Proteins are body-building compounds—the raw materials required for the growth and repair of damaged or worn-out tissues. Examples of foods that contain proteins are: milk, fish, eggs, meat.  
Vitamins provide no energy, but are needed in small amounts to speed up various chemical reactions in the body and to maintain good health. Examples of foods that contain vitamins are: carrots, eggs, green vegetables, nuts, fish.  
Minerals are elements that are required for healthy growth and to avoid deficiency diseases. Examples of foods that contain minerals are: milk, meat, fish, nuts, cheese, vegetables.

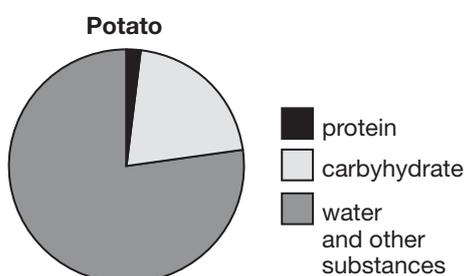
- 6 Minerals that are needed in larger amounts are called major elements, whereas those needed in smaller amounts are called trace elements.
- 7 Vitamins—vitamin A and vitamin B; minerals—iron and copper
- 8 Milk, liver, green vegetables, eggs
- 9 Kwashiorkor—the muscles waste away and body fluids accumulate in the skin, causing swelling; Vitamin A deficiency disease—poor vision in dim light, retarded growth, infections
- 10 A balanced diet is a diet that contains foods from different food groups, such as carbohydrates, fat and oil, protein, vitamins and minerals.
- 11 A standard amount eaten at one time, eg a bowl of cereal or a piece of fruit.
- 12 Energy expenditure may be different for different-sized people, and people may undertake activities at different speeds.
- 13 They may be more active than adults and are growing quickly.
- 14 Dietary requirements are different for females and males because they have different activity levels and nutritional needs, and females tend to be smaller than males.
- 15 From lowest to highest: sleeping, writing, cleaning, jogging, dancing
- 16 a  $1380/2 = 690$  kJ; b  $500 \times 3 = 1500$  kJ or more
- 17 The energy required by people varies according to the activity done each day. People who do a lot of manual work, such as farmers, builders and plantation workers, usually use a larger amount of energy than people who work in offices.
- 18 The person will start to lose weight because they are using more energy than they are taking in.
- 19 Learners' responses will vary. They should draw a simplified version of Figure 2.1.6 on page 33 of the Learner's Book.
- 20 Learners' responses will vary.
  - a Learners should use the energy value table on page 34 to add up the amount of energy in their healthy menu.
  - b The following table may be useful for learners adding up their junk food menu.

Food	Energy (kJ)	Carbohydrate (g)	Protein (g)	Fats (g)	Vitamin C (mg)	Calcium (mg)	Iron (mg)
Can of soft drink	668	40	0.1	0.1	0	11	0.1
Hamburger	1300	40	15.0	35.0	3	35	3.0
French fries	950	24	2.6	13.0	10	10	0.5

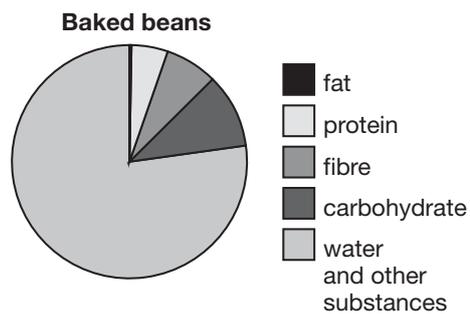
- 21 a Meat: 13 per cent fat, 18 per cent protein, 69 per cent water and other substances



- b Potato: 2 per cent protein, 21 per cent carbohydrate, 77 per cent water and other substances



- c Baked beans: 0.5 per cent fat, 5 per cent protein, 7 per cent fibre, 10.5 per cent carbohydrate, 77 per cent water and other substances



## Unit 2.2: Digestion

### Activity 6: A model intestine

Learner's Book page 41

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate how the small intestine works	<ul style="list-style-type: none"> <li>two 500 mL beakers</li> <li>two 20 cm lengths of dialysis tubing</li> <li>starch solution</li> <li>glucose solution</li> <li>iodine solution</li> <li>Testape</li> </ul>	<p>In this activity, learners make observations and interpret recorded data.</p> <p>Learners make and use models of dialysis tubing to interpret and explain how the small intestine works.</p> <p>Learners study the set-up of the dialysis tubes and explain their observations.</p>	<ol style="list-style-type: none"> <li>The iodine in the water reacted with starch to form a dark blue-black colour. The Testape reacted with the glucose to form a green colour.</li> <li>The glucose molecules were able to move out of the dialysis tube because they are small. The starch molecules were too large to move through the dialysis tubing and stayed inside the tubing.</li> <li>Dialysis tubing is a semi-permeable membrane like the small intestine. Only some molecules are able to pass through.</li> </ol>

## Answers

### Unit questions

Learner's Book page 42

- Incisors: cutting; canine: biting; pre-molars: grinding; molars: grinding
- Plaque is not the same as tooth decay. Plaque is a film of food, saliva and bacteria that weakens the tooth enamel and allows decay to occur.
- Regular flossing and brushing with toothpaste after each meal remove much of this plaque and drastically reduce the chances of tooth decay.
- Mouth, oesophagus, (liver), (gall bladder), stomach, (pancreas), (duodenum), small intestine, large intestine, rectum, anus

- 5 **a** Small intestine; **b** Large intestine; **c** Large intestine
- 6 **a** Liver; **b** Large intestine; **c** Mouth; **d** Stomach; **e** Gall bladder; **f** Oesophagus; **g** Small intestine
- 7 The large intestine is not the longest or the widest part of the digestive system, but it is the bulkiest. Undigested waste material passes into the large intestine, where water and a few minerals are absorbed.
- 8 Sphincters are necessary for keeping materials in the right location. If the sphincter at the top of the stomach fails, food and gastric juices rise regularly, leading to heartburn. If the sphincter at the bottom of the stomach fails, food does not stay in the stomach and enters the small intestine less digested and less ready to be absorbed.
- 9 Enzymes are chemicals that help break down large molecules in food into smaller ones that can be digested.
- 10 Harmful bacteria are killed in the stomach by the hydrochloric acid (HCl) in the gastric juices.
- 11 Chyme is partly digested semi-liquid food leaving the stomach.
- 12 The liver:
- converts glucose to glycogen
  - stores vitamins and minerals, including iron
  - helps in the production of a blood-clotting chemical
  - breaks down poisons such as alcohol.
- 13 Chewing breaks the food down into smaller pieces. This increases the surface area of the food, allowing it to be more easily attacked by enzymes.
- 14 By the time food gets to the small intestine, it is broken down enough to pass through the walls of the small intestine and into the bloodstream.
- 15 If the small intestine was smooth, rather than covered with villi, many fewer nutrients would be absorbed into the bloodstream, possibly leaving the person starved of nutrients.

### Extension question

*Learner's Book page 42*

Learners' responses will vary.

## Unit 2.3: Blood and circulation

### Activity 7: Blood cells under a microscope

*Learner's Book page 44*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To examine a prepared slide of blood	<ul style="list-style-type: none"> <li>• pre-prepared microscope slide containing a blood sample</li> <li>• microscope and lamp</li> </ul>	<p>In this activity, learners observe and interpret recorded data.</p> <p>Learners use appropriate diagrams and symbols when reporting on their investigations.</p> <p>Learners will be using microscopes, so the teacher must remind them how to obtain a good and clear view of the image observed.</p>	<p><b>1</b> Learners will probably have seen many red blood cells and a few white blood cells. Descriptions will depend on the quality of the slide.</p> <p><b>2</b> Learners' responses will vary.</p>

**Activity 8: Heart rate***Learner's Book page 46*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To examine the effect of activity on heart rate	<ul style="list-style-type: none"> <li>• watch or timer</li> <li>• graph paper or graphing software</li> </ul>	<p>In this activity, learners observe and interpret recorded data.</p> <p>Learners use appropriate diagrams and symbols when reporting on their investigation.</p> <p>Remind learners to follow the steps carefully to ensure similar results for all groups.</p>	<p><b>1–4</b> Learners' responses will vary.</p> <p><b>5</b> Learners' results will vary due to age, fitness, size and health. Everyone is different.</p>

**Answers****Unit questions***Learner's Book pages 48–49*

- 1 Red and white blood cells, platelets, plasma and antigens
- 2 White blood cells have a nucleus, while red blood cells do not. White blood cells are bigger than red blood cells. There are many more red blood cells than white blood cells in the human body.
- 3 White blood cells surround bacteria and viruses in an attempt to kill them.
- 4 Platelets
- 5 Plasma is a clear, yellow liquid in which red and white cells and platelets are suspended.
- 6 Oxygen
- 7 White blood cell
- 8 **a** False; **b** True; **c** True; **d** True
- 9 It is easy to see if a severe injury has occurred.
- 10 **a** The aorta carries fresh oxygenated blood from the heart to the body.  
**b** The pulmonary vein carries fresh oxygenated blood from the lungs to the heart.  
**c** The right ventricle pumps stale deoxygenated blood out of the heart to the lungs and the left ventricle pumps oxygenated blood out to the body.  
**d** The right atrium receives stale deoxygenated blood and pumps it to the right ventricle. The left atrium receives fresh oxygenated blood from the lungs and pumps it to the left ventricle.
- 11 The heart is made of cardiac muscle.
- 12 Arteries, veins and capillaries
- 13 Vein
- 14 A heart attack occurs when part of the heart dies because of a lack of blood caused by a blockage in one of the arteries supplying the heart with blood.
- 15 The blood in arteries is under high pressure. This high pressure causes an artery to spurt if it is cut. Veins are under much lower pressure and will not spurt.
- 16 **a** Pulmonary artery (to lungs); **b** Main vein from head; **c** Main artery (aorta); **d** Pulmonary veins (from lungs); **e** Main vein from body; **f** Lungs; **g** Liver; **h** Small intestines (gut); **i** Kidney
- 17 A person's heart beats faster when they are running because the muscles need more oxygen.
- 18 Do regular exercise, reduce fat intake, have medical checks.

**19** The right ventricle must pump blood to the lungs only, while the left ventricle must pump blood to the rest of the body, and so requires stronger walls.

**20**

Patient's blood	Donor's blood			
	A	B	AB	O
A	Yes	No	No	Yes
B	No	Yes	No	Yes
AB	Yes	Yes	Yes	Yes
O	No	No	No	Yes

## Unit 2.4: Excretion: getting rid of wastes

### Activity 9: Kidney dissection

*Learner's Book page 50*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To dissect a kidney and observe its structure	<ul style="list-style-type: none"> <li>newspaper</li> <li>chicken kidney</li> <li>dissecting board</li> <li>scalpel</li> <li>disposable gloves</li> </ul>	<p>Great care is needed in this activity because the instruments used are very sharp. Handle sharp instruments with caution. Always point them away from people and cut away from yourself and other people. Clean or dispose of all equipment appropriately, for example in detergent, and allow to dry. Ensure that learners wash their hands with detergent and warm water before leaving the lab.</p> <p>If there is not enough time or not enough kidneys for each group to have two types of kidneys, each group should do one and then examine the other type of kidney to compare them.</p>	<p><b>1</b> Fat on the kidney provides some protection from physical damage and helps prevent it from moving around in the body cavity. However, too much fat around the kidney can be unhealthy.</p> <p><b>2</b> Chicken kidneys are smaller than human kidneys, but similar to a human kidney in many ways. The basic structure is the same.</p>

## Answers

### Unit questions

*Learner's Book page 52*

- Excretion is the removal of wastes from the body.
- a** Carbon dioxide: chemical reactions in the cells; **b** Water: chemical reactions in the cells, extraction of water from food by the large intestine, filtering of some water from the blood by the kidneys; **c** Urea: produced by the liver and filtered from the blood by the kidneys

- 3 Waste products are carried by the blood to the lungs and kidneys.
- 4 The kidneys can filter 78 litres of blood in an hour.
- 5 Each kidney contains over a million tiny filtration units called nephrons.

6

Body part	Function
Kidney	Filters blood
Ureter	Allows urine to reach storage area
Urethra	Tube that allows urine to leave the body
Bladder	Urine storage
Circulatory system	Transports wastes and nutrients

- 7 Less water is lost due to sweating, so more is lost through urination.
- 8 Urine contains many chemicals that have been processed (or not) by the body.
- 9 The bladder can hold 1 litre, but 300 millilitres gives a person the urge to urinate.
- 10 Kidney stones crystallise into small, solid particles. They can be quite large and the only way they can exit is from the urethra, which hurts a lot.
- 11 Drinking lots of water will tend to flush out of the kidneys any particles that might make up a stone. A stone is therefore less likely to build.
- 12 A person can lead a normal life with only one healthy kidney.

**Extension questions**

*Learner's Book page 52*

1-2 Learners' responses will vary.

**Unit 2.5: Respiratory systems**

**Activity 10: Inhaled and exhaled air**

*Learner's Book page 53*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the gases that are in inhaled and exhaled air	<ul style="list-style-type: none"> <li>• flasks and glassware as shown in Figure 2.5.1</li> <li>• rubber tubing</li> <li>• limewater solution</li> </ul>	<p>This activity will require learners to use some chemicals to investigate the gases inhaled and exhaled, so the teacher must remind them about the safety procedures required.</p> <p>Learners must use chemicals, equipment and instruments responsibly and safely.</p> <p>After the activity, learners present their results using appropriate data presentation formats and comment on the nature of experimental errors.</p> <p>Ensure that the set-up of the apparatus exactly matches the diagram in the Learner's Book.</p>	<ul style="list-style-type: none"> <li>1 The limewater in flask A should have become milky as the carbon dioxide exhaled entered the solution.</li> <li>2 The limewater in flask B should have remained clear as the carbon dioxide was able to remain gaseous in the space above the limewater.</li> </ul>

## Answers

### Unit questions

Learner's Book pages 56–57

1	Structures	Functions
	Trachea	Carries air to and from the lungs
	Epiglottis	Prevents food from entering the trachea
	Nose	Filters, warms and humidifies air
	Cilia	Removes foreign particles from the lungs
	Alveolus	The site of gas exchange

- 2 **a** Larynx and epiglottis; **b** Coughing occurs.
- 3 Alveoli
- 4 **a** Haemoglobin is found in red blood cells.  
**b** The function of haemoglobin is to carry oxygen from the lungs to body cells.
- 5 **a** The diaphragm contracts.  
**b** The chest cavity enlarges.  
**c** The ribs are raised.  
**d** The intercostal muscles contract.  
**e** Pressure in the chest cavity decreases.
- 6 The large surface area allows a maximum rate of gas diffusion.
- 7 Features needed for effective gas exchange: high surface area; a thin, moist surface; and a means of transporting gases to and from cells.
- 8 **a** About the same; **b** Less; **c** Greater; **d** Greater
- 9 It is better to breathe through your nose than through your mouth because the nose filters, warms and humidifies the incoming air. The mouth does not do this.
- 10 **a** Nasal cavity; **b** Epiglottis; **c** Trachea; **d** Bronchus; **e** Larynx; **f** Alveoli; **g** Diaphragm; **h** Intercostals
- 11 **a** Trachea; **b** Carries air to and from the lungs; **c** Alveoli; **d** The site of gas exchange between air and blood

12 a	Apparatus	Body parts
	Plastic tube	Trachea
	Balloons	Lungs
	Bell jar	Chest
	Rubber floor	Diaphragm

- b** The space enlarges, causing pressure to drop, so air flows in.  
**c** Bell jar walls are fixed. The ribs move upwards and outwards.
- 13 **a** Oxygen  
**b** Haemoglobin  
**c** It is better to have the gas to join to haemoglobin. This joining is important because haemoglobin allows more oxygen to be carried than would be if it simply dissolved in the blood.

## Chapter review

### Answers

Learner's Book pages 57–60

1	Descriptions	Nutrients
	High in energy	Lipids
	Our main source of energy. Converted to glucose during digestion	Carbohydrates
	Required in small amounts for good health	Vitamins
	Provides bulk to move waste through intestines	Fibre
	Required for growth	Protein
	Not a nutrient, but required for chemical reactions in the body	Water
	Chemically simple, required for good health, provides no energy	Minerals

2 **a** Vitamin B1 (thiamine); **b** Vitamin D; **c** Vitamin C; **d** Vitamin B3 (riboflavin)

3 **a** Iron, iodine, copper; **b** Calcium, phosphorus, potassium

4 An adult normally has 32 teeth.

5 A normal filling is the filling of a small cavity in the enamel. Root canal treatment involves the sterilisation and filling of the pulp cavity.

6 **a** Tongue; **b** Epiglottis; **c** Trachea; **d** Liver; **e** Gall bladder; **f** Bile duct; **g** Duodenum (small intestine); **h** Ileum (small intestine); **i** Large intestine; **j** Caecum; **k** Appendix; **l** Anal sphincter muscles; **m** Bolus; **n** Salivary glands; **o** Oesophagus; **p** Diaphragm; **q** Stomach; **r** Pancreas; **s** Rectum; **t** Anus

7	Parts of digestive system	Comments
	Oesophagus	Connects mouth to stomach
	Gall bladder	Stores bile
	Small intestine	Where most absorption of nutrients occurs
	Large intestine	Where water is absorbed
	Duodenum	Start of small intestine
	Mouth	Digestion begins here
	Liver	The body's chemical factory
	Stomach	Like a cement-mixer for food and gastric juices
	Pancreas	Produces enzymes that help digest carbohydrates, fats and proteins

8 **a** Vena cava (from head); **b** Aorta; **c** Pulmonary artery; **d** Left atrium; **e** Pulmonary veins; **f** Bicuspid valve; **g** Left ventricle; **h** Septum; **i** Right ventricle; **j** Tricuspid valve; **k** Vena cava (from body); **l** Semi-lunar valves; **m** Right atrium

9 Enzymes that could be mentioned are amylase (saliva in mouth) and pepsin (stomach).

10 B (a little under 40 per cent)

11 Platelets are broken-down blood cells produced in bone marrow. They trigger the formation of fibrin, which helps clot the blood.

12 Angina occurs when a partly blocked artery in the heart causes pain. In a heart attack, these arteries are blocked completely and part of the heart muscle dies.

13 Fat and cholesterol may clog arteries.

14 **a** False. We exhale when we breathe out.

**b** False. Urea and carbon dioxide are waste products of cells.

**c** False. The kidneys are about the size of a fist.

**d** False. Kidneys filter about a quarter of the blood pumped by the heart in the same time.

**e** False. Urine travels down tubes called ureters to the bladder, which has a capacity of about one litre.

**f** False. Drinking at least a litre of water each day reduces the risk of kidney stones.

**g** True.

- 15** Fats contain twice as much energy as carbohydrates.
- 16** A sphincter is a ring-shaped muscle that stops substances going the wrong way. Peristalsis is a series of muscular contractions that push material in one direction.
- 17** Starch is broken down into much smaller glucose molecules in the mouth by the amylase enzyme, and glycogen is a stored form of glucose. That is, when the liver needs to store glucose, it converts it into glycogen.

**18**

Blood vessels	Descriptions
Vein	Return blood to heart
Artery	Under high pressure
Capillary	Fine tubes near cells

- 19** **a** i; **b** v; **c** iv; **d** iii; **e** ii and vi; **f** vi
- 20** To breathe in, the diaphragm *contracts* and the intercostal muscles *relax*. This causes the ribs to move *upwards* and *outwards*. These movements *increase* the size of the chest cavity, causing the pressure to *decrease*. Air then *flows in*.
- 21** The energy requirements of adolescent males are higher than those for females. For example, at the age of 15, males require 11.8 megajoules and females require 9.3 megajoules.
- 22** **a** No; **b** Yes; **c** No; **d** Yes

# Chapter 3: Chemical reactions and everyday uses

## Strand: Natural and processed materials

Suggested class time: 12 periods

### Sub-strand statement

When substances combine to form new substances we say that a chemical reaction has taken place. Some chemical reactions are fast; others are slow. Factors influencing the rate of reaction are temperature, amount in reaction (concentration), catalysts and the size of particles (surface area). Chemical reactions occur constantly in and around us.

## General learning outcomes

Learners should:

- 8.3.1** know that in a chemical reaction materials react to form new substances
- 8.3.2** know that many different types of chemical reactions happen naturally
- 8.3.3** be able to show different types of chemical reaction happening around them
- 8.3.4** understand that some chemical reactions occur faster than others
- 8.3.5** appreciate the importance of chemical reactions to their daily lives.

## Specific learning outcomes

Learners should be able to:

- 8.3.1.1** state that in a chemical reaction materials/substances combine (react) together to produce new substances called products
- 8.3.1.2** show that in a chemical equation reactants are on the left-hand side and products are on the right-hand side, using word equations only
- 8.3.2.1** identify some basic chemical reactions that are happening around them and identify the reactants and products, such as rusting of iron nails, mixing of lemon juice and coral, burning of firewood, chewing betel nut and lime making
- 8.3.3.1** demonstrate the reactions and write word chemical equations for:
  - i** rusting of iron nails
  - ii** mixing of lemon juice and coral
  - iii** burning of firewood
  - iv** chewing of betel nut
  - v** lime making (baking of coral)
- 8.3.4.1** identify and demonstrate factors that influence the rate of chemical reactions: temperature, concentration, catalyst and surface area
- 8.3.5.1** explain the importance of chemical reactions in our daily lives (eg photosynthesis, cellular respiration and rusting processes).

## Answers

### Suggested assessment events

*Solomon Islands Years 7–9 Science Syllabus*

- 1 a** Physical; **b** Chemical; **c** Chemical; **d** Physical; **e** Physical; **f** Physical
- 2 a** Photosynthesis: carbon dioxide + water + sunlight → glucose + oxygen
- b** Respiration: glucose + water → carbon dioxide + water + energy

- 3 a** Reaction rate increases with increasing temperature.  
**b** Reaction rate increases with increasing surface area.

### Challenge questions

*Learner's Book page 61*

- The five main signs of a chemical reaction are: colour change, property change, temperature change, gas formation and solid formation.
- Dihydrogen oxide is the chemical name for water. It means that oxygen is combined with two hydrogen atoms.
- Water is a chemical known as dihydrogen oxide ( $\text{H}_2\text{O}$ ).

## Unit 3.1: What are chemical reactions?

### Activity 1: Signs of chemical change

*Learner's Book page 62*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To observe changes during chemical reactions	<ul style="list-style-type: none"> <li>• solid copper carbonate</li> <li>• magnesium</li> <li>• dilute nitric acid</li> <li>• splint</li> <li>• matches</li> <li>• Bunsen burner</li> <li>• test-tube holder</li> <li>• test-tube rack</li> <li>• dilute sodium hydroxide</li> <li>• thermometer</li> <li>• dilute copper sulfate</li> <li>• solid zinc</li> <li>• 4 test tubes (one with stopper)</li> <li>• lab coat</li> <li>• safety glasses</li> </ul>	<p>Make sure that the acid used is at the correct diluted concentration. Treat all chemicals as dangerous and therefore handle them with great care. If anyone spills a chemical on their skin, wash the skin with plenty of water. Ensure that learners always face the test tube away from others.</p> <p>In the case of accident, call for help immediately.</p>	<ol style="list-style-type: none"> <li>The gas formed in the reaction in step 3 was carbon dioxide.</li> <li>If the zinc in step 5 was replaced with silver, there would be no reaction because silver is less reactive than copper.</li> </ol>

## Answers

### Unit questions

*Learner's Book pages 65–66*

- Colour changes.
  - Gas is given off.
  - Energy is produced or absorbed.
  - A precipitate forms.
  - One metal deposits on another.
- A solution is the combination of a solute and a solvent.
- 'Clear' means you can see through it. You might be able to see through a solution that has a colour.
- A precipitate forms when two clear solutions are mixed together, resulting in cloudiness or solid particles sinking to the bottom of the test tube.
- The reactants are water and energy.
  - The products are hydrogen and oxygen.
  - The reaction is endothermic.

- b i** The reactants are methane and oxygen.
- ii** The products are carbon dioxide, water and energy.
- iii** The reaction is exothermic.

<b>6</b>	<b>Chemical change</b>	<b>Physical change</b>
	<ul style="list-style-type: none"> <li><b>b</b> Burning gas</li> <li><b>f</b> Putting a soluble aspirin tablet in water</li> </ul>	<ul style="list-style-type: none"> <li><b>a</b> Cutting up cake</li> <li><b>c</b> Melting an ice-block</li> <li><b>d</b> Freezing cordial</li> <li><b>e</b> Water evaporating</li> </ul>

- 7** Burning gas or burning firewood, iron getting rusty, burning kerosene in a lamp
- 8**
  - a** Chemical change has occurred.
  - b** Chemical change has occurred.
  - c** Chemical change has occurred.
  - d** Physical change has occurred.
  - e** Chemical change has occurred.
- 9** Chemical equations can be very useful because they provide a quick way to represent complex reactions and they give a ratio of the amounts of reactants reacting and the products formed.
- 10**
  - a** Copper + nitric acid → copper nitrate + nitrogen monoxide + water
  - b** Sulfuric acid + solid sodium carbonate → carbon dioxide + water + sodium sulfate
  - c** Magnesium + oxygen → magnesium oxide
  - d** Carbon dioxide + water → (starch) glucose + oxygen

## Unit 3.2: Reaction types

### Activity 2: Electroplating

*Learner's Book page 67*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the displacement reaction associated with electroplating	<ul style="list-style-type: none"> <li>• 6 V DC power source</li> <li>• 250 mL beaker</li> <li>• 2 insulated wires with crocodile clips on one end</li> <li>• 1 very thin 7 × 4 cm strip of copper metal (coiled copper wire may also be used)</li> <li>• 1 strip of stainless steel</li> <li>• sandpaper</li> <li>• tongs</li> <li>• wash bottle of distilled water</li> <li>• 1 M zinc sulfate solution</li> <li>• 2 M nitric acid</li> <li>• lab coat</li> <li>• safety glasses</li> <li>• gloves</li> </ul>	<p>Always treat all chemicals as poisonous and handle them carefully.</p> <p>2M nitric acid is quite a strong level of concentration.</p> <p>It can cause eye irritation. If you spill it on your fingers or hands you must wash them with plenty of water.</p> <p>In the case of accident, call for help immediately.</p>	<p><b>1</b> Zinc (blue-grey coloured solid) is deposited on the copper strip after 3 minutes. Copper is reddish-brown in colour.</p> <p><b>2</b> The chemical equation for the reaction is as follows:</p> <p>Zinc sulfate + copper → copper sulfate + zinc</p> <p>This reaction is possible because of the energy provided by the batteries. Without the batteries this reaction would not take place. Energy is needed in electroplating.</p>

## Answers

### Unit questions

*Learner's Book page 71*

- 1 A combination reaction occurs when two or more substances combine to form a new substance. For example: carbon + oxygen  $\rightarrow$  carbon dioxide
- 2 It is written as O<sub>2</sub> rather than just O, because oxygen is a diatomic molecule.
- 3 A decomposition reaction occurs when one substance breaks down into two or more new substances. For example: calcium carbonate  $\rightarrow$  calcium oxide + carbon dioxide
- 4 Carbon dioxide
- 5 A precipitation reaction occurs when two clear solutions are mixed, forming an insoluble solid (called a precipitate).
- 6 (s) means solid, (l) means liquid, (g) means gas, (aq) means aqueous.
- 7 A neutralisation reaction occurs when an acid is added to a base, forming water and other substances. For example: hydrochloric acid + sodium hydroxide  $\rightarrow$  sodium chloride + water  
 $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
- 8 The products formed are water and metal salt.
- 9 A combustion reaction occurs when a substance is burnt in oxygen, so O<sub>2</sub> is always a reactant. For example: magnesium + oxygen  $\rightarrow$  magnesium oxide  
 $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$
- 10 A displacement reaction occurs when one metal deposits on (settles on top of) another. For example:  
 zinc + copper sulfate  $\rightarrow$  zinc sulfate + copper  
 carbon dioxide + oxygen  $\rightarrow$  carbon dioxide  
 calcium carbonate  $\rightarrow$  calcium oxide + carbon dioxide
- 11 Learners' responses depend on reactions chosen.
- 12 **a** Low solubility in water; **b** Soluble in water; **c** Low solubility in water; **d** Soluble in water
- 13 **a** Decomposition reaction; **b** Neutralisation reaction; **c** Displacement reaction  
**d** Combination reaction
- 14 **a** Hydrogen peroxide  $\rightarrow$  hydrogen + oxygen  
**b** Phosphoric acid + ammonia  $\rightarrow$  water + ammonium phosphate  
**c** Magnesium + zinc chloride  $\rightarrow$  zinc + magnesium chloride  
**d** Sulfur + iron  $\rightarrow$  iron sulfide

## Unit 3.3: The rate of chemical reactions and their importance in our daily lives

### Activity 3: Rates of reactions 1

Learner's Book page 72

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate how the surface area affects reaction rate	<ul style="list-style-type: none"> <li>lab coat</li> <li>safety glasses</li> <li>gloves</li> <li>marble chips (large and small)</li> <li>powdered calcium carbonate</li> <li>dilute hydrochloric acid</li> <li>stopwatch</li> <li>spatula</li> <li>4 test tubes</li> <li>test-tube rack</li> <li>10 mL measuring cylinder</li> <li>electronic balance</li> </ul>	<p>This is a good homework activity for learners. They should consider the design of their experiment and also a hypothesis.</p> <p>Learners can work in groups. Encourage them to discuss with each other the design of the experiment. You can also ask them to present their design in class. This is a good way of exposing them to public speaking.</p>	<p><b>1</b> The smaller the surface area, the slower the reaction. The larger the surface area, the faster the reaction.</p> <p><b>2</b> Learners' responses will vary.</p>

### Activity 4: Rates of reactions 2

Learner's Book pages 72–73

Processes and skills	Resources	Teacher's support notes	Answers to questions						
To investigate the variables that affect reaction rates	<ul style="list-style-type: none"> <li>lab coat</li> <li>safety glasses</li> <li>gloves</li> <li>magnesium strips</li> <li>ice</li> <li>1 M HCl</li> <li>hydrogen peroxide solution</li> <li>solid manganese dioxide</li> <li>stopwatch</li> <li>spatula</li> <li>4 test tubes</li> <li>test-tube rack</li> <li>10 mL measuring cylinder</li> <li>2 × 100 mL beakers</li> </ul>	<p>All chemicals should be treated as poisonous and should be handled with care. If any chemicals are spilt on learners' skin, make sure they wash the skin thoroughly with plenty of water.</p> <p>Learners form into pairs. One person in each pair starts the timer and the other adds acid and magnesium to the tube. In a large class, you could have some groups cut the magnesium into small pieces. Then all results could be reported back to the class.</p>	<p><b>1</b></p> <table border="1"> <thead> <tr> <th>Made reactions faster</th> <th>Made reactions slower</th> </tr> </thead> <tbody> <tr> <td>High temperature</td> <td>Low temperature</td> </tr> <tr> <td>Catalyst</td> <td>No catalyst</td> </tr> </tbody> </table> <p><b>2</b> If you apply heat, the rate of reaction will increase because you are increasing the kinetic energy of the reaction, thus increasing the rate of collision and therefore increasing the rate of the reaction.</p> <p><b>3</b> The manganese dioxide acts as a catalyst. Remember, a catalyst is anything that increases the rate of reaction, but does not take part in the reaction.</p>	Made reactions faster	Made reactions slower	High temperature	Low temperature	Catalyst	No catalyst
Made reactions faster	Made reactions slower								
High temperature	Low temperature								
Catalyst	No catalyst								

## Answers

### Unit questions

*Learner's Book page 76*

- 1 An example is sulfuric acid.
- 2 The rate of reaction is how quickly or slowly the reaction occurs.
- 3 Increase the temperature so that the kinetic energy of the reactants increases, resulting in a faster rate; increase the surface area of the reactants.
- 4 Three uses of sulfuric acids are: making fertilisers, making organic compounds and refining petroleum.
- 5 **a**  $\text{H}_2\text{SO}_4$ ; **b**  $\text{CO}_2$ ; **c**  $\text{C}_6\text{H}_{12}\text{O}_6$
- 6 The elements that make up sulfuric acid are: hydrogen, sulfur and oxygen.

## Chapter review

### Answers

*Learner's Book page 76*

- 1 If a chemical reaction occurs, one or more following will be observed: colour change, one metal deposited on another, temperature change, gas formation, or solid formation. This list is not complete; many other observations could be recorded with specific chemical reactions.
- 2 Rain is a physical change and not a chemical change, because water vapour changes to liquid (rain), which is just a change of state.
- 3 Some metals are more reactive than others because they give up their outer shell electrons.
- 4 'Diatomic' means that two of the same atoms bond to form a stable molecule. For example:  $\text{O}_2$  is used instead of O by itself.
- 5 **a** Combination reaction; **b** Acid and carbonate reaction
- 6 The reaction that is used to coat metal is called electrolysis.
- 7 **a** Sodium chloride + carbon dioxide + water  
**b** Calcium nitrate + water

# Chapter 4: Atmosphere, climate and weather

## Strand: Earth and beyond

Suggested class time: 8 periods

### Sub-strand statement

This sub-strand deals with the atmosphere, climate and weather. The atmosphere is the thick layer of gases surrounding the Earth. The atmosphere consists of four layers – the troposphere, stratosphere, mesosphere and ionosphere. Climate is the average weather for a long period of time in a particular area or region. Weather is the state of the atmosphere at a particular place and time with respect to variables such as temperature, rainfall, moisture, wind speed and pressure.

## General learning outcomes

Learners should:

- 8.4.1** know that the space above the Earth's surface is the atmosphere
- 8.4.2** know that the atmosphere consists of different gases
- 8.4.3** know that the troposphere contains essential gases for living organisms
- 8.4.4** understand that convection currents and expansion of gases cause atmospheric patterns
- 8.4.5** know that the wind is a result of air movement
- 8.4.6** know the development of a tropical cyclone
- 8.4.7** understand the different climatic zones in the world
- 8.4.8** be able to measure different daily weather conditions
- 8.4.9** appreciate the significance of water and water cycle to plants and animals.

## Specific learning outcomes

Learners should be able to:

- 8.4.1.1** identify from a diagram the different layers of the atmosphere: troposphere, stratosphere, mesosphere and ionosphere
- 8.4.2.1** identify the main gases in the different layers of the atmosphere: troposphere, stratosphere, mesosphere and ionosphere
- 8.4.3.2** identify three essential gases for living organisms in the troposphere layer as oxygen, carbon dioxide and nitrogen
- 8.4.4.1** explain land and sea breezes by reference to concepts of gas expansion, convection and heating
- 8.4.5.1** use a diagram to describe the pattern of air movement
- 8.4.6.1** describe the formation of a tropical cyclone and its pathway
- 8.4.7.1** identify and explain on a world map different climatic zones caused by the patterns of heating and cooling of the Earth's surface
- 8.4.8.1** measure the daily temperature, rainfall, air pressure, wind speed and moisture in their area and other areas
- 8.4.9.1** express the importance of water to humans and other organisms
- 8.4.9.2** express the importance of the water cycle.

## Answers

### Suggested assessment events

*Solomon Islands Years 7–9 Science Syllabus*

- 1 The closest layer to the Earth is the troposphere. Above this is the stratosphere, which also contains the ozone layer. Progressively further out is the mesosphere, thermosphere and lastly the exosphere. This is shown in Figure 4.1.1 of the Learner's Book.
- 2 Refer to Figure 4.2.5 in the Learner's Book.
- 3 a There are different methods that can be used to record and represent rainfall information, including recording the data in a table (table of results) or presenting the data in graphs (bar, column or pie chart). A rain gauge can be used to collect and measure the amount of rainfall each day in a week. We can also record the highest and lowest rainfall in a week.

Suggested table for recording daily rainfall and temperature:

Date	Time of day when recording	Rainfall (mm)	Min temp	Max temp

- b This is an open-ended question. Learners should give some of the following reasons why weather is important in everyday life:
  - rainy and cloudy weather: plants use rainfall to produce food (photosynthesis process), rain gives us more water for drinking, bathing and washing
  - sunny weather: plants use sunlight to make food (photosynthesis process), sunlight provides temperature conducive to supporting life, we need sunlight for drying purposes
  - windy weather: wind is important in seed-dispersal processes, wind provides cool air for people.

### Challenge questions

*Learner's Book page 77*

- 1 Atmosphere is the layer above the Earth's surface that consists of gases such as oxygen, carbon dioxide, nitrogen and other gases.
- 2 A person who studies the atmosphere is called a meteorologist. Learners may be able to search the internet to find information about some well-known meteorologists.
- 3 The three main gases in the atmosphere are oxygen, carbon dioxide and nitrogen. Oxygen is about 21 per cent of the atmosphere and nitrogen about 78 per cent. All of the remaining gases make up about 1 per cent of the atmosphere, including such gases as argon (0.93 per cent) and carbon dioxide (0.039 per cent). However, water vapour is also an important component, and can make up from 0 to 4 per cent of the atmosphere. Other trace gases are neon, helium, krypton and xenon.
- 4 The important processes that make up the water cycle are precipitation; accumulation; evaporation and transpiration; and condensation.
- 5 Low-pressure systems. The large bodies of water in the coral seas tend to store large amounts of heat, which affects air pressure and leads to low-pressure systems that drive cyclones.

## Background information

### Solomon Islands climate

The climate of Solomon Islands is a typical warm tropical climate. There are two dry seasons, from December to February and June to mid-September, and two rainy seasons, from February to the end of May and from September to the end of November. Annual temperatures generally range from 26°C to 32°C, although they can go down as low as 22°C. East to south-east winds prevail from May to October, while west to north-west winds occur from November to April. A number of tropical low-pressure systems occur each year, but few of these develop into tropical cyclones. The average frequency of cyclone occurrence is between one and two per year.

## Unit 4.1: The atmosphere

### Activity 1: Layers of the atmosphere

Learner's Book page 78

Processes and skills	Teacher's support notes	Answers to questions
To identify the layers of the atmosphere	Direct learners to read the section 'Layer upon layer', on pages 78–79 of the Learner's Book. Support learners to compare their prior knowledge about the layers of the Earth with the layers of the atmosphere. Further research on specific layers of the atmosphere may also assist learners in this activity.	<p><b>1</b> The different layers of the atmosphere are:</p> <ul style="list-style-type: none"> <li><b>i</b> Troposphere: This is the lowest atmospheric layer and is around 11 km thick. Most clouds and weather are found in the troposphere. The troposphere is thinner at the poles (averaging about 8 km) and thicker at the equator (averaging about 16 km). The temperature decreases with altitude.</li> <li><b>ii</b> Stratosphere: This is found from 11 to 48 km above the Earth's surface. This is where the ozone layer is found, which absorbs most of the harmful radiation from the Sun.</li> <li><b>iii</b> Mesosphere: In this region, the atmosphere is thin.</li> <li><b>iv</b> Thermosphere: The thermosphere starts at about 55 km.</li> <li><b>v</b> Ionosphere: The ionosphere overlaps the other atmospheric layers, from above the Earth.</li> </ul> <p><b>2</b> Troposphere: clouds. Stratosphere: planes, weather balloons. Mesosphere: meteors. Thermosphere: stars, shuttles, aurora</p> <p><b>3</b> Troposphere</p>

## Answers

### Unit questions

Learner's Book page 80

- 1 a** Humans live in the *troposphere*.
- b** Commercial aircraft travel in the stratosphere.
- c** *Nitrogen* is the most common gas in the atmosphere.
- d** The *stratosphere* protects us from X-rays and gamma rays.
- e** The ozone layer is part of the stratosphere *but at the upper layer*.
- f** Weather happens in the troposphere.
- g** *Very little air* is in the ionosphere or *Most air is in the troposphere*.

- 2 **a** Stratosphere, thermosphere; **b** Troposphere, mesosphere; **c** Thermosphere  
 3 **a** Temperature drops; the pressure also drops.  
**b** Temperature increases.  
**c** Temperature decreases.  
**d** Temperature increases.

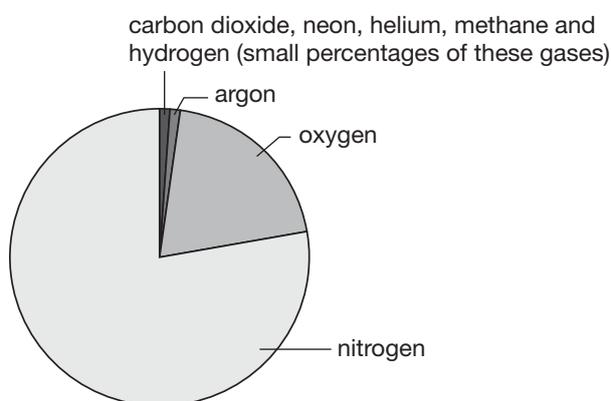
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Gas	Percentage (%)
Nitrogen	78
Oxygen	20
Argon	0.9
Carbon dioxide	0.03
Neon	0.002
Helium	0.0005
Methane	0.0002
Hydrogen	0.00005

5

Gas	Purpose
Nitrogen	In the nitrate form, plants use it for their growth. Also used in refrigerators for cooling.
Oxygen	For respiration in humans and other animals.
Argon	Used in graphite electric burners to prevent the graphite from burning.
Carbon dioxide	Photosynthesis in plants, corals, algae and many other photosynthetic organisms.
Neon	Used in advertising signs. It produces a bright reddish-orange colour. Some other lights with different colours are sometimes called neon lights.
Helium	Used to cool superconducting magnets in MRI scanners. It is lighter than air. Airships and balloons can be filled with the gas to gain lift. It also is used to condense hydrogen and oxygen for making rocket fuel.
Methane	Used in heating and cooling, cooking, electrical power generation and, when compressed, as a vehicle fuel.
Hydrogen	Used in making water (combination of hydrogen and oxygen).

- 6 Percentage of each gas in the atmosphere. (Note: Other gases appear as 0 per cent because they are only a very small percentage. Please refer to the above table for their exact percentage composition.)



- 7 **a** The atmosphere has several layers, one of which is the troposphere; so the troposphere is just one part of the whole atmosphere of the Earth.  
**b** The troposphere is where the activities of the Earth take place so, in a way, it is the atmosphere of the Earth.

## Unit 4.2: Weather

### Activity 2: Making clouds

*Learner's Book page 84*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To determine what conditions are needed to make clouds	<ul style="list-style-type: none"> <li>• 400 mL beaker</li> <li>• ice cubes</li> <li>• evaporating dish</li> <li>• Bunsen burner</li> <li>• heat-proof mat</li> <li>• tripod</li> <li>• gauze mat</li> <li>• matches</li> <li>• safety glasses</li> </ul>	<p>Learners can use water boiled in a kettle, or over a fire, for demonstration purposes, in order to observe how water evaporates and condense again. To see the condensed water, place a flat mirror over the steam.</p> <p>Ensure that bowls and beakers are of suitable for stacking so that the beaker does not tip and spill boiling water. Before repeating the experiment with ice cubes in the evaporating dish, ask learners what they expect will happen compared with the previous experiment.</p>	<ol style="list-style-type: none"> <li><b>1</b> Water vapour is water in gaseous state, instead of its liquid state (water) or its solid state (ice).</li> <li><b>2</b> When water vapour cools it condenses back into liquid water, forming clumps of small droplets called clouds.</li> <li><b>3</b> Clouds form when water vapour cools and condenses on tiny pieces of dust, dirt, sea salt and other microscopic particles. When billions of these particles occur in an area then it becomes visible as a cloud. And when the cloud becomes too heavy, it falls as rain.</li> </ol>

### Activity 3: Cyclones

Learner's Book page 84

Processes and skills	Teacher's support notes	Answers to questions
To identify what causes a cyclone	<p>Category 1 tropical cyclone: Strongest gusts are less than 125 km/h. Effects: gales, minimal house damage, damage to some crops, trees.</p> <p>Category 2 tropical cyclone: Strongest gusts are 125–164 km/h. Effects: destructive winds. House damage may be minimal but it depends on types of houses. Significant damage to signs, trees and caravans. Heavy damage to some crops. Small boats may capsize.</p> <p>Category 3 severe tropical cyclone: Strongest gusts are 165–224 km/h. Effects: very destructive winds. Some roof and structural damage.</p> <p>Category 4 severe tropical cyclone: Strongest gusts are 225–279 km/h. Effects: very destructive winds. Significant roofing and structural damage.</p> <p>Category 5 severe tropical cyclone: Strongest gusts are more than 280 km/h. Effects: extremely destructive winds. Extremely dangerous with widespread destruction.</p>	<p><b>1</b> Tropical cyclones are low-pressure systems that form over warm tropical waters and have gale-force winds (sustained winds of 63 km/h or greater and gusty winds over 90 km/h) near the centre. Tropical cyclones start at the warm tropical oceans and do not form unless the sea-surface temperature is above 26.5°C.</p> <p><b>2</b> Other names for a cyclone are: hurricane, typhoon, tornado and storm.</p> <p><b>3</b> Tropical cyclones gain their energy from evaporation of warm ocean water. When this moisture rises and condenses, it releases latent heat, which fuels the storm. However, as the cyclone moves over the land it no longer has this latent heat source, since there is very little water available for evaporation on land. Therefore, its energy source is effectively removed. The friction over land is considerably greater than that over water, and this acts to weaken the storm's structure. This is especially true over rugged terrains, and mountains in particular. This is why a hurricane may hold together better over flat land, but less as it moves over the mountains.</p>

### Answers

#### Unit questions

Learner's Book pages 85–86

- 1**
  - a** Hot air rises and cold air drops.
  - b** The equator receives more *heat* from the Sun than do the poles.
  - c** Hot air circulates away from the *equator* to the *poles*.
  - d** Trade winds are *global* winds.
- 2**
  - a** Evaporation of water
  - b** Condensation of water vapour
- 3** A drop in temperature, normally caused by the cloud being forced upward by a change in terrain
- 4** Altocumulus, stratocumulus, stratus, cumulonimbus, nimbostratus

- 5 Learners' responses will vary but should include the idea that the flow of water from sea to clouds to rain then run-off from land to sea is called the 'water cycle'.
- 6 Cyclones are sometimes called typhoons or hurricanes.
- 7 Warm humid air begins to spiral clockwise and upwards, cooling and condensing as it goes. Energy is released and the air is warmed again, forcing it to go even higher, reducing the air pressure at ground level. Air is sucked in from the seas around, bringing high-speed winds and torrential rain.
- 8 A cyclone loses strength when it passes over land and loses its water supply and energy.
- 9 It can pick up pollution particles as it forms in the atmosphere.
- 10 The poles would be even colder if there were no convection currents since there would be no 'warm' air moving in from the equator.
- 11 The temperatures at the equator would be much hotter if there were no convection currents.
- 12 Plants remove water from the soil and release it into the atmosphere.
- 13 Learners' responses will vary but should include the idea that meteorologists forecast the weather and study the atmosphere to improve our understanding of the Earth's climate.
- 14
  - a From bitumen to forest
  - b From sea to land
  - c From rocks to sand
- 15 Learners' responses will vary.

### Extension questions

*Learner's Book page 86*

- 1 Learners could create a table like the one below to assist them in collecting information. Learners could also insert pictures of the different types of clouds into the table.

Date	Time of day	Type of cloud	Rainfall	Picture

- 2 This exercise may be better suited to a class or small group project, as many learners may not have a fish tank or suitable transparent container. Learners should consider Figure 4.2.5 in the Learner's Book as a model and try to reproduce as best as possible the entire cycle. Tanks must be covered and should have a light to stimulate evaporation of water.

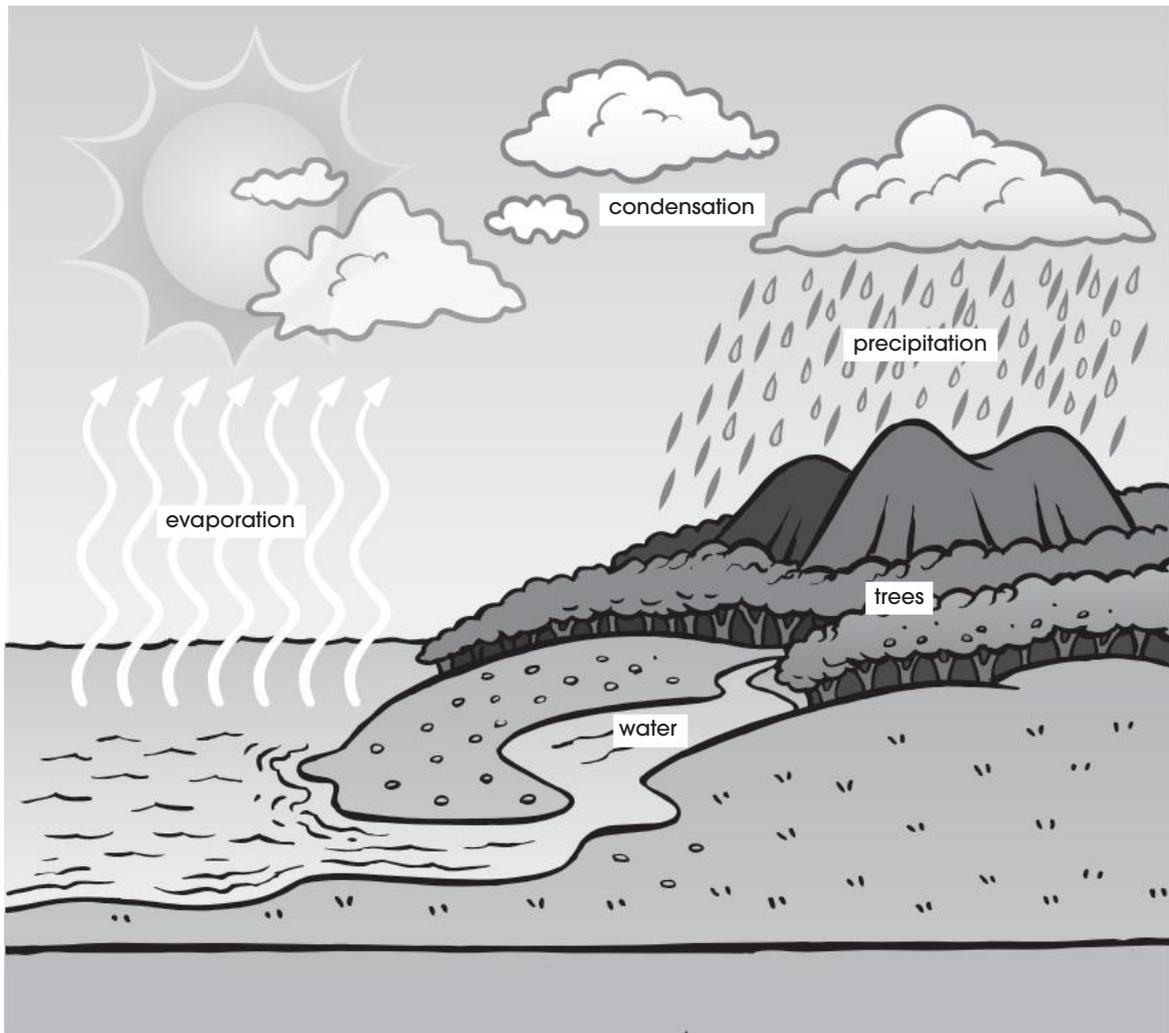
## Chapter review

### Answers

*Learner's Book page 86*

- 1
  - a False; it is called troposphere.
  - b True
  - c False; condensation occurs when water turns from vapour to liquid.
  - d False; hot air is lighter.
  - e False; water heats more slowly than rock.
  - f True
  - g True

2

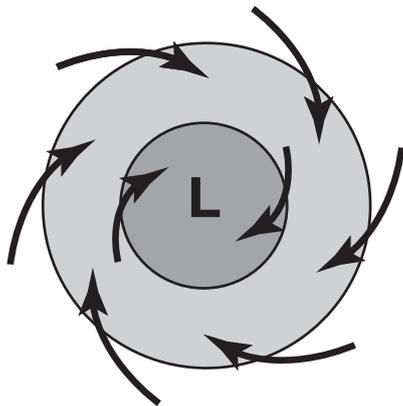


- 3
- Nimbostratus clouds produce heavy rain or snow.
  - Cumulonimbus clouds produce thunderstorms with lightning.
  - Altocumulus clouds produce light showers.
  - Stratocumulus clouds produce drizzle.
  - Stratus clouds produce drizzle or fine rain.
  - Cumulus clouds do not produce rain.
  - Cirrocumulus clouds do not produce rain.
  - Cirrus clouds do not produce rain.

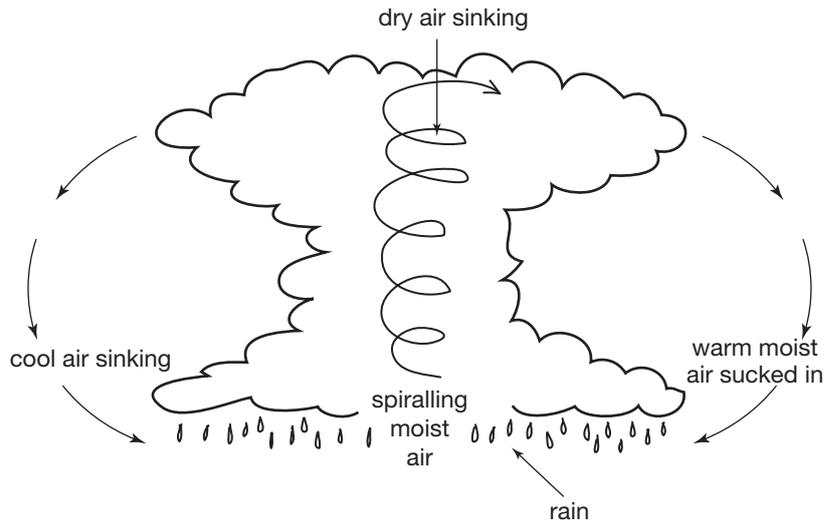
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Job title	Main tasks	Skills required
<p>Meteorologist</p>	<p>A meteorologist is an individual with specialised education who uses scientific principles to explain, understand, observe or forecast the Earth's atmospheric phenomena and/or how the atmosphere affects the Earth and life on the planet. This specialised education would be a bachelor's or higher degree in meteorology or atmospheric science. Individuals who have little formal education in the atmospheric sciences, or who have taken only industry survey courses, and who disseminate weather information and forecasts prepared by others, are called weathercasters.</p> <p>Types of meteorologists:</p> <ul style="list-style-type: none"> <li>• Broadcast meteorologists: These are the people who interpret and report the weather for television.</li> <li>• Research meteorologists: These scientists work for the government; eg MET (SI), NASA, the military.</li> <li>• Teachers and professors: These people use their knowledge of the atmosphere and meteorology to become educators; sharing their knowledge at a high school or university level can help to create future generations of meteorologists.</li> <li>• Climate meteorologists: These meteorologist looks at long-term weather patterns and data to help predict future climate trends and past climate data.</li> <li>• Archive meteorologists: Many weather scientists will also be in charge of researching, verifying, and reporting on storms of the past.</li> </ul>	<p>An advanced degree in meteorology. Many universities offer degree courses in meteorology.</p> <p>Once you have a degree, you can begin to search for jobs in meteorology, depending on your area of specialty within the science.</p>

5



6



A cyclone is a storm or system that rotates around a centre of low atmospheric pressure. Winds in a cyclone blow clockwise in the southern hemisphere (anticlockwise in the northern hemisphere). In cyclones, air close to the ground is forced inward towards centre of the cyclone, where pressure is lowest. It then rises upwards, expanding and cooling in the process. This cooling increases the humidity of the rising air, which results in cloudiness and humidity in the cyclone.

**7** The layers of the atmosphere are the troposphere, stratosphere, mesosphere and thermosphere.

# Chapter 5: Plant processes and marine systems

## Strand: Life and living

**Suggested class time: 16 periods**

### Sub-strand statement

This sub-strand is about plant processes and marine ecosystems. Green plants undergo photosynthesis using carbon dioxide, water and light to produce glucose. The green pigment in the leaves is the chlorophyll. Chlorophyll absorbs light for photosynthesis. Plants release energy from the breakdown of food (glucose) by aerobic respiration. The plant root hairs absorb water and minerals (essential for plant growth) from the soil. Special vessels in plants transport nutrients and food.

Marine ecosystems include the ocean, coral reef, mangroves and all organisms (plants and animals) in the ecosystem. Marine plants and animals are important sources of food for Solomon Islanders. The intertidal zone is the area from the high-tide water mark (HTWM) to the low-tide water mark (LTWM). The coral reef covers the shallow part of the ocean.

## General learning outcomes

Learners should:

- 8.5.1** know that plants are the primary producers for life on Earth
- 8.5.2** know that plants carry out the process of photosynthesis
- 8.5.3** be able to show that the plant has special vessels for the transport of food, nutrients and water
- 8.5.4** know that root hairs absorb water and minerals from the soil in all different parts of the plant
- 8.5.5** know that plants carry out respiration to produce energy for their cells
- 8.5.6** know that the marine ecosystem has abundant sources of food types
- 8.5.7** understand that the different ecosystems support different types of organisms
- 8.5.8** be able to show that pollution affects species diversity and abundance
- 8.5.9** know that there are different methods used to protect our ecosystems
- 8.5.10** understand that marine organisms depend on each other for survival
- 8.5.11** be able to show the external and internal anatomy of a fish
- 8.5.12** know the different methods of fishing
- 8.5.13** appreciate environmentally friendly methods of fishing.

## Specific learning outcomes

Learners should be able to:

- 8.5.1.1** state that plants are the primary producers in an ecosystem
- 8.5.2.1** explain that photosynthesis occurs in the presence of chlorophyll in green leaves
- 8.5.2.2** write the photosynthesis reaction in words
- 8.5.3.1** demonstrate that plants have special vessels for food, nutrients and water transport
- 8.5.4.1** identify from a labelled diagram the main parts of the root hairs
- 8.5.5.1** write the word equation for and describe different stages in the process of respiration

- 8.5.6.1** describe common marine ecosystems:
- i** mangrove
  - ii** intertidal zone
  - iii** coral reef
  - iv** deep sea
- 8.5.6.2** identify any five marine organisms living within the different marine ecosystems
- 8.5.6.3** identify any five food sources from the different marine ecosystems
- 8.5.7.1** explain the adaptation of organisms to their ecosystem:
- i** mangrove trees—specialised roots to withstand salt water
  - ii** fish—gills to separate air from water
- 8.5.8.1** investigate and compare the species diversity and abundance in polluted and non-polluted marine ecosystems:
- i** mangrove
  - ii** intertidal
  - iii** coral reef
  - iv** deep-water ocean
- 8.5.9.1** describe different local methods used to protect our marine resources:
- i** use of selected fishing techniques
  - ii** banning of fishing grounds for a period of time
  - iii** harvesting certain marine species only
- 8.5.10.1** draw food chains for organisms in the:
- a** mangroves
  - b** intertidal zone
  - c** coral reef
  - d** deep-water ocean
- 8.5.10.2** describe at least two symbiotic relationships in the coral reef ecosystem, for example:
- i** sea anemones and clown fish
  - ii** shark and remora fish
- 8.5.11.1** dissect a fish
- 8.5.11.2** identify, draw and label the external and internal parts of a fish:
- external parts—mouth, eye, nostril, operculum (gill cover), spiny dorsal fin, soft dorsal fin, caudal fin (tail), pectoral fin, pelvic fin, scales, vent, anal fin, lateral line
  - internal parts—kidney, swim bladder, gonads (eggs), spinal cord, spine, brain, gills, heart, liver, stomach, intestine
- 8.5.12.1** describe methods of fishing in their community
- 8.5.12.2** describe non-sustainable fishing in their community
- 8.5.13.1** express the importance of sustainable fishing in their community.

## Answers

### Suggested assessment events

#### *Solomon Islands Years 7–9 Science Syllabus*

- 1** Refer to Figure 5.1.2 in the Learner’s Book for a summary of this experiment. However, the following tips can be used to modify it using young pawpaw leaves instead of celery. Individually place each young leaf into differently coloured water, without splitting the stems. Young leaves will show the colour better because they are relatively thin. Instead of beakers, test tubes or small measuring cylinders can be used, each with different coloured water. If possible, learners should observe the leaves change in colour throughout the day.

- 2 Learners' responses will vary. However, the following points are important when writing scientific reports. Scientific reports should have the following sections: aim, introduction, method, results and conclusion. The aim should clearly outline the question that is being asked. The introduction should provide a brief summary of what is known and why the experiment is being completed, for example 'to better understand how plants move water to the leaves'. The method outlines how the experiment was conducted. The results should explain what observations were made. The conclusion should summarise what they have learnt.
- 3 Refer to page 108 of the Learner's Book. Conservation organisations such as the Nature Conservancy protect their marine resources from people harvesting turtles. Marine Protected Areas can be put in place to protect certain reefs for a period of time to allow fish to repopulate the area. Local communities can make decisions to work together to protect their marine areas from destructive fishing.

### Challenge questions

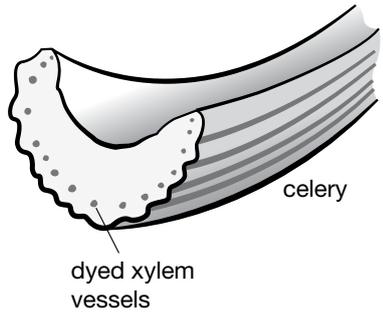
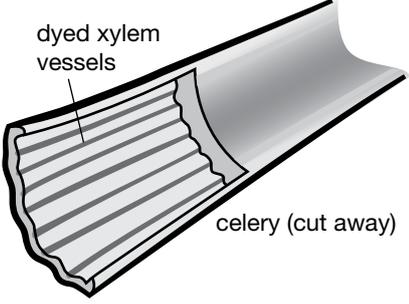
*Learner's Book page 87*

- 1 Plants require sunlight for photosynthesis, and therefore cannot grow under pitch-black conditions.
- 2 Water filters out sunlight. Plants at the bottom of deep water cannot photosynthesise and therefore would not survive.
- 3 Plants are usually green because of the chlorophyll in their leaves.
- 4 We can tell the age of a tree that has been cut down by looking at a cut cross-section of its trunk. The cut cross-section reveals yearly rings of growth—by counting the rings, you can discover the age of the tree.
- 5 The spikes of cacti:
  - are actually leaves—they evolved to become spikes to minimise the amount of water that evaporates from the plant, helping it survive in desert climates where water levels are extremely low.
  - protect them from animals and people.
- 6 The plant's stem and leaves may droop and become flaccid if the water content in the cells falls.
- 7 Learners' responses will vary depending on where they live. Marine ecosystems are coral reefs, mangroves, oceans and coastal areas.
- 8 Corals photosynthesise similar to land plants. They use zooxanthalae as a photosynthetic pigment.
- 9 Most fish exchange gases using gills on both sides. Fish exchange gases by drawing oxygen-rich water through their mouths and pumping it over their gills.

## Unit 5.1: Plant transport systems

### Activity 1: Water transport in celery

Learner's Book page 88

Processes and skills	Resources	Teacher's support notes	Answers to questions
To observe the movement of water in the xylem of celery	<ul style="list-style-type: none"> <li>celery stick with leaves</li> <li>2 beakers</li> <li>razor blade</li> <li>dye</li> </ul>	<p>This activity will help learners to understand that water travels through plants. They will observe water transport in the celery plant when they see the dye in the water in the celery stalk.</p> <p>A large number of different plants can be used in this type of experiment. In general, leaves that are lighter in colour will show the dye more clearly. Also, flowers will take the dye into their petals; white flowers are excellent for showing dye uptake.</p>	<p><b>1</b> The dye moved through the celery stem into the leaves. If left for long enough, the leaves would become coloured as the dye spread from the vascular bundle to individual cells.</p> <p><b>2 a</b> Horizontal (cross section) section</p>  <p><b>b</b> Vertical (longitudinal) section</p>  <p><b>3</b> As a control and comparison. Half the celery was placed in water with no dye to show that the dye could not move sideways or back down the celery stalk. It also shows that certain vascular bundles lead to different leaves.</p>

## Answers

### Unit questions

Learner's Book page 91

- Carbon dioxide and water are converted into glucose and oxygen in the presence of sunlight.
- Carbon dioxide enters the leaf and oxygen leaves the leaf. Water is transported in and out of the leaf. Glucose is transported from the leaf to other parts of the plant.
- False. Water is conducted *up* the plant stem through the xylem.
  - False. *Glucose* is transported around the plant in the phloem.
  - False. Xylem and phloem are grouped together in *vascular bundles*.
  - False. *New* xylem and phloem cells are made from cambium.
- Phloem
  - Xylem
- Pressure in the roots pushes the water up and evaporation from the leaves sucks the water upward.

- 6 When plant cells lose water, the pressure in the cells decreases and the plant wilts (becomes flaccid).
  - 7 When there is sufficient water, the plant cells are under enough pressure to remain firm or turgid.
  - 8 Phloem cells lie just under the bark and may be damaged by ringbarking. This could kill the plant as nutrients are carried in the phloem cells.
  - 9 Xylem cells turn into wood.
  - 10 Carbon dioxide from the air enters the leaves of the plant providing a source of carbon. In the leaf, carbon dioxide is converted into glucose, which is transported to other parts of the plant and stored as starch or cellulose. These compounds contain a lot of carbon.
  - 11 Water enters the stem, moves up the plant, enters and fills the plant cells, enabling the stem to stand up right rather than wilt.
  - 12 Plants need photosynthesis in order to obtain food. Sunlight is essential for photosynthesis so plants will face the Sun to receive maximum sunlight.
  - 13 The leaves do not directly face the Sun as they are hanging down. This reduces water loss. It also allows both sides of the leaf to receive a good amount of light, maximising photosynthesis.
  - 14 Removing leaves from a plant will prevent evaporation of water from its leaves. This in turn will reduce water being drawn up through the stem. This will cause the plant to wilt.
  - 15 Needle-shaped leaves have smaller spaces through which water can escape. This is an adaptation that enables the plant to lose less water.
- 16 Water + carbon dioxide  $\xrightarrow[\text{chlorophyll}]{\text{sunlight}}$  glucose + oxygen
- 17 About 15 growth rings are evident in the top left trunk, making the tree about 15 years old.
  - 18 The root hairs are very numerous. This would result in a large increase of surface area, allowing a large amount of water to be absorbed.

### Extension questions

*Learner's Book page 91*

- 1 Learners' posters should feature diagrams of paper processing and description. Good posters use images to deliver the message, with short and succinct text to summarise the main points.
- 2 Radish seeds are small. Therefore the initial root is small and has only fine root hairs as it begins to grow, whereas a healthy plant that is pulled out of the ground will have a relatively large expanded root and relatively long taproot.

## Unit 5.2: Photosynthesis and respiration

### Activity 2: A product of photosynthesis

*Learner's Book page 92*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the products of photosynthesis	<ul style="list-style-type: none"> <li>• 2 x 600 mL beakers</li> <li>• 2 glass funnels</li> <li>• 2 test tubes</li> <li>• sodium hydrogen carbonate solution (0.5 per cent)</li> <li>• 2 pieces of actively growing Elodea (Canadian pond weed)</li> <li>• light source</li> <li>• wooden splint</li> <li>• safety glasses</li> </ul>	<p>Collect the Elodea plants before the activity begins. If your school is located near the sea or reef, you can use seaweed plant for this experiment. Elodea is found in the swampy creeks in Solomon Islands and will give a good result when you use it in this experiment.</p>	<ol style="list-style-type: none"> <li>1 The sodium hydrogen carbonate solution provides a source of CO<sub>2</sub> for the Elodea.</li> <li>2 The O<sub>2</sub> is collected in the inverted test tube as a product of photosynthesis.</li> <li>3 The beaker in the dark should not produce O<sub>2</sub>, as light is required for photosynthesis.</li> </ol>

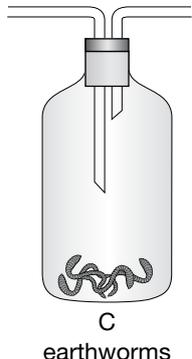
### Activity 3: Green leaves and photosynthesis: Teacher demonstration

Learner's Book pages 94–95

Processes and skills	Resources	Teacher's support notes	Answers to questions
To examine where the products of photosynthesis are stored in leaves	<ul style="list-style-type: none"> <li>• potted plant with variegated leaves</li> <li>• potted plant of the same species with completely green leaves (a hibiscus plant would be suitable)</li> <li>• 3 beakers of boiling water (these should ONLY be heated using an electric hot plate)</li> <li>• 2 large test tubes containing ethanol or methylated spirits</li> <li>• iodine solution</li> <li>• forceps</li> <li>• scissors</li> <li>• 2 watch-glasses or 2 glass Petri dishes</li> <li>• safety glasses</li> </ul>	<p>This is a teacher demonstration activity. Remind learners to be careful because they might burn themselves if they touch the apparatus.</p> <p>Learners are required to observe carefully and record and present their experimental results appropriately. They must comment on the nature of any experimental errors they observe.</p>	<ol style="list-style-type: none"> <li>1 Starch is identified by iodine becoming blue-black.</li> <li>2 The leaves are boiled in ethanol to remove the chlorophyll and damage the cell a little to allow iodine to penetrate.</li> <li>3 Starch is found only in the green parts of a leaf.</li> <li>4 Only the green areas of a leaf are able to photosynthesise and hence produce starch.</li> </ol>

### Activity 4: A product of respiration

Learner's Book page 96

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the products of respiration	<ul style="list-style-type: none"> <li>• flasks and glassware as shown in Figure 5.2.11</li> <li>• filter pump</li> <li>• sodium hydroxide solution</li> <li>• limewater</li> <li>• potted plant</li> <li>• several insects or earthworms</li> <li>• plastic bag</li> <li>• black paper</li> </ul>	<p>This activity requires learners to use chemicals, expensive glass equipment and instruments responsibly and safely.</p> <p>Design of the modified part of the activity using earthworms is shown below:</p>  <p style="text-align: center;">C earthworms</p>	<ol style="list-style-type: none"> <li>1 Flask A removes the CO<sub>2</sub> from the air entering the apparatus. Flask B indicates the efficacy of flask A by changing colour if residual CO<sub>2</sub> exists in the tube.</li> <li>2 Flask D indicates the production of CO<sub>2</sub> by earthworms.</li> <li>3             <ol style="list-style-type: none"> <li>a The plastic bag ensures gas exchange is reduced through the roots.</li> <li>b Black paper hinders photosynthesis to promote respiration.</li> </ol> </li> <li>4 The limewater in flask D should become milky, while that in flask B should remain clear.</li> <li>5             <ol style="list-style-type: none"> <li>a Learners' responses will vary.</li> <li>b Learners' responses will vary.</li> </ol> </li> </ol>

## Activity 5: Light intensity and photosynthesis

Learner's Book page 97

Processes and skills	Resources	Teacher's support notes
To investigate the effect of light intensity on the rate of photosynthesis	<ul style="list-style-type: none"> <li>• thermometer</li> <li>• test tube</li> <li>• sodium hydrogen carbonate solution</li> <li>• light</li> <li>• water plant</li> <li>• water bath</li> </ul>	<p>Learners will investigate at least two different light intensities, preferably including strong light, dull light and absence of light. They should be encouraged to present their results in tabular and graphical form.</p> <p>Demonstrate safe and technical uses of a range of instruments and chemicals before actually doing the activity.</p>

## Activity 6: Energy production in respiration

Learner's Book page 97

Processes and skills	Resources	Teacher's support notes	Answers to questions
To determine the heat energy produced by respiration in plant seeds	<ul style="list-style-type: none"> <li>• 2 wide-mouth thermos flasks</li> <li>• 2 thermometers, cotton wool</li> <li>• pea seeds</li> <li>• boiling water</li> <li>• mild disinfectant</li> </ul>	<p>This activity will require usage of some expensive equipment, so learners must be extremely careful to act responsibly and safely.</p> <p>Provide learners with the necessary information to achieve the appropriate results.</p>	<ol style="list-style-type: none"> <li>1 There should be a temperature increase in the flask containing unboiled seeds only.</li> <li>2 The killed seeds provide a comparison or control to ensure the living seeds are the cause of any temperature change.</li> <li>3 The disinfectant kills any microorganisms such as fungi present on the seeds. These may affect the results, as microorganisms are capable of respiration.</li> </ol>

## Answers

### Unit questions

Learner's Book pages 98–99

1	Scientists	Discoveries
	Priestley	Oxygen is produced
	de Saussure	Water is used
	Ingenhousz	Light is necessary
	Senebier	Carbon dioxide is used.

- 2 **a** False; **b** False; **c** True; **d** False
- 3 Chlorophyll is needed because it contains chemicals that trap the correct amount of the Sun's energy needed for photosynthesis.
- 4 Light energy is converted to chemical energy.
- 5 All living things require food in the form of glucose. Plants are able to produce glucose from carbon dioxide and water. Animals cannot do this so they are dependent on plants and therefore photosynthesis.
- 6 **a** Carbon dioxide and water; **b** Chlorophyll and light; **c** Glucose and oxygen

- 7 To provide energy for animal cells
- 8 Carbon dioxide, water and energy
- 9 The products of photosynthesis become the reactants for respiration.
- 10 Photosynthesis occurs in chloroplasts and respiration occurs in mitochondria.
- 11 Photosynthesis does not occur as one reaction. There are many enzymes required to speed up the individual chemical reactions that go together to make up the overall equation of photosynthesis. It is not possible to cause these individual steps to happen in one test tube.
- 12 Growth and repair
- 13 **a** Starch; **b** No photosynthesis occurs because no carbon dioxide is available; **c** To remove any previously stored starch
- 14 **a**  $H_2O + \text{light energy} \rightarrow O_2 + H^+$ ; **b**  $CO_2 + H^+ \rightarrow C_6H_{12}O_6$ ; **c** Stage one
- 15 **a** Photosynthesis
  - b** More light energy is available, so a greater rate of photosynthesis occurs.
  - c** Learners' responses will vary, eg higher carbon dioxide level, higher temperature.
- 16 **a** Reactions speed up at higher temperatures.
  - b** Enzymes are affected at high temperatures. If they are altered, enzyme activity slows and finally stops.
- 17 **a** Oxygen.
  - b** Oxygen relights a glowing splint test.
  - c**  $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$  (chlorophyll and light needed).
  - d** More gas would be produced by the larger plant mass.

**Extension questions**

*Learner's Book page 99*

- 1 Learners' responses will vary.
- 2 Learners' responses will vary.

**Unit 5.3: Marine systems**

**Activity 7: Threats to marine ecosystems**

*Learner's Book page 100*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To observe and investigate various human-made materials/litter that threaten the marine ecosystem	<ul style="list-style-type: none"> <li>• notebook</li> <li>• pen/pencil</li> </ul>	<p>This activity will require learners to observe and assess the various types of litter found on beaches that threaten the lives of the marine organisms.</p> <p>This is a field trip activity, so you will need to prepare questions to assist learners to achieve the aim of the activity.</p>	<p><b>1</b> Learners should record details of the litter they find in a table or as a list of types of litter (eg plastic litter, can litter, paper litter), making a mark when they see a piece of each type.</p> <p><b>2</b> Learners should count up the number of each type of litter they found.</p> <p><b>3–6</b> Learners' responses will vary.</p>

**Activity 8: Richness and diversity of a marine ecosystem***Learner's Book page 103*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To determine the number of different organisms and how many of each are present in different habitats in a marine ecosystem	<ul style="list-style-type: none"> <li>• clipboard</li> <li>• activity sheet</li> <li>• metre rule</li> <li>• magnifying glass</li> <li>• pen</li> <li>• pencils</li> <li>• extra sheets of paper</li> </ul>	<p>Please consider the precautions outlined in the Learner's Book and also with reference to your knowledge about the site at which you will conduct the fieldwork.</p> <p>You are also encouraged to improvise or come up with something new or different if the site for this activity does not allow you to follow all the procedures outlined in the Learner's Book.</p>	<ol style="list-style-type: none"> <li>1 Learners will come up with the list of all organisms they have found.</li> <li>2 Answers will depend on the organisms that learners have found.</li> <li>3 Reasons may include overharvesting or pollution of the marine ecosystems.</li> </ol>

**Activity 9: Internal and external parts of a fish***Learner's Book page 105*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate and identify the main parts of a common fish	<ul style="list-style-type: none"> <li>• sharp knife</li> <li>• fish just caught or kept in the freezer</li> </ul>	Fish come in all shapes and sizes but the main parts of the fish are the same. Learners should therefore be comfortable with all types of fish if they can identify the common types.	<ol style="list-style-type: none"> <li>1 Fish use their gills (breathe or take in oxygen).</li> <li>2 Learners' responses will vary.</li> <li>3 Learners' responses will vary.</li> </ol>

**Answers****Unit questions***Learner's Book pages 108–109*

- 1 This is a general question and is open to all kinds of answers from the learners. Consider the background of learners when discussing this question, for example whether they live on the coast or far from it. Learners' responses should include: sources of food, sources of salt, for recreation.
- 2 Intertidal zone, mudflats, coral reefs, mangroves.
- 3 **a** Learners should either recall from their experience or list as many organisms they can think of.  
**b** From the list that learners make, they should group the organisms into edible and non-edible. When they have finished they should compare their lists. Remember that some learners will eat organisms that others do not eat.
- 4 Corals photosynthesise similar to land plants. They use zooxanthalae to help them carry out photosynthesis.
- 5 Clams also use zooxanthalae to produce their food.
- 6 **Fringing reefs:** reefs that grow attached to the shoreline of islands. Fringing reefs begin growth in shallow water close to shore and tend to spread outward.  
**Barrier reefs:** reefs that grow along the outer edges of continental shelves, separated from the mainland by open water. They are actually made up of many separate small reefs separated by channels.  
**Atolls:** circular reefs enclosing lagoons. Atolls begin by colonising sea mounts or volcanoes, and then grow upward as the sea mount sinks and/or the sea level rises.

- 7** Coral can be killed by bleaching, which occurs when run-off from the land, for example during flooding, settles on the coral polyps and kills them. Corals can also die when people use dynamite to kill fish. Listen to other answers provided by the learners.
- 8** Learners' responses will vary. Take note of these responses and discuss them with learners.
- 9** Variation in temperature, salinity, fresh water, heat
- 10** Cutting mangroves for housing and firewood, reclamation for housing/settlements, conversion to agriculture
- 11** Learners' responses will vary. Discuss with them how different names can be used for the same fish.
- 12** Use of gill nets, dynamite
- 13** Sell fish in the markets, export fish overseas through direct export or charge fishing vessels that fish in our waters
- 14** An endangered species is one that can become extinct if no proper measures are taken to protect it. The species may be low in stock because it is being overharvested or its environment is changing.
- 15**
- a** Because barracuda are thin and long (streamlined), they move faster than parrot fish, which have big and heavy bodies.
  - b** The teeth of the parrot fish show that they are grazers (feeding on algae and rocks). Barracuda have sharp canine teeth, typical of meat eaters. Barracuda eat other fish. So, the parrot fish is an herbivore while the barracuda is a carnivore.
  - c** Since the barracuda survives on other small fish, it needs to have the speed to outpace and then kill them.
- 16**
- a** Severe flooding and run-off from the land causes the water to become muddy. Chemicals will also flow to the sea, potentially killing the corals and organisms in the water.
  - b** During flooding, sediments are deposited on the coral polyps, blocking sunlight from reaching the photosynthetic pigment in the corals. This then prevents corals from producing their own food.
  - c** Learners should make a list of the organisms (fish, shells etc) that are found in coral reefs. Corals are important for the survival of these organisms. If the corals die, organisms that live in the corals will also die. This is because these organisms find their food and raise their young in the corals.
  - d** Many Solomon Islanders harvest corals to use in making lime for chewing betel nut. Dynamite fishing, although illegal, is also on the rise.
- 17**
- a** Coral, clam shells, algae. You can also search the internet to find other marine organisms that carry out photosynthesis.
  - b** Fish take in water through their mouths and pump it over their gills. The gills then push the water out. In this way, oxygen is transported into their bodies.
  - c** Since corals survive through photosynthesis, they need sunlight. Sunlight cannot penetrate deep sea water, so corals cannot survive there.
- 18** Learners' responses may vary, depending on where they live. Sample answer:
- a** We are only allowed to use fishing lines to fish—no other form of fishing is permitted. Fishing is restricted to Solomon Islanders at certain times of the year.
  - b** Only take what you need and do not destroy mangroves.
  - c** Fishers and divers are not allowed to stand on coral.
  - d** Shell can be collected only at certain times of the year and are restricted in size and number.

## Chapter review

### Answers

*Learner's Book pages 109–110*

- 1**
- a**  $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$  (chlorophyll and light needed)
  - b** Converts light energy to the chemical energy needed by all living things. Replaces the oxygen used in respiration

- 2 Dead xylem cells
- 3 **a** Light intensity, carbon dioxide concentration and temperature  
**b** More light provides more energy. Carbon dioxide is a reactant. Increasing reactant concentration increases rate. Higher temperatures usually mean faster reactions.
- 4 For respiration and for conversion to other substances such as starch and cellulose
- 5 Plants photosynthesise during the day and respire *at all times of the day* and night.
- 6 **a** Starch; **b** Glycogen
- 7 **a** Fish, urchins, sea anemones, barnacles, chitons, crabs, isopods, mussels, sea stars and many marine gastropod molluscs, such as limpets  
**b** Fish, sea weeds, mussels, etc
- 8 Xylem carries water and minerals, while phloem carries food.
- 9 The stages in each process are not the reverse of each other. They involve different steps and different enzymes. Even though the overall equation is the opposite, the reactions that take place are quite different.
- 10 Comparison of photosynthesis and respiration

	Photosynthesis	Respiration
Reactants	Carbon dioxide and water	Glucose (or other fuel) and oxygen
Products	Glucose and oxygen	Carbon dioxide and water
Light requirement	Essential—provides energy	Not required
Type of process	A building process leading to increased mass	Breakdown process leading to decreased mass
Energy changes	Light energy changed to chemical energy	Chemical energy changed to heat, energy of movement and other forms

- 11 Learners' responses will vary. Refer them to Activity 3 on pages 94–95 of the Learner's Book for a model of such an experiment.
- 12 Plants in the desert have fewer stomata, to conserve water.

13

	Photosynthesis	Respiration
Occurrence	Plant cells containing chlorophyll	All living cell
Cell structures used	Chlorophyll	Mitochondria
Reactants	Carbon dioxide and water	Glucose and oxygen
Products	Glucose and oxygen	Carbon dioxide and water
Type of process	A building process leading to increased mass	A breakdown process leading to decreased mass
Energy change	Light energy change to chemical energy	Chemical energy change to heat, energy of movement
Light requirement	Essential—provides energy	Not required

- 14 Learners' responses may vary, but could include that fresh tuna are caught from the ocean, lagoon or near the coastline.
- 15 **a** C and D  
**b** B, C and D  
**c** B—respiration occurring to produce carbon dioxide (no photosynthesis to lower carbon dioxide)  
**d** D—oxygen is produced, but there are no fish present to use it up
- 16 **a** Water levels, carbon dioxide concentration and temperature  
**b** Plant C, because red light is most strongly absorbed by chlorophyll. More light means more photosynthesis.

# Chapter 6: Heat and sound

## Strand: Energy and change

**Suggested class time: 8 periods**

### Sub-strand statement

This sub-strand deals with heat and sound. Heat is the condition of being hot or cold. Heat is a form of energy that associates with the movement of atoms or molecules in a material. The higher the temperature, the faster the movement of the atoms or molecules in the material and hence the greater the energy present in the material. Conduction carries heat through solids. Convection carries heat through liquids. Radiation carries heat through empty space. Heat energy causes expansion of matter. Sound is formed by vibration of particles. Sound energy travels through solids, liquids and gases. Sound does not travel through empty space.

## General learning outcomes

Learners should:

- 8.6.1** know that heat is a form of energy
- 8.6.2** understand that heat transfers by conduction, convection and radiation
- 8.6.3** be able to show heat transfer
- 8.6.4** be able to show that heat can cause expansion of matter
- 8.6.5** appreciate that heat gives us heat energy
- 8.6.6** know that vibration of particles of matter cause sound waves
- 8.6.7** know the sound hearing range
- 8.6.8** know that sound travels through different media
- 8.6.9** be able to show different sound media
- 8.6.10** know the parts of the ear
- 8.6.11** know the functions of the parts of the ear
- 8.6.12** appreciate that talking produces sound waves.

## Specific learning outcomes

Learners should be able to:

- 8.6.1.1** state that heat is caused by movement of atoms or molecules in the material and produces energy
- 8.6.2.1** explain that heat energy is transferred by conduction, convection and radiation
- 8.6.3.1** demonstrate heat transfers by conduction, convection and radiation
- 8.6.4.1** demonstrate expansion and contraction of metallic material when heated or cooled
- 8.6.4.2** explain how the particles of materials take up more space when they are heated
- 8.6.5.1** list ways that heat energy is used in their lives, for example:
  - i** to cook food
  - ii** to keep warm
  - iii** to make things
- 8.6.6.1** explain that sound is caused by vibrating particles
- 8.6.6.2** state that sound has pitch and loudness
- 8.6.6.3** list four local materials as sources of sound in order of increasing pitch
- 8.6.6.4** state that sound needs a medium in which to travel: solid, liquid or gas

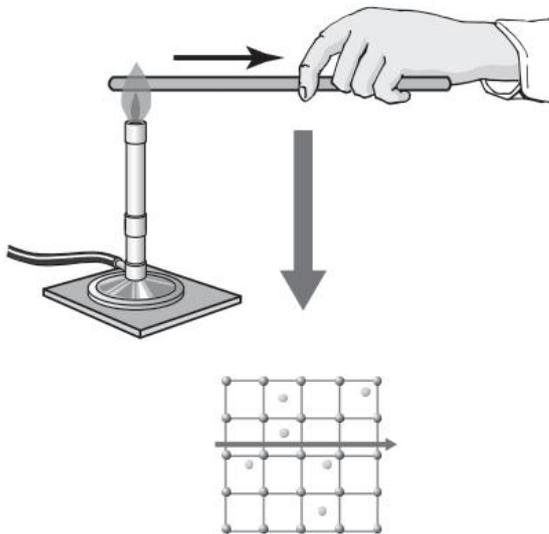
- 8.6.6.5** state that sound moves as a wave, formed by compression and rarefaction of particles
- 8.6.7.1** identify the hearing range of our ears between 20 and 20 000 Hz
- 8.6.8.1** describe the speed of sound in solids, liquids and gases
- 8.6.9.1** demonstrate, using different media, how sound travels, for example: **i** string, telephone (solid); **ii** listening to radio (air); **iii** clapping hands under water (liquid)
- 8.6.10.1** identify and label the main parts of the human ear: pinna, outer ear canal, eardrum, hammer, anvil, stirrup, semicircular canal, nerve and cochlea
- 8.6.11.1** describe the function of the main parts of the ear: outer ear canal, eardrum, hammer, semicircular canal, nerve and cochlea
- 8.6.12.1** express the ways in which sound affects their lives; for example: **i** gives them direction; **ii** gives them instruction; **iii** makes them wake up; **iv** makes them feel excited.

## Answers

### Suggested assessment events

*Solomon Islands Years 7–9 Science Syllabus*

1



Note the heat movement along the piece of metal as it is heated.

- 2 a** The wood being hit/vibrating
- b** The vibrating of air in the column
- c** The guitar string
- d** An electronic keyboard makes a sound electronically. A keyboard that is not electronic will make a sound from the lever being pressed against wires, or an organ has columns of air in pipes.

### Challenge questions

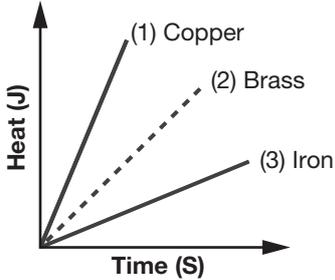
*Learner's Book page 111*

- 1** Learners' responses will vary but may include light energy, heat energy, mechanical energy, gravitational energy, electrical energy, sound energy, chemical energy, nuclear or atomic energy.
- 2** The pool will feel colder, as you will have more heat loss from your body.
- 3** A thermos stops/reduces heat transfer.
- 4** Learners' responses will vary but may include home appliances, outdoor appliances, computers, the oven to cook and so on.
- 5** When sound is too loud it can be dangerous. It is more dangerous with prolonged exposure to extremely loud decibels.

## Unit 6.1: Heat

### Activity 1: Conduction in metal rods

Learner's Book page 112

Processes and skills	Resources	Teacher's support notes	Answers to questions
To compare the heat conductivity of different metals	<ul style="list-style-type: none"> <li>three rods made of different metals (eg iron, copper, brass)</li> <li>candle</li> <li>tripod</li> <li>Bunsen burner</li> <li>heat-proof mat</li> <li>timer</li> </ul>	Ensure that learners use appropriate apparatus for this activity. The Bunsen burner must be adjusted to achieve the blue flame.	<p>1 From best to worst: copper, brass, iron</p> <p>2 Learners' responses will vary. The graph should look similar to this:</p> 

### Activity 2: Conduction in water

Learner's Book pages 112–113

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the ability of water to conduct heat	<ul style="list-style-type: none"> <li>Bunsen burner</li> <li>heat-proof mat</li> <li>test tube</li> <li>small ice-blocks</li> <li>steel wool</li> <li>safety glasses</li> <li>test-tube holder</li> </ul>	When learners heat the test tube in the Bunsen burner flame, they must make sure to face the test tube away from others.	<p>1 It is most likely that the ice will melt before the water boils.</p> <p>2 This experiment shows that the heat-conducting ability of water is high.</p>

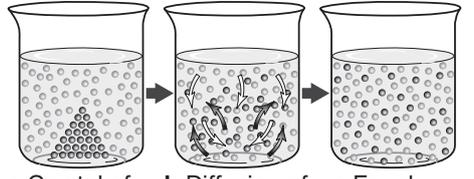
### Activity 3: Insulators

Learner's Book page 114

Processes and skills	Resources	Teacher's support notes	Answers to questions																																												
To compare the insulating properties of different materials	<ul style="list-style-type: none"> <li>two soft drink cans or small metal containers</li> <li>insulating materials (eg cloth, cotton wool, foam, rubber, newspaper, carpet scraps, fibreglass insulation)</li> <li>thermometer</li> <li>hot water</li> <li>beaker</li> <li>timer</li> </ul>	<p>Ask learners to draw up the following table in their workbooks before they start the experiment.</p> <table border="1" data-bbox="539 1563 1145 2089"> <thead> <tr> <th>Time</th> <th>Temperature (one layer)</th> <th>Temperature (two layers)</th> <th>Temperature (three layers)</th> </tr> </thead> <tbody> <tr><td>1</td><td></td><td></td><td></td></tr> <tr><td>2</td><td></td><td></td><td></td></tr> <tr><td>3</td><td></td><td></td><td></td></tr> <tr><td>4</td><td></td><td></td><td></td></tr> <tr><td>5</td><td></td><td></td><td></td></tr> <tr><td>6</td><td></td><td></td><td></td></tr> <tr><td>7</td><td></td><td></td><td></td></tr> <tr><td>8</td><td></td><td></td><td></td></tr> <tr><td>9</td><td></td><td></td><td></td></tr> <tr><td>10</td><td></td><td></td><td></td></tr> </tbody> </table> <p>Use different materials and compare the insulating ability of the different materials.</p>	Time	Temperature (one layer)	Temperature (two layers)	Temperature (three layers)	1				2				3				4				5				6				7				8				9				10				<p>1–3 Learners' responses will vary.</p> <p>4 The container that was left uncovered is called the 'control'. All the other variables can be compared with the control to see if there are significant differences in the results obtained.</p>
Time	Temperature (one layer)	Temperature (two layers)	Temperature (three layers)																																												
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## Activity 4: Purple convection currents

Learner's Book page 115

Processes and skills	Resources	Teacher's support notes	Answers to questions
To observe convection currents in water	<ul style="list-style-type: none"> <li>• single crystal of potassium permanganate (or RARO juice crystals)</li> <li>• 250 mL beaker</li> <li>• Bunsen burner</li> <li>• tripod</li> <li>• gauze mat</li> <li>• heat-proof mat</li> <li>• glass tube or straw</li> </ul>	Ensure that learners use appropriate apparatus for this activity. The Bunsen burner must be adjusted to achieve the blue flame.	<p><b>1</b></p> <ul style="list-style-type: none"> <li>◦ water molecules (solvent)</li> <li>◦ dye molecules (solute)</li> </ul>  <p><b>a</b> Crystal of dye is placed in water</p> <p><b>b</b> Diffusion of water and dye molecules</p> <p><b>c</b> Equal distribution of molecules results</p> <p>The particles would be equally distributed, starting from the bottom of the beaker, and gradually moving up to the top of the beaker, until the coloured particles are equally distributed around the beaker.</p> <p><b>2</b> This is due to convection currents; the particles flow from a hot region to a cold region.</p> <p><b>3</b> Day-to-day experiences of convection currents at home: For instance, if you place a hot cup of coffee on the table, then remove the cup of coffee after a few minutes and place your hands on the table where the cup was placed, you can feel that the table is warm. This is because heat from the cup was transferred to the table by convection currents—particles flowed from the hot region (cup of coffee) to the cold region (surface of the table).</p>

## Activity 5: Radiation emission

Learner's Book page 117

Processes and skills	Resources	Teacher's support notes	Answers to questions
To find what colour best radiates heat energy	<ul style="list-style-type: none"> <li>• two cans (one black and one silver or white)</li> <li>• measuring cylinder or beaker</li> <li>• two thermometers or temperature probes</li> <li>• hot water</li> <li>• beaker</li> <li>• timer</li> </ul>	Make sure that learners use the appropriate variables along the horizontal and vertical axes.	<p><b>1</b> Learners' responses will vary.</p> <p><b>2</b> Silver or white are better radiators of heat, followed by black.</p> <p><b>3</b> The temperature of the water in each can had to be the same at the start so that the rate of heat absorption could be plotted against time.</p>

## Activity 6: Radiation absorption

Learner's Book page 118

Processes and skills	Resources	Teacher's support notes	Answers to questions
To find what colour best absorbs heat energy	<ul style="list-style-type: none"> <li>two thermometers or temperature probes</li> <li>black card</li> <li>white card</li> <li>two retort stands with clamps</li> <li>100 W light globe</li> <li>heat-proof mat</li> </ul>	Support learners to develop an understanding of the concept of radiation absorption as they work through this activity.	<p><b>1</b> Black</p> <p><b>2</b> The closer the light globe is to a thermometer, the higher the temperature reading.</p> <p><b>3</b> Same-sized cards should be used for accuracy purposes.</p> <p><b>4</b> Twice the distance away, temperature will be reduced by half.</p>

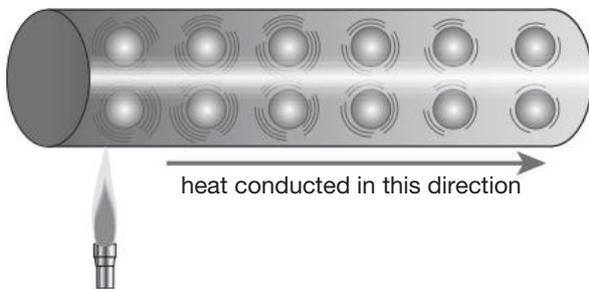
## Answers

### Unit questions

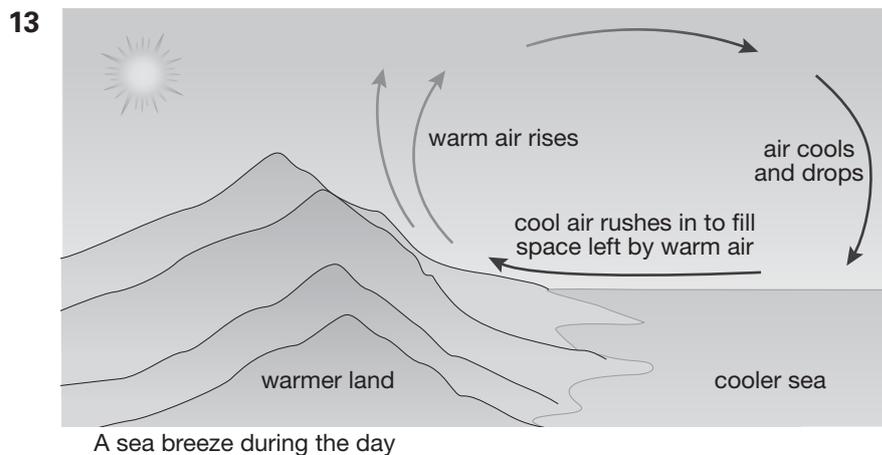
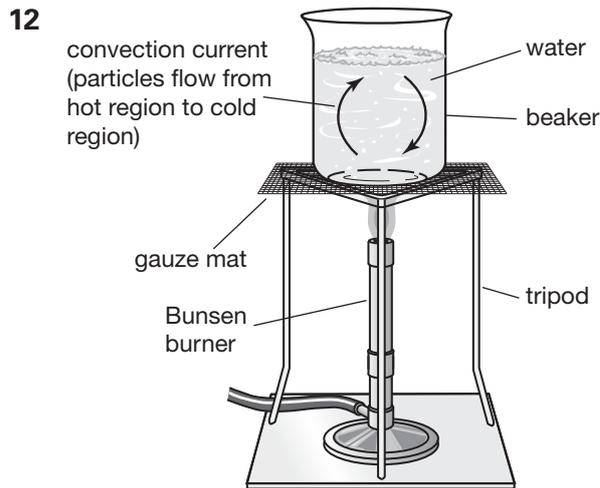
Learner's Book pages 119–120

- 1 A flame, an electric hotplate, a light bulb
- 2 Heat is form of energy, but temperature is not. Temperature measures how much these particles are vibrating due to heat energy.
- 3 Conduction, convection, and radiation
- 4 Conduction occurs when the particles in one part of an object vibrate more, and these vibrations are passed on from particle to particle through the object.
- 5 Objects must be in contact and have a temperature difference.

6

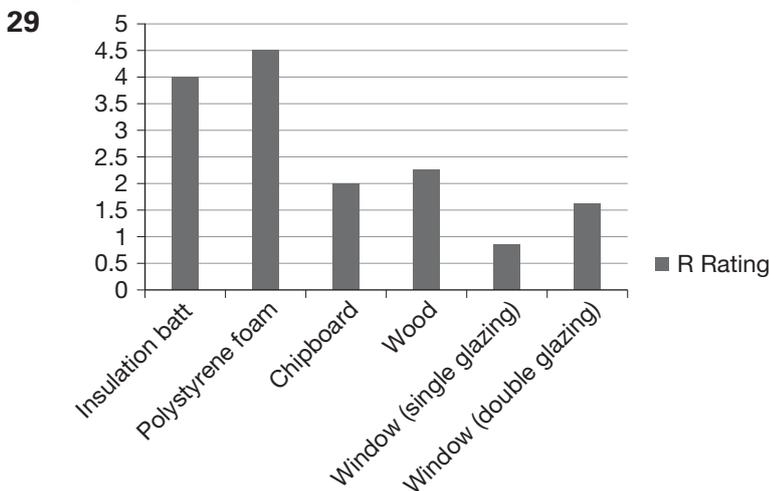


- 7 Copper, water, air, outer space (best to worst conductors)
- 8 An insulator is another name for a bad conductor. Polystyrene foam is one example.
- 9 Pockets of air (a poor conductor of heat) are trapped between the fibres in the fur.
- 10 Double glazing is the use of two sheets of glass with a layer of insulating air between them. It reduces heat loss.
- 11 Convection involves particles moving throughout a material, whereas conduction involves particles vibrating in fixed positions within a material.



- 14** A light bulb, toaster and hot plate emit both heat and light.
- 15** Clouds at night act as an insulating layer in the sky and reflect the radiation emitted by the ground back to the ground.
- 16** Since cool air sinks, it is not likely to flow over the top of tub-type freezers.
- 17** Cold air flows downwards into the room and replaces warmer air.
- 18** There is no material containing particles to vibrate (as in conduction) or move (as in convection) in outer space, so heat from the Sun must reach us by radiation.
- 19**
- a** Solar heating panels—black, absorbs heat well
  - b** Outside a house in a hot country—white, reflects heat well
  - c** Car radiator—black, emits heat well
  - d** Fire-fighting uniform—shiny silver, reflects heat well
- 20**
- a** No material required—radiation
  - b** Particles vibrate—conduction
  - c** Particles move through a material—convection
- 21** B (Black objects are better emitters and better absorbers of heat than white objects)
- 22** Learners' responses will vary but could include: Conduction—heat moving up a spoon in a cup of coffee; Convection—warm air rising above a gas flame on a stove; Radiation—an electric radiator.
- 23** The walls of the flask are made of two thin layers of glass with a vacuum between to prevent heat loss due to conduction and convection. The glass walls have a silvered coating to reduce emitted radiation. See Figure 6.1.18 on page 119 of the Learner's Book.

- 24 a** Learners' responses will vary but could include reverse-cycle air conditioner, refrigerator, solar heater, hot water service, radiator or toaster.
- b** Learners' responses will vary but could include: cools homes, offices and supermarkets; allows for storage of foods; allows for the use of solar energy to generate heat and electricity in remote areas for low running costs.
- 25** The outside of a kettle is shiny to reduce the heat lost by radiation after it has boiled (and so reduce the need to reboil).
- 26** Hot plate emits radiation; Saucepan conducts heat to its contents; Steam rises due to convection.
- 27** Most of the heat in an open fire goes up the chimney (by convection). A wood heater reduces the amount of heat lost in several ways: a narrower cylindrical chimney reduces convection losses; control of the flow of oxygen to the fire helps to prolong burning so logs last longer; and a fan may direct warm air into the room, rather than allow convection currents to take most of the heat up the chimney.
- 28** Hot air rises, so hot air released near the ceiling will tend to concentrate there. A better design is where vents are at floor level, so the natural tendency for air to rise causes a more even spread of hot air throughout the room.



## Extension questions

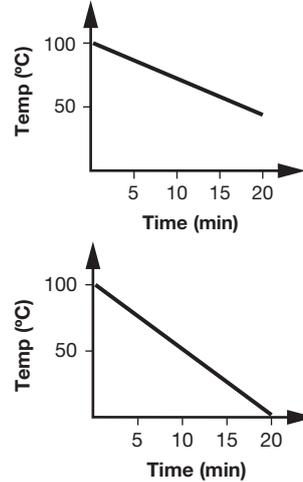
*Learner's Book pages 120*

- Learners should discuss how the Sun's radiation is absorbed in the atmosphere and then trapped and re-radiated through the atmosphere.
- Learners' responses may include:
  - uses—cooking, heating using air conditioning
  - preventing heat transfer—insulation in roof or walls, types of floors.
- It is suggested that the tail was used to absorb and emit heat. It is thought to be reptile-like. Learners could investigate how lizards absorb and emit heat from their skins and how they need to keep warm.

## Unit 6.2: Expansion of solids, liquids and gases

### Activity 7: Heat and temperature

Learner's Book page 121

Processes and skills	Resources	Teacher's support notes	Answers to questions
To observe the difference between heat and temperature	<ul style="list-style-type: none"> <li>• 2 cans or beakers</li> <li>• measuring cylinder</li> <li>• hot water</li> <li>• 2 thermometers</li> <li>• timer</li> </ul>	When learners place the thermometer into the beakers, they should ensure that the tip of the thermometer does not touch the bottom of the beaker. They can use wooden tongs to hold the thermometer.	<p><b>1</b></p>  <p><b>2</b> Sample answer: Beaker 1: 100 mL of hot water, therefore heat will flow to the surroundings at a slower rate. Beaker 2: 50 mL of hot water, therefore heat will flow to the surroundings at a faster rate.</p>

### Activity 8: Heat and glass

Learner's Book page 122

Processes and skills	Resources	Teacher's support notes	Answers to questions
To observe the effect of boiling water on glass	<ul style="list-style-type: none"> <li>• glass beaker</li> <li>• watch-glass</li> <li>• tripod stand</li> <li>• Bunsen burner</li> <li>• gauze mat</li> <li>• heat-proof mat</li> </ul>	Support learners to develop an understanding of the concept of expansion of particles in solids, liquids and gases as they work through this activity. Using appropriate apparatus will give accurate results.	<p><b>1</b> When water is heated, water vapour starts to form under the watch glass.</p> <p><b>2</b> When water is boiled, water starts to form on top of the watch glass.</p>

### Activity 9: Heating an empty tin

Learner's Book page 122

Processes and skills	Resources	Teacher's support notes	Answer to question
To observe the effect of heat on metal	<ul style="list-style-type: none"> <li>• empty Milo or milk tin and lid</li> </ul>	Be sure to remove the labels around the tin before heating.	The is heat transferred from the tin to the top so the normal appearance of the tin changes and the tin expands.

**Activity 10: Expansion of solid***Learner's Book pages 122–123*

Processes and skills	Resources	Teacher's support notes	Answer to question
To observe the expansion of a metal rod	<ul style="list-style-type: none"> <li>• cardboard box</li> <li>• brick</li> <li>• candle and stand</li> <li>• coconut leaf midrib</li> <li>• books and paper pointer</li> <li>• Blu-Tack</li> </ul>	Support learners to understand the concept of expansion in solids due to excitement of particles as they work through the activity.	The paper point moved from its original position due to the expansion of the rod, which resulted from heat being transferred from the candle.

**Activity 11: Ball and hoop***Learner's Book page 123*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the expansion of metals on heating	<ul style="list-style-type: none"> <li>• brass ball and hoop apparatus</li> <li>• tongs</li> <li>• Bunsen burner</li> <li>• heat-proof mat</li> </ul>	<p>The Bunsen burner must produce a blue flame.</p> <p>Do not use a big brass ball, as it will take longer for expansion to occur.</p>	<p><b>1</b> When heating took place, particles in the brass ball got excited. As a result, the brass ball started to expand. When expansion occurred, the brass ball enlarged in size.</p> <p><b>2</b> Heat could be applied to the hoop to increase its size.</p>

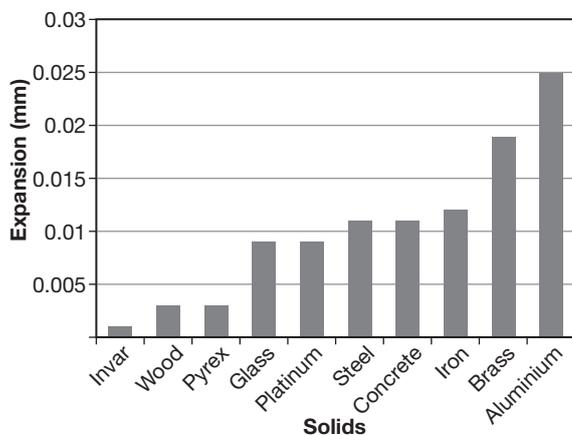
**Activity 12: An expansion gauge***Learner's Book page 125*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To evaluate an apparatus for comparing the expansion of different metals	<ul style="list-style-type: none"> <li>• metal rod</li> <li>• retort stand</li> <li>• clamps</li> <li>• pivot</li> <li>• ruler</li> <li>• Bunsen burner</li> <li>• splint</li> <li>• heat-proof mat</li> </ul>	Ensure that learners have developed an understanding of the concept of expansion before they begin this activity.	<p><b>1</b> A long splint is better because it takes more time to expand.</p> <p><b>2</b> A splint with the same length should be used for each metal and the amount of heat produced should be constant.</p>

**Answers****Unit questions***Learner's Book pages 126–127*

- 1 Substances generally *expand* when heated and *contract* when cooled.
- 2 Generally, particles have more kinetic (vibrational) energy when they are heated; the particles push each other further apart so they occupy more space.
- 3 The particles in the solids vibrate more when heated.
- 4 Figure 6.2.17 best shows the solid after heating.
- 5 Liquids expand more than solids because in liquids the particles are not tightly packed as they are in solids. So, when liquids are heated they vibrate more than in solids.
- 6 The two uses of expanding liquids are in thermometers and radiators of engines.
- 7 A gas can be stored in a container to prevent it from expanding when heated.

- 8 The pressure increases in the container when the gas is heated.
- 9 A gas trapped in a container that is heated will exert more *pressure* on the walls than in a cold container.
- 10 Water is not suitable for use in thermometers because:
  - it does not respond quickly to changes in temperature due to high specific heat and low thermal conductivity
  - it is transparent, sticks to glass and has a high rate of evaporation
  - it has a low temperature range of 0–100°C
  - due to anomalous expansion, the temperature scale will not be uniform.
- 11 Knowing a patient's temperature accurately may be crucial in diagnosing an illness or treatment. The constriction or kink holds the liquid at the final temperature after removal from the patient.
- 12 A clinical thermometer is usually shaken after use so that the temperature reading is back to room temperature before it is used on another person.
- 13 The particles in a gas move quickly in all directions, but they don't get far before they bump into each other or the walls of their container. When gas particles hit the walls of their container they cause pressure. The more particles that hit the walls, the higher the pressure. This is why the pressure in a tyre or balloon goes up when more air is pumped in.
- 14 The bimetallic strip that would bend most would be the one made of iron and aluminium. This is because aluminium has a higher expansion rate than brass, and will therefore bend more given the same amount of heat on the two strips.
- 15 Order of expansion is: Pyrex, platinum, concrete, brass.
- 16 Expansion with an increase in temperature of 1° Celsius:



## Unit 6.3: Sound

### Activity 13: A sound cannon

Learner's Book page 128

Processes and skills	Resources	Teacher's support notes	Answers to questions
To make a sound cannon that will blow out a candle	<ul style="list-style-type: none"> <li>• cardboard tube (eg a poster tube)</li> <li>• cling wrap</li> <li>• masking tape or rubber bands</li> <li>• match</li> </ul>	Support learners to understand the concept of sound as they work through this activity.	<ol style="list-style-type: none"> <li>1 The flame will turn to move to the left (to the west).</li> <li>2 This is done to avoid disturbance to the surroundings.</li> <li>3 The small hole allowed the sound wave to diffuse through.</li> </ol>

**Activity 14: The speed of sound***Learner's Book page 130*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To compare the speeds of sound and light	<ul style="list-style-type: none"> <li>starting pistol</li> <li>long tape measure or trundle wheel for measuring 100–300 m</li> <li>stopwatch</li> </ul>	Speed of sound in air = 343 m/s Speed of sound in water = 1400 m/s Speed of sound in steel (solid) = 5000 m/s	<ol style="list-style-type: none"> <li>The time it takes is an important factor since light travels faster than sound.</li> <li>The advantage of calculating the average is that the answer obtained will not be too large or too small, but one that lies exactly in the middle.</li> <li>Learners' responses will vary.</li> </ol>

**Activity 15: Reflection and absorption of sound***Learner's Book page 130*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To determine the reflecting and absorbing capacities of different materials	<ul style="list-style-type: none"> <li>sound-level meter or sound probe</li> <li>various materials to test as reflectors and absorbers of sound</li> </ul>	Support learners to understand the fact that sound reflects and absorbs depending on the type of surface used.	<ol style="list-style-type: none"> <li>Glass</li> <li>Fabric, plasterboard, wood, cardboard and glass</li> </ol>

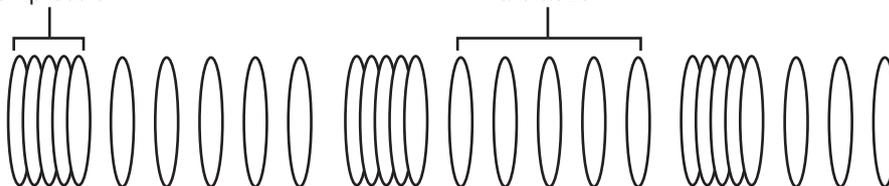
**Activity 16: Measuring cylinder resonance***Learner's Book page 133*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To examine resonance in a measuring cylinder	<ul style="list-style-type: none"> <li>250 mL measuring cylinder</li> <li>tuning fork</li> </ul>	Support learners to understand that resonance can occur when a vibrating object causes another to vibrate at the same time.	<ol style="list-style-type: none"> <li>Learners' responses will vary, but the length will depend on the tuning fork frequency used and the size of the measuring cylinder used.</li> <li>Water is added in small amounts so that the resonant frequency can be judged exactly.</li> </ol>

**Answers****Unit questions***Learner's Book page 134*

- A (air particles which travel from X to Y)
- Learners' responses will vary but could include guitar, panpipe, drum, microphone, bird and insect.
- compression

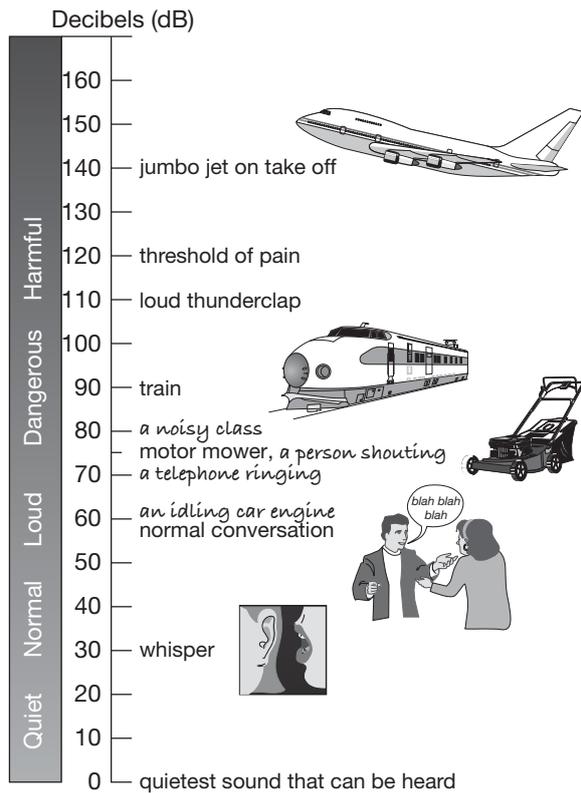
rarefaction



Longitudinal wave

- 4 a** Compression: reduction in size of an item (in volume, length or some other dimension) after or while being subjected to stress
- b** Rarefaction: reduction of an item's density (the opposite of compression).
- 5** The speed of sound is the distance travelled during a unit of time by a sound wave propagating through an elastic medium. In dry air at 20°C (68°F), the speed of sound is 343.2 metres per second.
- 6** In air, sound waves would travel the following distance in 3 seconds:  
 $343.2 \text{ m/s} \times 3 = 1029.6 \text{ m}$
- 7** 1 kilometre = 1000 metres  
 $1000/343.2 = 2.9 \text{ seconds}$
- 8** Sound travels fastest in steel.
- 9** Useful echo: depth sounding. Not-so-useful echo: at a concert.
- 10** Animals that use echolocation are bats and dolphins.
- 11** Some advantages of ultrasound are: the reassurance of seeing a healthy baby moving; a diagnostic tool if a problem is suspected.
- 12** Reverberation is the collection of reflected sounds from the surfaces in an enclosure such as an auditorium.
- 13 a** True; **b** False; **c** True
- 14 a** Frequency: the number of times that a repeated event occurs per unit of time
- b** Resonance: In physics, resonance is the tendency of a system to oscillate with greater amplitude at some frequencies than at others.  
 In sound applications, a resonant frequency is a natural frequency of vibration determined by the physical parameters of the vibrating object.
- 15** The frequency of the sound from a guitar string can be changed by increasing the tightness of the string.
- 16** Above 80 dB
- 17** Learners' responses will vary but may include power generator, jackhammer or train.
- 18** Sound travels at approximately 300 metres per second.  
 $d = v \times t$  or  $t = d/v$ , where:  
 $d$  = the distance the sound wave travelled back and forth  
 $v$  = velocity of sound  
 $t$  = the time it takes the sound to go back and forth.  
 Note: because the sound travels back and forth the distance is always doubled.  
 Therefore we can say  $2D = v \times t$   
 $2D = 300 \text{ m/s} \times 2\text{s}$   
 Note that the seconds cancel each other out so you are left with metres only as your unit.  
 $2D = 600 \text{ m}$   
 $D = 600/2 \text{ m}$   
 $= 300 \text{ m}$   
 So the learner stands at distance of 300 m from the house.
- 19** This is an open-ended question that allows learners to think about the expression and make their own suggestions about its meaning. For example, learners may suggest that the expression means 'don't listen to what a person is saying'.
- 20** When you push someone on a swing, the person moves back and forth (up and down) in a half-circular motion. This is similar to resonance of sound, where waves vibrate up and low in a half-circular motion.
- 21** The highest amplitude would be the loudest sound.

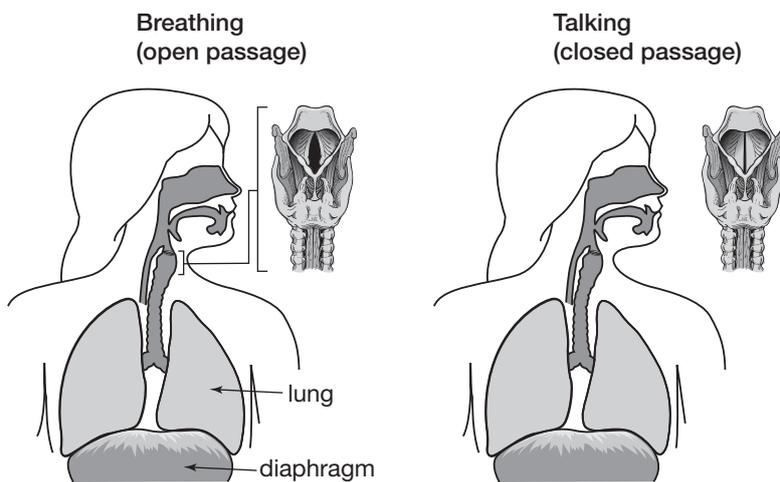
22 Learners' responses will vary. Sample answer:



### Extension questions

Learner's Book page 134

- Learners' responses will vary. Sample answer: The mucous membranes known as the vocal cords vibrate when you speak. They open when you inhale and close when you hold your breath.



- A sonic boom is the loud noise a person on the ground hears when an aeroplane flies overhead faster than the speed of sound. When a plane travels through the air, it pushes the air molecules aside, creating a shock wave, just as a boat creates a wave.
- Learners' responses will vary.

## Unit 6.4: Hearing

### Activity 17: Hearing tests 1

*Learner's Book page 135*

Processes and skills	Teacher's support notes	Answers to questions
To examine the directional ability of our ears in detecting sounds	IMPORTANT: Learners who have ear problems should NOT participate in this activity.	<ol style="list-style-type: none"> <li>1 The closer the sound source, the better the results obtained.</li> <li>2 The ability to hear in all directions is affected.</li> <li>3 Two ears are important because sound travels in all directions.</li> </ol>

### Activity 18: Hearing tests 2

*Learner's Book page 135*

Processes and skills	Teacher's support notes	Answers to questions
To listen to different sounds from around the school grounds	Support learners to understand that sound travels in all directions as they work through this activity.	<ol style="list-style-type: none"> <li>1 Learners' responses will vary but they should identify the sound source with the shortest distance.</li> <li>2 Learners' responses will vary but they should identify the sound source with the longest distance.</li> <li>3 Learners' responses will vary but the sound source should be at a fairly close distance.</li> <li>4 Learners' responses will vary but they should identify the sound source with a relatively short distance.</li> </ol>

## Answers

### Unit questions

*Learner's Book pages 137–138*

- 1 Vibration
- 2 Decibels (dB)

3

Part	Description/function
Pinna	Fleshy ear flap, collects sound
Eardrum	Thin sheet of muscle which vibrates in response to sounds
Ossicles	Three bones (hammer, anvil and stirrup) which receive vibrations from the eardrum
Oval window	Section at the boundary between the middle and inner ear
Cochlea	Coiled, fluid-filled tube
Semicircular canals	Three perpendicular sections which help us balance
Auditory nerves	Pass messages to the brain which are interpreted as sounds

- 4 The inner ear
- 5 Hammer, anvil and stirrup, as a group called ossicles
- 6 The cochlea
- 7 At the oval window
- 8 The sound came from the right.

- 9** If a sound reaches both ears at the same time, our brain interprets this to tell us the source of the sound is directly in front of, behind or above us.
- 10** There are three dimensions in which we exist.
- 11** **a** Wax helps prevent entry of dust and bacteria.  
**b** Wax can cause blockages of the ear canal, resulting in ringing of the ears or a degree of deafness.
- 12** Exposure to loud sounds or a blow to the head can cause damage.
- 13** You might experience partial deafness and/or ringing in the ears.
- 14** Learners' responses will vary but may include mowing the lawn, using a circular saw, or attending a rock concert.
- 15** **a** Train  
**b** Plane taking off  
**c** Whisper
- 16** About 80 decibels or louder
- 17** Learners' responses will vary but may include listening to the radio.
- 18** Large ears help to give the animals early warning of predators.
- 19** Two ears help us to determine sound direction and thus would aid in survival, eg it helps animals to determine from which direction a predator is approaching.
- 20** Infection can disturb the semicircular canals, which help us balance.
- 21** Caleb possibly has an ear infection where there is a partial blockage with wax. Sarah possibly has more serious, permanent damage to part(s) of the ear that allow hearing.
- 22** **a** motor mower—75 dB; could be dangerous  
**b** large truck passing—75 to 80 dB; could be dangerous  
**c** helicopter up close—120 dB; could be harmful  
**d** person shouting at 1 metre—70 dB; not harmful  
**e** racing car—90 dB; possibly dangerous  
**f** music through headphones—70 dB; but depends on the volume  
**g** classroom chatter—60 dB; not harmful

## Extension questions

*Learner's Book page 138*

- 1** Learners will be able to find out a lot of information about stethoscopes. The basic principle of the stethoscope is that it sends the sound up the tube so it can be heard by the ear. In some ways the stethoscope works similarly to an ear.
- 2** The bionic ear is an electronic hearing device. The first recipient was Mona Andersson. Learners may be able to research information about the development of the bionic ear and how it works.
- 3** Learners construct their models based on what they have learnt in this chapter so far.
- 4** **a** Learners may require assistance in both designing their experiments and recording their results.  
**b** Learners should suggest whether what they do is harmful and why. They should critically analyse their suggestions.

## Chapter review

### Answers

*Learner's Book pages 138–139*

- 1** Heat can be transferred in three different ways: by conduction, convection or radiation. Conduction is when two objects at different temperatures are in contact with each other. Heat flows from the warmer to the cooler object until they are both at the same temperature.

Convection occurs when warmer areas of a liquid or gas rise to cooler areas in the liquid or gas. As this happens, cooler liquid or gas takes the place of the warmer areas, which have risen higher. This cycle results in a continuous circulation pattern and heat is transferred to cooler areas. In liquids and gases, convection is usually the most efficient way to transfer heat. Both conduction and convection require matter to transfer heat. Radiation is a method of heat transfer that does not rely upon any contact between the heat source and the heated object. For example, we feel heat from the Sun even though we are not touching it. Heat can be transmitted through empty space by thermal radiation.

2	Insulators	Conductors
	Foam esky	Nail
	Wooden table	Metal oven tray
	Plastic cup	Barbecue grill
	Frypan handle	Woollen garment

- 3 a Water is a better conductor of heat than air.  
 b Water molecules are much closer to each other than air molecules. The closer the molecules to each other, the quicker the conduction of heat.
- 4 A sea breeze is an example of *heat convection*.
- 5 An example of radiated heat is heat from the Sun.
- 6 The best objects for absorbing heat are dark objects, while light-coloured objects emit heat better.
- 7 A sound wave is a longitudinal wave.
- 8 B
- 9 a True; b False

10	Technology	Use of technology	Type of energy	How it works
	Ultrasound	Viewing unborn babies	Sound	Sound waves are sent into the body and reflected back from bones, tissue etc. The reflected sound is converted into an image on a screen.
	Fish finder (echolocation)	To find fish below the surface of water	Sound	Sound is bounced off the fish and returned to the instrument.
	Guitar	To make music	Sound	A plucked guitar string produces sound by passing vibrations into the air.
	Solar hot water system	To use the Sun's energy to make hot water	Heat	Solar hot water systems also make use of convection.
	Insulation batt	To reduce the flow of heat	Heat	Insulation batts trap air within fibreglass fibres.

- 11 Radiation
- 12 Reverberation is when an echo overlaps with the original sound (ie a quick echo).
- 13 320 metres per second
- 14 a 700 m  
 b 350 m
- 15 Resonance

# Chapter 7: The fragile crust

## Strand: Earth and beyond

**Suggested class time: 12 periods**

### Sub-strand statement

This sub-strand deals with the fragile Earth. The Earth is made up of layers—molten materials near the centre and solid rocks near and at the surface. The solid layer is the lithosphere. It floats on the mantle (molten layer). The solid crust consists of huge pieces called plates. The movement of these plates produces great forces. This is the theory of plate tectonics. The results of these forces are geological events such as earthquakes and volcanoes. Scientists believe that the Earth is about 4.5 billion years old.

## General learning outcomes

Learners should:

- 8.7.1** know the Earth's layers and the movement of the Earth's plates (plate tectonics)
- 8.7.2** understand the different types of plate movements
- 8.7.3** be able to show a model of plate tectonics
- 8.7.4** know the geological features
- 8.7.5** know the units to measure the strength of earthquakes
- 8.7.6** know the cross-section of an erupting volcano
- 8.7.7** appreciate that seismic wave developments in Solomon Islands are measured by the Geology Division
- 8.7.8** know that the Earth has been in existence for a very long time.

## Specific learning outcomes

Learners should be able to:

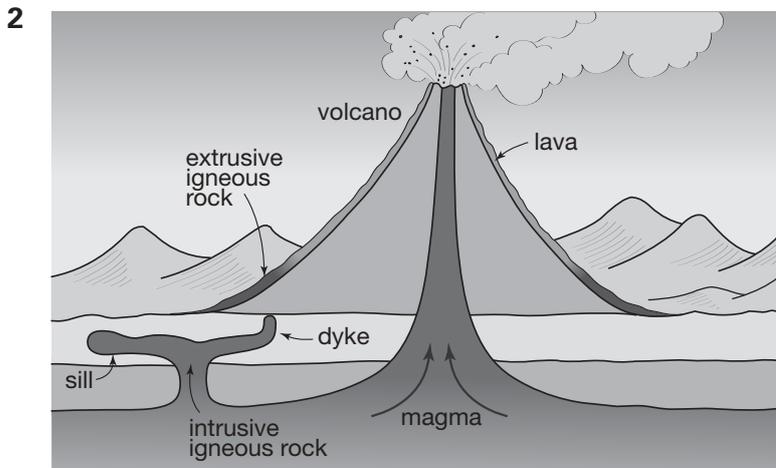
- 8.7.1.1** describe the Earth's main layers: crust, mantle and core
- 8.7.1.2** understand that the lithosphere is made of solid rock (plates) that continue to move
- 8.7.2.1** explain the movement of the Earth's plates: **i** pulling away; **ii** diving; **iii** sliding horizontally; **iv** plate interactions
- 8.7.3.1** construct models to demonstrate plate tectonics: **i** pulling away; **ii** diving; **iii** sliding horizontally; **iv** plate interactions
- 8.7.4.1** describe the geological features that are the result of tectonic activities: **i** earthquakes; **ii** volcanoes; **iii** fault lines
- 8.7.5.1** identify the strength of earthquakes on the Richter and Mercalli scales
- 8.7.6.1** draw and label a cross-section of an erupting volcano
- 8.7.7.1** make a visit to a Geology Office close to your school
- 8.7.7.2** display in class, pictures of earthquakes and volcanoes in Solomon Islands
- 8.7.8.1** describe the Earth's different geological time scales
- 8.7.8.2** describe fossils and their use in predicting the ages of rocks.

## Answers

### Suggested assessment events

*Solomon Islands Years 7–9 Science Syllabus*

1 Tectonic plate: sheet of crust, partly molten bottom and top layer of mantle that all shift as one



### Challenge questions

*Learner's Book page 140*

- 1 True. Australia is moving (very slowly) northward.
- 2 Los Angeles and San Francisco could become neighbouring suburbs because they are lying on different tectonic plates that are moving closer together.
- 3 Australia does not have many earthquakes or volcanoes because it does not lie on or near a plate tectonic boundary. New Zealand lies on a plate tectonic boundary and so it experiences many earthquakes and has many volcanoes.
- 4 Mauna Kea is the tallest mountain on Earth, but it is not as high in altitude as Mt Everest. This is because its base is 6000 metres under sea level.

## Unit 7.1: Plate tectonics

### Activity 1: The planet Splatter

*Learner's Book page 141*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To reconstruct a supercontinent	<ul style="list-style-type: none"> <li>• A4 photocopy of the map in Figure 7.1.1</li> <li>• scissors</li> <li>• blank A4 sheets of paper</li> <li>• glue</li> </ul>	This activity helps learners to visualise how supercontinents formed before moving apart. Evidence such as fossil remains of animals (slug), plants (fern) and changes of northern direction of ancient magnetic rocks is used to trace and reconstruct the supercontinent that existed many millions of years ago.	<ol style="list-style-type: none"> <li>1 Different magnetic orientations line up; the slug remains are located in a single band covering three continents; the fern remains are located on two continents that fit neatly together.</li> <li>2 There may be more than one way to arrange the continents. However, only one arrangement involves the continents fitting snugly together.</li> </ol>

## Activity 2: Convection currents

Learner's Book page 144

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the movement of convection currents	<ul style="list-style-type: none"> <li>• 1 large beaker (500 mL)</li> <li>• 1 medium beaker (200 mL)</li> <li>• small bottle</li> <li>• two-holed stopper that can fit well into a small bottle with two glass tubes inserted</li> <li>• tripod stand</li> <li>• Bunsen burner</li> <li>• gauze mat</li> <li>• heat-proof mat</li> <li>• box of matches</li> <li>• food colouring or pop drink powder</li> <li>• Blu-Tack or plasticine</li> </ul>	<p>Teachers should guide learners in doing this activity. Hot water may cause burning of skin; therefore learners need to be extra cautious.</p> <p>The colouring of the water will enable learners to see the movement of water particles as they rise up from the warmer (hotter) region to the cooler region. This is how convection currents are believed to have occurred in the Earth's mantle, causing movement of the Earth's plates (crust).</p>	<ol style="list-style-type: none"> <li><b>1</b> The heated water will flow up and then when it cools it will flow back down.</li> <li><b>2</b> Convection currents are the result of changing temperatures and pressure of particles cycling.</li> <li><b>3</b> Hot coloured water particles rise, and cold coloured water particles fall.</li> <li><b>4</b> The purpose of the two glass tubes is to show the direction of the hot-water particles and the direction of the cold-water particles. Hot-water particles rise and cold-water particles fall.</li> <li><b>5</b> Colouring the water made it easier to observe the movement of water particles in the bottle. Hot currents rise, cold currents fall.</li> </ol>

## Answers

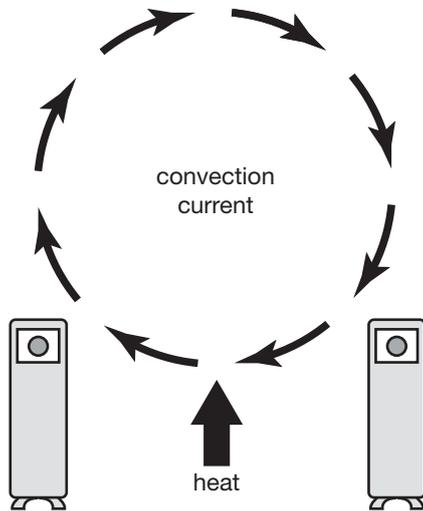
### Unit questions

Learner's Book pages 145–146

- 1** Evidence that suggests the continents were once joined: the shape of the continents; fossil remains of the same fern-like plants and Triassic reptiles; rock formations in mountains on different continents; ancient glaciers; coal above the Arctic Circle; magnetism in ancient rocks.
- 2**
  - a** Gondwana: Australia, Antarctica, South America, Africa, India
  - b** Laurasia: North America, Europe, most of Asia
- 3** Surprising discoveries about the ocean floor when it was first mapped:
  - There are huge volcanic mountain ranges down the centre of the oceans.
  - The rock of the ocean floor is much younger than that of the continents.
  - Deep ocean trenches exist.
  - The rock of the continents is less dense than that of the ocean floor.
  - The ocean floor has magnetic stripes that indicate that the rock is of different ages.
- 4** The oldest rocks on the ocean floor are those closest to the trenches and the youngest are next to the ridges.
- 5**
  - a** Tectonic plate: sheet of crust, partly molten bottom and top layer of mantle that all shift as one
  - b** Mantle: molten rock under intense pressure and temperature; the layer under the crust
  - c** Crust: thin layer of solid rock that we live on; the 'skin' of the Earth
- 6** The crust is 8 to 64 km thick.
- 7** The theory of plate tectonics suggests that the Earth's crust is made from a series of rock plates that shift around on convection currents in the mantle.
- 8** Convection currents are caused by hot material rising and cooler material dropping. Convection currents are believed to occur in the mantle.

- 9 a False: Triassic reptiles could *not* have swum the distances required to populate different continents.  
 b True  
 c False: Many of the continents that do not have glaciers now *were once cold enough* to have them.  
 d True
- 10 Temperatures along the ridges are higher than elsewhere in the ocean because this is where magma emerges and cools to become solid rock. This hot lava heats the water around it.

11



- 12 The mantle is kept hot because the crust traps heat like a blanket; patches are continually being heated by radioactive decay of uranium, thorium and potassium.
- 13 If the asthenosphere cooled and became solid, the plates would stop moving.

### Extension questions

*Learner's Book page 146*

- 1 If an average lifetime is 80 to 100 years, then the plate on which Australia sits will move northward at between  $5 \times 80 = 400$  cm to  $5 \times 100 = 500$  cm per year. This is equivalent to 4 to 5 metres.
- 2 In 1915, Alfred Wegener proposed a radical theory. He suggested that there was once a supercontinent called Pangaea, which split to form the continents. These then drifted into their current positions.
- 3 Sonar is an instrument that uses sound waves. It is used to measure the depth of the seabed by sending sound waves to the bottom of the ocean or sea.

## Unit 7.2: At the edges

### Activity 3: Plates that separate (mid-ocean ridges)

*Learner's Book page 147*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To model and investigate the mid-ocean spreading of tectonic plates	<ul style="list-style-type: none"> <li>carton (Navy biscuit/noodle) or any empty cardboard box</li> <li>A3 sheets of paper/brown paper roll</li> <li>coloured pencils or highlighters</li> <li>scissors</li> <li>sticky tape</li> <li>pegs</li> </ul>	In this activity learners make a model that represents the separation (moving apart) of two plates in the ocean (underwater) that form mid-ocean ridges. The different colour stripes represent the different rock formed at each movement (moving apart in a particular time).	<ol style="list-style-type: none"> <li>The movement of the paper is similar to the action of the plates in creating rock at a mid-ocean rift.</li> <li><b>a</b> paper; <b>b</b> air; <b>c</b> paper pushing up; <b>d</b> pegs and hands; <b>e</b> join in paper; <b>f</b> coloured stripes</li> <li>The paper rises on both sides of the join.</li> <li>According to Figure 7.2.1, mustard represents the oldest rock while pink represents the youngest rock.</li> <li>The youngest (pink) rock would be swallowed first if the movement reversed.</li> </ol>

### Activity 4: Colliding plates

*Learner's Book page 149*

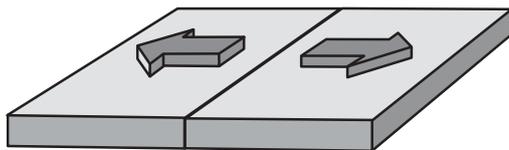
Processes and skills	Resources	Teacher's support notes	Answers to questions
To model what happens when two tectonic plates collide	<ul style="list-style-type: none"> <li>stack of about 30 A4 pages (use scrap paper)</li> <li>a textbook</li> </ul>	<p>In this activity learners make a model that represents three types of plate collisions at plate boundaries.</p> <p>Test 1: collision occurred between two continental plates of the same density</p> <p>Test 2: collision occurred between a continental plate (low density) and an oceanic plate (high density). The oceanic plate subducted under the continental plate.</p> <p>Test 3: collision occurred between two oceanic plates. However, the faster plate sank in the collision to form a subduction zone as well.</p>	<ol style="list-style-type: none"> <li>The tests simulate plate collisions. Test 1 represents the collision of two continental plates, resulting in a mountain range. Test 2 represents the collision of two oceanic plates, resulting in a subduction zone, as two similar objects (stacks of paper) are involved. Test 3 represents the collision of an oceanic plate with a continental plate, resulting in a subduction zone, as two different objects (book and stack of paper) are involved.</li> <li>Rock has layers due to uneven cooling rate.</li> <li><b>a</b> test 1; <b>b</b> test 3; <b>c</b> test 2</li> <li>Learners' responses will vary. The following examples are taken from the text: <b>a</b> Himalayas; <b>b</b> Japan; <b>c</b> Peru/Chile trench</li> </ol>

## Answers

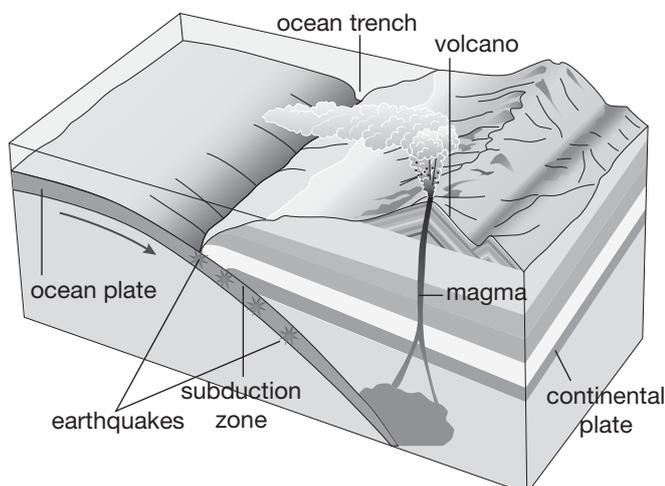
### Unit questions

*Learner's Book pages 151–152*

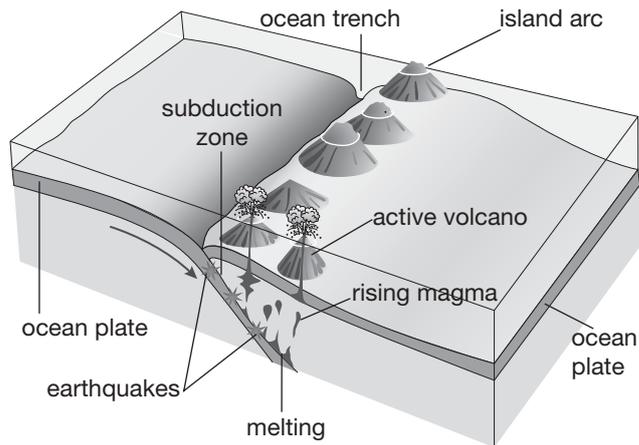
- 1 **a** Transform or scraping, spreading, collision  
**b** Transform or scraping—two plates move, pass or slide past each other; spreading—two plates move apart or away from each other; collision—two plates move toward each other
- 2 The mid-ocean ridge constantly tries to heal itself, forming a 'rock scab' that is the ridge itself. Magma keeps breaking through the scab, however, oozing out and forcing the repair to happen all over again.
- 3 A subduction zone is where one plate (usually the ocean plate) dives under a (continental) plate. Friction causes earthquakes along it and melts the rock. The molten rock may have enough pressure to break the surface to form volcanoes.
- 4 **a** The faster; **b** The heavier; **c** The oceanic plate
- 5 Lots of earthquakes occur at transform boundaries. Some can be very strong.
- 6 **a** Rift valleys are formed between boundaries where the plates move apart. A weakened line (fault) in the crust causes a huge crack or rift valley to form and hot liquid magma forces its way up from the mantle to fill it. The magma cools and solidifies as it hits the water, and creates the underwater mountain ranges observed in the Atlantic and Pacific oceans.  
**b** A boundary that dives into the mantle is called a subduction zone. It occurs when an oceanic plate collides with a continental plate. The upper plate is crushed, thickens and forms folded mountains along its edge.  
**c** Boundaries that cause trenches (ocean trenches) form where the oceanic plate drops below the continental plate. Although some of these trenches are filled with sediment, many are incredibly deep.  
**d** Boundaries that cause huge, folded mountains occur when a continental plate collides with another continental plate. Both plates have similar densities and neither can push the other underneath. Instead the plates crumple, fold and push up to form mountains.
- 7 **a** Spreading; **b** Transform; **c** Collision; **d** Spreading
- 8 **a** Spreading plate boundaries



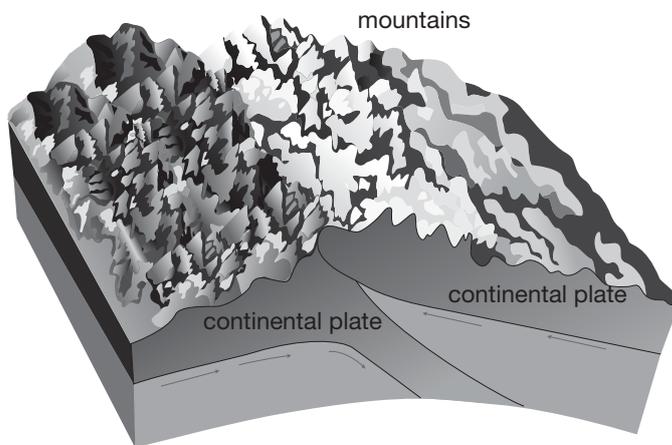
**b** Oceanic plate meets continental plate



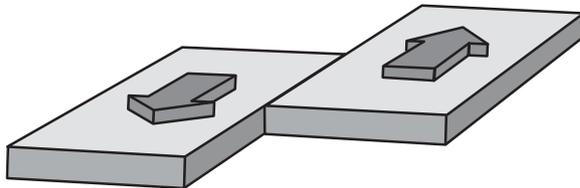
**c** Oceanic plate meets oceanic plate



**d** Continental plate meets continental plate



**e** Transform plate boundaries



- 9 a** Himalayas: Indo-Australian plate with Eurasian plate  
**b** Mid-Atlantic Ridge: African plate with South and North American plates  
**c** Mariana Trench: Philippine plate with Pacific plate  
**d** San Andreas fault: Pacific plate with North American plate
- 10** As a result of the force and pressure, the upper plate is crushed, thickens and forms folded mountains along its edge.
- 11 a** Assuming an average lifetime of between 70 and 90 years, the Himalayas will grow between 70 and 90 centimetres.  
**b i** A further 10 metres will take 1000 years; **ii** A further 100 m will take 10 000 years;  
**iii** A further 1 km (1000 m) will take 100 000 years.
- 12** Mediterranean Sea: the Red Sea needs to widen another 260 km (500 – 240 km). 260 km = 26 000 000 cm. So the time taken would be:  $26\,000\,000/20 = 1\,300\,000$  years = 1.3 million years.

## Unit 7.3: Earthquakes

### Activity 5: Slinky springs: transverse and longitudinal waves

*Learner's Book pages 153–154*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To model the movement of P (primary) and S (secondary) waves	<ul style="list-style-type: none"> <li>• slinky spring</li> <li>• dense smaller-diameter slinky</li> <li>• string</li> <li>• paper</li> <li>• sticky tape</li> </ul>	<p>P and S waves are seismic waves (formed during an earthquake) that travel through the body of the Earth.</p> <p>A plastic kind of slinky spring can be found in most Chinese shops in Honiara. Ensure that the Science department purchases them for the school.</p> <p>This experiment can be conducted by two learners. They should take turns.</p>	<p><b>1 a</b> Sideways, back and forth; <b>b</b> Back and forth along the line of the spring.</p> <p><b>2</b> An ant in part A may become twisted, while in part B it would get squashed.</p> <p><b>3 a</b> Part B; <b>b</b> Part A</p>

### Activity 6: Building a seismometer

*Learner's Book page 155*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To construct a working model of a seismometer	<ul style="list-style-type: none"> <li>• retort stand</li> <li>• bosshead and clamp</li> <li>• spring</li> <li>• heavy weight</li> <li>• adhesive tape</li> <li>• felt pen</li> <li>• cardboard or piece of masonite attached to A4 paper</li> </ul>	<p>In this activity, learners develop their psychomotor skills in designing and constructing a model of a seismometer.</p> <p>Ensure that all the required resources are available. If they are not, you will need to improvise.</p> <p>Guide learners in creating an earthquake by thumping the bench on top and at the end. Learners can observe how a real seismometer is supposed to work in recording seismographs (seismic wave).</p>	<p><b>1</b> The movement that caused the seismographs to work was the up-and-down movement of the spring, weight and felt pen.</p> <p><b>2</b> The graph didn't stop after the earthquake did, because there was still the up-and-down movement of the spring and the weight.</p>

## Answers

### Unit questions

*Learner's Book page 158*

- 1 Friction exists at plate boundaries because tectonic plates separate, collide and scrape over each other. None of this movement is smooth.
- 2 The friction between the plates is normally enough to stop movement of the plates for a while. The plates are still pushing, however, and the pressure builds until it overcomes the friction. That is when the plates move, suddenly.

- 3** Body: Primary (P) and secondary (S)  
Surface waves: Rayleigh (R) and Love (L)
- 4 a** Longitudinal (or compression): primary waves and sound waves. They push and pull and do not behave in the up-and-down motion of water waves that we are used to.  
**b** Transverse: S and L waves, water waves, light
- 5** Refraction is the bending of a light or sound wave as it passes from one material to another.
- 6** Different densities and temperatures of the rock below the surface cause changes in speeds of P and S waves and cause them to be bent or refracted.
- 7** S waves apparently do not pass through the Earth's core since there is always a 'shadow' opposite the epicentre. S waves cannot pass through liquid, indicating that the outer core must be liquid.
- 8** R waves are rolling waves, like breakers at a surf beach. They are the slowest but often the largest and most destructive.  
L waves are the fastest surface waves and have a side-to-side motion, like a moving snake. They arrive last. They are up-and-down waves, just like water waves, but cannot travel through water; an ocean will stop them.
- 9** They can be very small (measure 1–2 on the Richter scale). They may occur only along plate boundaries. Countries far from plate boundaries may not feel the earthquakes.
- 10** Any earthquake above 7 on the Richter scale must be considered dangerous, as major damage can be expected.
- 11** Aftershocks are smaller earthquakes that often occur after a large earthquake. They are generated when the slabs that have been moved by the larger earthquake finally settle down.
- 12** Aftershocks can be more dangerous than the actual earthquake, because buildings may have been damaged and made unstable by the first earthquake.
- 13** Tsunamis are formed when the epicentre of the earthquake is under the ocean floor. The earthquake causes waves to form. These waves can travel very fast and their height increases as they reach shallow water. They can cause great damage.
- 14** There are very few videos or photographs of tsunamis because they often catch people by surprise.
- 15** All of Australia sits on the Indo-Australian plate. There are no major boundaries running through it. Papua New Guinea and New Zealand both straddle the Indo-Australian and Pacific plates and sit on a boundary where earthquakes can be expected.
- 16 a** Body waves travel through the body of the Earth, while surface waves travel the longer distance across the surface.  
**b** A longitudinal wave is a 'push-pull' wave, and moves particles back and forth in the direction of the movement of the wave. A transverse wave is an up-and-down wave that moves particles at right angles, or sideways, to the direction of its movement.
- 17 a** L (and sometimes R); **b** S and L; **c** P; **d** P and S
- 18 a** *Tsunamis* are huge waves caused by earthquakes.  
**b** An earthquake of strength 5 on the Richter scale is *10 times* the strength of a 4.  
**c** Earthquakes are caused by plates slipping.  
**d** The focus of an earthquake is the exact point where an earthquake starts.  
**e** Tsunamis are *small* when in deep water.
- 19** The value of a tremor on the Richter scale is 4–5, and on the Mercalli scales is IV–V.
- 20 a** Total destruction, low number of buildings survive, valley fills with mud from landslides and floods  
**b** From 0 to 10 times per year

### Extension question

*Learner's Book page 158*

Learners' responses will vary but they should include some of the following information:

- what an earthquake is (the movement of tectonic plates due to high pressure)
- what causes an earthquake (high pressure inside the Earth's core)
- what you should do if an earthquake strikes:
  - go into an open space if you are in your home
  - go to higher ground if located on lower ground
  - stay far away from coastal areas to avoid potential tsunamis.

## Unit 7.4: Volcanoes

### Activity 7: Volcanic clouds

*Learner's Book page 159*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the formation of volcanic clouds	<ul style="list-style-type: none"> <li>• large beaker</li> <li>• pneumatic trough or transparent jar</li> <li>• 100 mL flask</li> <li>• rubber stopper with hole</li> <li>• food dye or pop-drink sachet</li> <li>• heater/kettle or Bunsen burner</li> <li>• stirring rod</li> <li>• flat-bottomed flask or empty Schweppes bottle</li> </ul>	<p>Warning: Hot water is dangerous. It can burn the skin. Teachers and learners must be very careful when doing this experiment.</p> <p>Teachers can improvise if the equipment listed is not available (eg cut SB empty bottles or Schweppes bottle and large dish or buckets).</p>	<ol style="list-style-type: none"> <li>1 Learners' responses will vary.</li> <li>2 Learners' responses will vary. Hot water comes out of the flask but as it mixes with the cold water it falls to the bottom of the pneumatic trough or large beaker.</li> <li>3 Coloured water represents lava/ magma from the volcano and clear water represents the air.</li> <li>4 When hot ash from the volcano mixes with cold air it will fall to the surface of the Earth.</li> <li>5 A likely reason for hot ash falling when it mixes with cold air is that hot air is less dense and rises, and cold air is more dense, heavier and falls.</li> </ol>

### Answers

#### Unit questions

*Learner's Book page 162*

- 1 Krakatoa was a small volcanic island west of Java, Indonesia. It caused the largest explosion ever recorded in human history when it erupted in 1883.
- 2 Some volcanoes may not be seen because they are under water.
- 3 Savo

- 4** Fissures are cracks and vents are openings through which eruptions occur.
- 5** Volcanoes are most likely to be found on the edges of tectonic plates than in the middle because the pressure is greater on the edges. The build-up of pressure is due to the burning of the lithosphere as it is subducted into the mantle.
- 6** Magma, lava, volcanic lahar, volcanic bomb, fume (steam and gases) and smoke (made up of fine rock, dust or ash and rocks)
- 7** **a** The hot volcanic ash clouds rise because they are lighter than the surrounding air.  
**b** Volcanic ash can settle back to Earth as a thick blanket, burying people and destroying properties. Rain can turn the ash into lahar, which can destroy anything downstream. Volcanic ash can travel across the planet in jet-stream winds of more than 30 km per hour. It has the potential to block the sunlight, making the planet cooler and producing spectacular sunsets.
- 8** **a** Lava is what emerges from erupting volcanoes. It is made up of magma, gases (hydrogen sulfide) and steam.  
**b** The magma chamber is the area deep under the surface where molten rocks called magma form.  
**c** Lahar is volcanic ash that is turned into a river of mud by rain.
- 9** Volcanic bombs are large solid pieces of rock that are blown out when a gas explosion destroys part of a volcano. They can also form when hot lava is thrown into the air.
- 10** **a** Lava is the same as magma.  
**b** A dormant volcano is a *sleeping* volcano.  
**c** Volcanic ash moves *faster* than lava.  
**d** White lava is hotter than red lava.  
**e** Ash clouds *travel long distances*.
- 11** The smell that is always around volcanoes and hot springs is caused by the release of gases such as hydrogen sulfide (smells of a rotten egg).
- 12** The area around the Pacific is often called the 'Ring of Fire' because of the existence of volcanoes around the edges of the Pacific plate.
- 13** Volcanic areas are also areas of high earthquake activity because volcanoes are usually situated along plate boundaries, especially the colliding plates. This is also where earthquakes occur, as plates slip and release pressures as they move towards each other.
- 14** Distance = 5000 km; time = 4 hours  
= 5000/4  
= 1250 km/h

## Unit 7.5: Faults and folds

### Activity 8: Faults and folds

Learner's Book pages 163–164

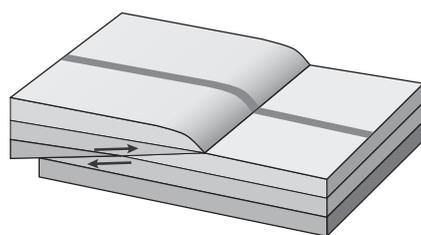
Processes and skills	Resources	Teacher's support notes	Answers to questions
To model faults and folds in the land	<ul style="list-style-type: none"> <li>• plasticine in four colours, or dough with colouring if plasticine cannot be found</li> <li>• rolling pin</li> <li>• fine wire (guitar wire) or a hacksaw blade</li> </ul>	<p>A properly mixed dough (flour and water) with food colouring can be used instead of plasticine. Flour and food colouring are readily available in Honiara bulk shops.</p> <p>If flour and food colouring cannot be obtained, try using clay soil. Remove all rock particles and mix with water to create moulds for faults and folds.</p>	Could be an anticline after erosion

### Answers

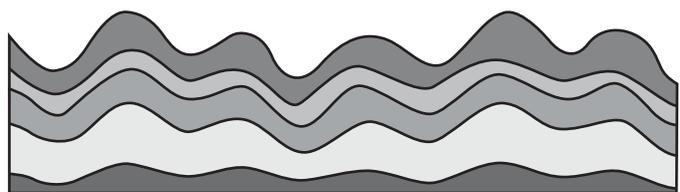
#### Unit questions

Learner's Book page 166

- 1 Faults can be normal, reverse or transcurrent.
- 2 If the rock that makes the fault scarp is hard, it will weather slowly. If soft, it will weather quickly and will be carried away by erosion, leaving a rounded rise instead.
- 3 A substance shows plastic behaviour if it can bend and fold without breaking.
- 4 Rock can act in a plastic way if it is under extreme pressure, as is typically the case when folding occurs.
- 5 **a** A normal fault and a transcurrent fault: refer learners to Figure 7.5.3 in the Learner's Book.  
**b** A fault and a fold



reverse fault



fold

- c** A syncline and an anticline: refer learners to Figure 7.5.8 in the Learner's Book.
- 6 Top diagram: Layer K was laid down first, followed by J, I, H, G, F, E and D on top. All were laid flat. Pressure folded the layers upwards, forming an upward fold or anticline. Erosion removed the top of the fold, until D and E were nearly worn away. The erosion left the surface flat once more. Sediment laid new layers: C first, then B and A on top. Bottom diagram: Layer D was laid down first, followed by C, B, A. A reverse fault then occurred, followed by erosion to present profile.

## Unit 7.6: Geological time

### Activity 9: Dinosaur fossils

*Learner's Book page 167*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To make a fossil of a dinosaur	<ul style="list-style-type: none"> <li>clay or plasticine (to make a mould)</li> <li>pin</li> <li>probe or blunt pencil</li> <li>tracing paper or photocopy of the skeleton in the Learner's Book</li> <li>rolling pin or piece of dowel</li> <li>cardboard or shoe-box lid</li> <li>plaster mix, water</li> </ul>	<p>Explain to learners the process of moulding and casting. The mould is a negative impression of the fossil, like making ice or food in a mould. The cast is the shape of the fossil, like the ice made in the ice tray.</p> <p>You could also use a fish skeleton to make a fossil. You will need to bake the whole fish, remove the meat from the bones. You are then left with the skeleton. Place the full skeleton on a sheet of A4 paper and cover the skeleton with dough. Leave the skeleton and the dough at least two hours. You will find that mark of the fish skeleton will be left on the dough.</p> <p>Learners can also make a fossil out of a guava or mango tree leaf.</p>	<ol style="list-style-type: none"> <li>Real fossil moulds are sometimes naturally formed when the actual organism has broken down and left behind an impression or shape. Latex, plaster or even dough can be used to make the cast.</li> <li>A mould fossil (a mould is created based on the picture). A cast or dough fossil is made using objects such as fish skeletons or leaves.</li> </ol>

### Activity 10: 'Radioactive' cubes

*Learner's Book page 169*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To model the radioactive decay of uranium	<ul style="list-style-type: none"> <li>50 or more small wooden cubes, with one face marked (eg with a dot)</li> <li>cup</li> <li>graph paper</li> <li>marker (black or blue colour)</li> </ul>	<p>Cubes can be purchased in some Chinese shops or second-hand shops. If you cannot find them in the shops, create them by cutting sawed timber and use a marker pen to mark them.</p>	<ol style="list-style-type: none"> <li>Learners' graphs should resemble the graph in Figure 7.6.6.</li> <li>Learners' responses will vary.</li> <li>Differences may vary considerably with initial trials, but will reduce with repetition.</li> <li>The actual half-life of the real radioactive uranium isotope is 713 million years.</li> </ol>

## Answers

### Unit questions

*Learner's Book pages 171–172*

- 1 A fossil is evidence of past life in a rock or other materials. This evidence may be the remains of a plant or animal, or an impression such as a footprint. In rare cases, a complete animal may be preserved.
- 2 **a** False: A dinosaur footprint *is* a fossil.  
**b** True  
**c** True  
**d** False: Fossils are *most likely to be found* under oceans or other bodies of water.  
**e** True  
**f** False: Fossils of complete animals *do* exist.
- 3 Uranium decays into lead over time.
- 4 **a** Carbon is a radioactive substance that may be used to date plant and animal fossils.  
**b** It could not be used to date fossils that are 100 000 years old because its limit is 70 000 years.
- 5 Cenozoic (recent life), Palaeozoic (ancient life), Archaeozoic (primitive life) and Azoic (without life)
- 6 Cretaceous, Jurassic, Triassic
- 7 Changes of environmental condition do not allow species of animals or plants to survive. For example, if the global environment becomes too warm, plants and animals cannot adapt, and therefore die, and species become extinct. If the food sources of animal species die out due to changes in environmental conditions, the animals are also likely to die if they are unable to adapt to new food sources.
- 8 Index fossils are fossils that lived over a comparatively short period of time and were widespread. They are useful because they can help to determine the age of a layer of rock. Ammonites are an index fossil.
- 9 Scientists believe the Earth to be about 4.5 billion years old.

10

Period	Span (millions of years)
Quaternary	2
Tertiary	63
Cretaceous	79
Jurassic	64
Triassic	40
Permian	42
Carboniferous	72
Devonian	46
Silurian	30
Ordovician	67
Cambrian	65
Precambrian	2130

- 11 **a** Carboniferous; **b** Cretaceous; **c** Silurian; **d** Precambrian (Archaeozoic era); **e** Jurassic; **f** Ordovician; **g** Precambrian (Proterozoic era); **h** Jurassic; **i** Cretaceous
- 12 Older fossils can sometimes be found in rock above newer fossils when movement in the Earth's crust causes the layer of sedimentary rock containing the fossil to move upwards to form part of a mountain range.

- 13** Rock containing fossils of sea life can end up in a desert or inland area far from the ocean because:
- the land has faulted and folded
  - the coastline has changed
  - the sea levels have changed
  - the continents have shifted.
- 14**
- A group of three creatures were travelling together when they were frightened and scattered in three directions.
  - A large creature tracked a smaller creature, caught it and ate it.

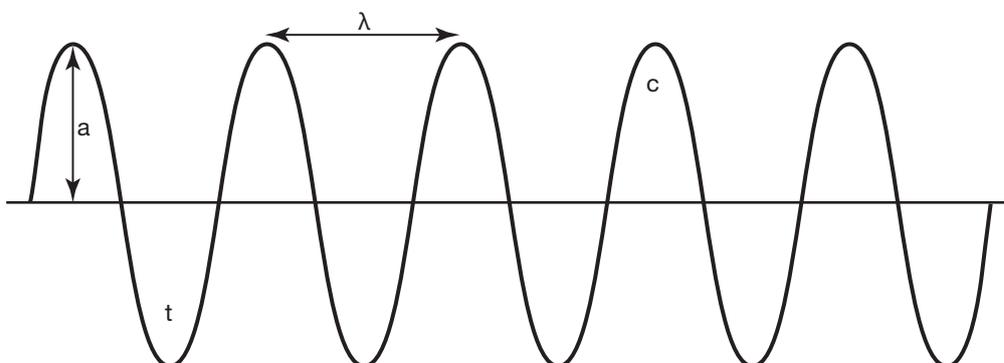
## Chapter review

### Answers

*Learner's Book pages 172–173*

- The Earth is like toast on soup in that both have slabs of moving solid crust floating on a hot, thick liquid.
- All the current continents were part of Pangaea. Hence, Pangaea is literally 'all the lands'. Its 'babies' are Gondwana and Laurasia.
- a** The north poles of ancient rocks that are magnetic all point in different directions. When the continents are pieced together the north poles all point in the same direction, suggesting that the continents have shifted and twisted.

**b** Magnetic stripes exist parallel to the mid-ocean ridges. The stripes closest to the ridges are the newest and the ones further out are older, suggesting that they are moving away from the ridges and towards the trenches.
- The idea of moving plates is called the theory of plate tectonics.
- The theory of continental drift assumes that only the continents are shifting. The theory of plate tectonics involves much larger slabs of rock (which also carry the shifting continents). Convection currents push the rock of the mantle around. The bottoms of the plates are partially molten or 'soggy', and are carried with the mantle as it moves underneath them.
- Plate boundaries are where plates separate, collide or scrape over each other. Friction occurs and stops movement until the pressure is sufficient to overcome the friction. When it does, the plate slips and an earthquake results.
- The subduction zone is completely molten at 200 km below the surface.
- Primary, secondary, Raleigh and Love waves are all detected by a seismometer. They are in the order: P first, S next, then R and L basically together and last.
- Transverse wave



**Key**

- a amplitude
- t trough
- c crest
- $\lambda$  wavelength

- 10** **a** S and L; **b** P; **c** R
- 11** Three different ways in which mountain ranges can form are: continent–continent collision, forming folded mountains; volcanic action at plate boundaries or hotspots; normal faults creating horst and graben, which can erode into mountain ranges and basins.
- 12** A fault is a weak spot or break in the crust along which the crust can move in an earthquake. There is no break in the crust when folded. The crust buckles instead of breaking and shifting.
- 13** **a** False; **b** True; **c** True; **d** False; **e** True; **f** True; **g** True
- 14** **a** Animals with large bones or shells are more likely to form fossils.  
**b** These solid hard materials do not rot easily and therefore are likely to form fossils.
- 15** Scientists date a rock by measuring the amount of uranium in it.
- 16** **a** Palaeozoic; **b** Palaeozoic; **c** Cenozoic; **d** Mesozoic
- 17** Various answers are possible, for example: **a** fish; **b** algae; **c** humans.
- 18** The mysteries of the ocean floor were discovered only in the 20th century with the invention of sonar and the need for good ocean-floor maps in World War II.
- 19** A map of the world in the future will be different from today's map because all the plates and their continents are shifting. Some will join, others will separate, some will slide along each other.
- 20** The mantle is solid but still able to move due to the extreme pressures and temperatures there. Other 'solid' substances that can 'move' are plasticine, clay and mud.
- 21** The ocean floor is like a conveyer belt as it carries the newly created rock from the mid-ocean ridges across the ocean towards the trenches.
- 22** Dense materials sink and light materials float. The rock of the continental plates is less dense than the rock of the ocean plates. The continents thus will 'float' on the ocean floor, and the ocean plate will sink under the continent.
- 23** When plates slip past each other, there is a lot of frictional force to overcome, and pressure builds up. When pressure is released, energy is also released, causing vibration as the plates slip past each other (earthquake).
- 24** Magma is molten rock full of gas (mainly steam). Its density is less than the surrounding rock and so it will push upwards through the covering tectonic plate.
- 25** The temperature near the ceiling of a room is always hotter than at floor level because of convection currents. The warmer air rises and the cooler air falls.
- 26** The density of the magma is less than the density of the surrounding rock and so the magma pushes upwards through the tectonic plate.
- 27** Volcanic ash rises in the atmosphere because it is hot and tends to rise (hot air always rises due to less density).
- 28** Dust, ash, steam and gases

# Chapter 8: Small particles of matter

## Strand: Natural and processed materials

**Suggested class time: 12 periods**

### Sub-strand statement

This sub-strand deals with elements as building blocks of matter. Elements are made of the same type of atoms. An atom has protons and neutrons in the centre and electrons outside the atom. These particles—electrons, protons, and neutrons—determine the structure of an atom.

## General learning outcomes

Learners should:

- 8.8.1** know that elements are building blocks of matter
- 8.8.2** know that an element is made up of the same type of atom
- 8.8.3** be able to show the structure of an atom
- 8.8.4** appreciate the atomic models developed by scientists.

## Specific learning outcomes

Learners should be able to:

- 8.8.1.1** give examples of elements (the first twenty elements in the periodic table and common elements, such as silver, zinc, lead, mercury, copper and iron)
- 8.8.1.2** write the symbols of the first twenty elements and the common elements, such as silver, zinc, lead, mercury, copper and iron
- 8.8.2.1** identify common elements such as aluminium foil, iron nail, gold medal, silver medal
- 8.8.3.1** draw diagrams of the first twenty atoms, showing nucleus (with neutrons and protons) and electrons
- 8.8.3.2** use common everyday materials to construct a model of an atom
- 8.8.4.1** name scientists and their contributions to the understanding of atoms and elements.

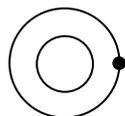
## Answers

### Suggested assessment events

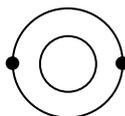
*Solomon Islands Years 7–9 Science Syllabus*

- 1** The first twenty elements are as follows in order of increasing size: hydrogen (H), helium (He), lithium (Li), beryllium (Be), boron (B), carbon (C), nitrogen (N), oxygen (O), fluorine (F), neon (Ne), sodium (Na), magnesium (Mg), aluminium (Al), silicon (Si), phosphorus (P), sulfur (S), chlorine (Cl), argon (Ar), potassium (K) and calcium (Ca).

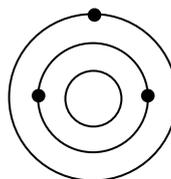
2



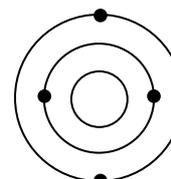
hydrogen (1)



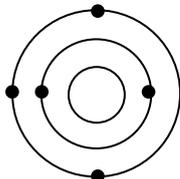
helium (2)



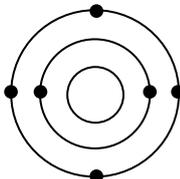
lithium (2,1)



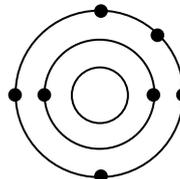
beryllium (2,2)



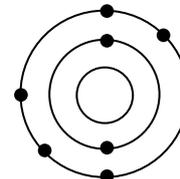
boron (2,3)



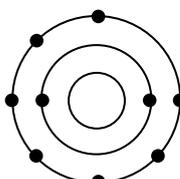
carbon (2,4)



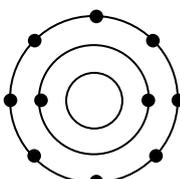
nitrogen (2,5)



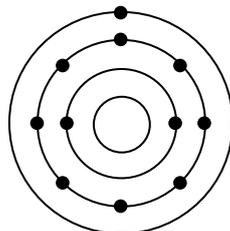
oxygen (2,6)



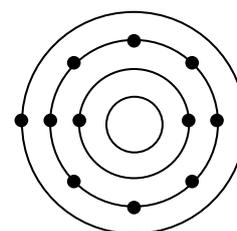
fluorine (2,7)



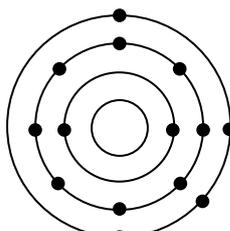
neon (2,8)



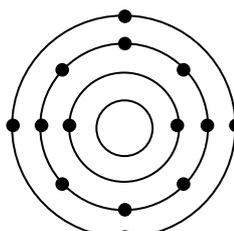
sodium (2,8,1)



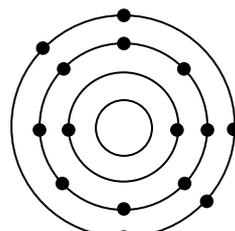
magnesium (2,8,2)



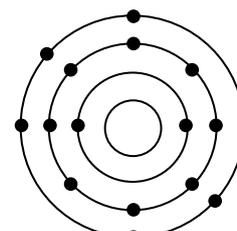
aluminium (2,8,3)



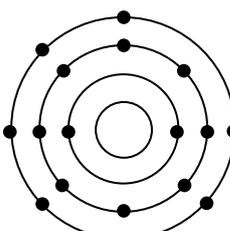
silicon (2,8,4)



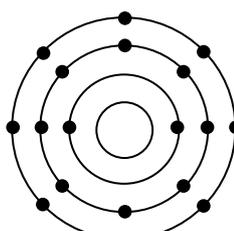
phosphorus (2,8,5)



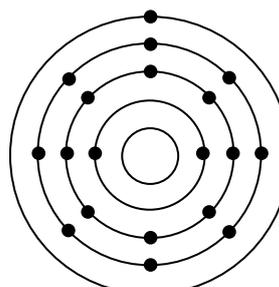
sulfur (2,8,6)



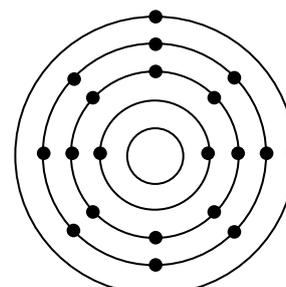
chlorine (2,8,7)



argon (2,8,8)



potassium (2,8,8,1)



calcium (2,8,8,2)

### Challenge questions

*Learner's Book page 174*

- 1 Iron
- 2 Chlorine (Cl)
- 3 No new substance is made when water is added to cordial. You simply have a mixture of water and cordial.

## Unit 8.1: Elements

### Activity 1: Solid, liquid or gas?

Learner's Book page 176

Processes and skills	Resources	Teacher's support notes	Answers to questions		
To classify the first twenty elements into solid, liquid or gas state, using the periodic table	<ul style="list-style-type: none"> <li>periodic table chart</li> </ul>	Display the chart on the board and guide learners to identify the elements according to their groups and periods and whether they are metals, and whether they are solid, liquid or gas at room temperature.	<b>No.</b>	<b>Element</b>	<b>State at room temperature</b>
			1	Hydrogen	Gas
			2	Helium	Gas
			3	Lithium	Solid
			4	Beryllium	Solid
			5	Boron	Solid
			6	Carbon	Solid
			7	Nitrogen	Gas
			8	Oxygen	Gas
			9	Fluorine	Gas
			10	Neon	Gas
			11	Sodium	Solid
			12	Magnesium	Solid
			13	Aluminium	Solid
			14	Silicon	Solid
			15	Phosphorus	Solid
			16	Sulfur	Solid
			17	Chlorine	Gas
			18	Argon	Gas
			19	Potassium	Solid
			20	Calcium	Solid

## Answers

### Unit questions

Learner's Book page 176

- An element is a substance that is made up of the same type of atoms. An atom has a nucleus and shells. The nucleus is in the centre and it contains the protons and neutrons. The electrons are on the shells around the nucleus.
- The list of the first twenty elements is as follows: hydrogen, helium, lithium, beryllium, boron, carbon, nitrogen, oxygen, fluorine, neon, sodium, magnesium, aluminium, silicon, phosphorus, sulfur, chlorine, argon, potassium and calcium.
- a** Sodium—Na; **b** Magnesium—Mg; **c** Copper—Cu; **d** Hydrogen—H; **e** Lithium—Li
- Carbon can be said to be the most common of the listed elements.
- We have only identified 118 elements (so far). However, we have many substances and compounds because elements have the ability to chemically combine (join together) to form different substances and compounds.

## Extension questions

*Learner's Book page 176*

- 1 **a** An atom is made up of different parts. The nucleus is a very small part of the atom (much less than 1 per cent) and the electron parts of the atom circle the nucleus. There is nothing else filling in the space that is being circled. Therefore it is said to be mostly empty space. This is verified by Ernest Rutherford's gold foil experiment.
- b** The inside of a pencil is made of carbon in the form of the mineral graphite.
- 2 Learners are expected to research the uses of the three elements. Various uses may be found. Some examples are: Helium: balloons, cooling medium for a range of technology, in space technology; Boron: in different forms boron is used in rocket fuel ignition, enamels in manufacturing, in flares; Nitrogen: fertilisers, nitric acid, nylon, dyes and explosives.

## Unit 8.2: Inside atoms

### Answers

#### Unit questions

*Learner's Book page 179*

- 1 Dalton, Thomson, Rutherford and Bohr
- 2 New Zealand physicist Ernest Rutherford proposed a nuclear model in which negatively charged electrons orbit a positive nucleus, with most of the atom being empty space. This was discovered in his famous gold foil experiment. Niels Bohr, a Danish physicist and assistant to Rutherford, extended Rutherford's model to include electron shells—regions in which a given number of electrons may move. James Chadwick (Great Britain) discovered the neutron.
- 3 The dough in the 'plum pudding' model represents the positive charges.
- 4 The sultanas and raisins represent the electrons (negatively charged) in the atom.
- 5 **a** The proton was discovered in 1914 by Ernest Rutherford from New Zealand. He did not name it until 1920.  
**b** The neutron was discovered in 1932 by James Chadwick of Great Britain.  
**c** The electron was discovered in 1897 by Sir Joseph John Thomson of Great Britain.
- 6 In Rutherford's famous foil gold experiment, when positively charged alpha particles were fired around the atom, most of them went easily through it. However, when they were again fired at the centre of the atom, they scattered. This led Rutherford to believe that the centre of the atom must be positively charged.
- 7 The particles that contribute most to the mass of an atom are protons and neutrons.
- 8 **a** An electron (-); **b** A neutron (0); **c** A proton (+)
- 9 An atom is made up of three subatomic particles. They are: protons and neutrons, which are found in the nucleus (centre of the atom), and electrons, which orbit around the nucleus on shells or energy levels. Atoms are described as being made up of empty space because a large part of them is made up of shells, which provide the pathways for the orbits of the electrons. This was discovered by Ernest Rutherford in his famous gold foil experiment, in which positively charged alpha particles were fired at an atom and most of them passed easily through part of the atom.

#### Extension question

*Learner's Book page 179*

Learners should refer to the timeline on page 177 of their Learner's Book as a starting point. Encourage them to use a range of resources to find more information than is provided in the Learner's Book. They could also investigate one or two of the significant developments on that timeline in more detail.

## Chapter review

### Answers

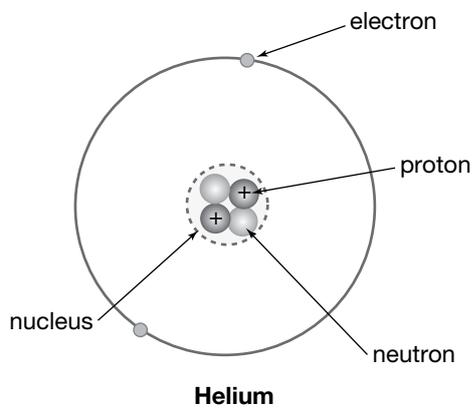
Learner's Book page 180

- 1 **a** C; **b** Al; **c** Au; **d** Sn  
 2 **a** Nitrogen; **b** Phosphorus; **c** Potassium; **d** Boron  
 3 The charge and relative size of the subatomic particles found in an atom are given in the table below.

Subatomic particles	Charge	Size	Where it is found in the atom
Proton	Positive (+)	1 AMU	Nucleus
Neutron	Neutral (no charge)	1 AMU	Nucleus
Electron	Negative (-)	0	Electron shell/energy levels

- 4 **a** True; **b** False; **c** False; **d** True

5



# Chapter 9: Microbes

## Strand: Life and living

**Suggested class time: 16 periods**

### Sub-strand statement

There are tiny living things called microorganisms, or microbes. Many of these microbes we cannot see with our eyes. However, we can see them through a microscope. There are five main groups of microbes—bacteria, fungi, protists, viruses and algae. These microbes have different methods of reproduction. Some cause diseases while others are useful to us. Those microbes that cause diseases are called germs. There are modern and traditional medicines for treatment of diseases caused by germs.

## General learning outcomes

Learners should:

- 8.9.1** know that all ecosystems have tiny living things called microorganisms (microbes)
- 8.9.2** be able to use a microscope and observe microbes
- 8.9.3** understand microorganism reproduction
- 8.9.4** know that some microbes are harmful and some are useful
- 8.9.5** be able to show the life cycle of the microbe that causes malaria
- 8.9.6** know the treatment of some diseases
- 8.9.7** appreciate the continuous work of scientists in the improvement of medicine and also our traditional ways of treating diseases.

## Specific learning outcomes

Learners should be able to:

- 8.9.1.1** identify examples of each of the five microbes: bacteria, fungi, protists, viruses and algae
- 8.9.2.1** demonstrate the correct use of a microscope
- 8.9.2.2** use a microscope to observe microbes in prepared slides and from water samples from a pond
- 8.9.2.3** classify microbes in the five main groups
- 8.9.3.1** explain different methods of microbe reproduction: **i** bacteria—binary fission; **ii** yeast—budding; **iii** virus—injecting DNA into the host cell
- 8.9.4.1** identify two examples of harmful bacteria, viruses, protists and fungi, and state the diseases they cause
- 8.9.4.2** identify two examples of useful bacteria
- 8.9.4.3** describe the useful bacteria in: **i** nitrogen fixation (converting nitrogen in the atmosphere into nitrates); **ii** fermentation (making of wine)
- 8.9.5.1** draw a simple diagram to illustrate the life cycle of the plasmodium (malaria parasite) in the human blood and liver
- 8.9.6.1** state the range of treatments for malaria: **i** modern treatments; **ii** traditional treatments
- 8.9.7.1** express the different tastes of the old malaria tablets compared to the new malaria tablets and traditional medicine.

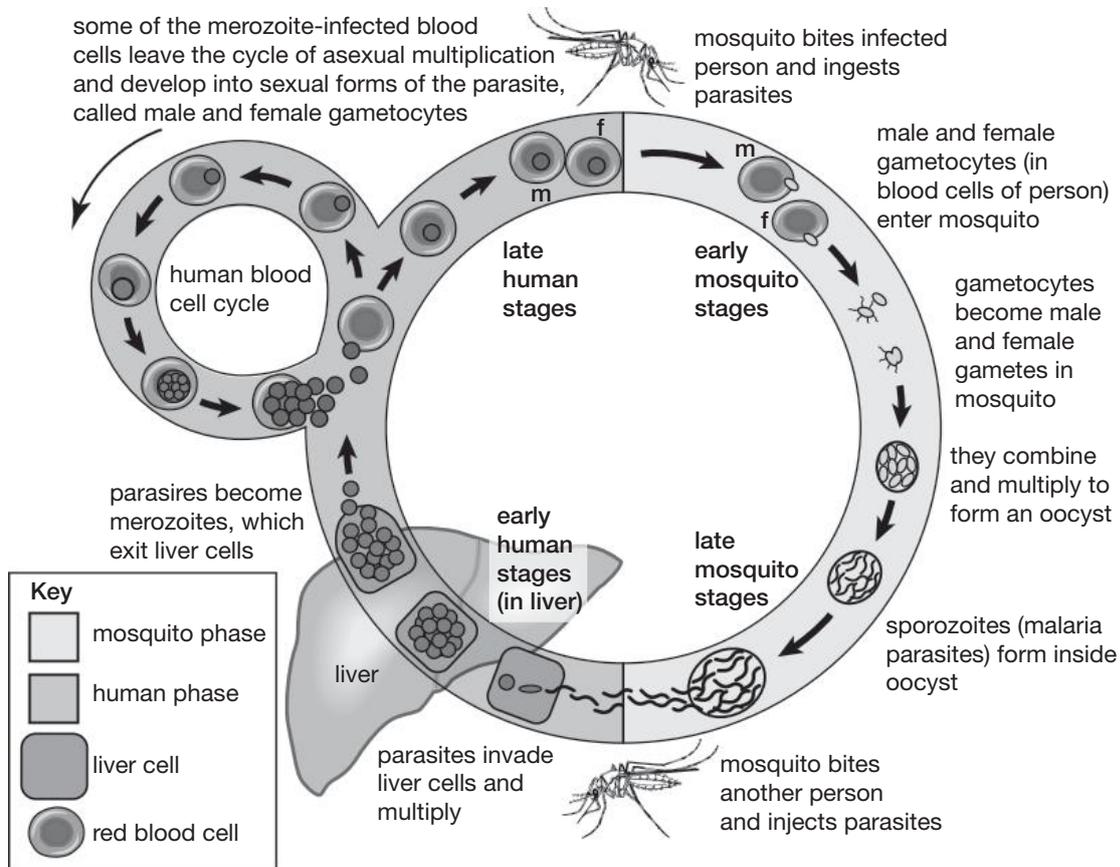
## Answers

### Suggested assessment events

*Solomon Islands Years 7–9 Science Syllabus*

- 1 **a** A microorganism is a very small organism that can be seen only through a microscope.
- b** A macro-organism is an organism that we can see with the naked eye.

2



### Challenge questions

*Learner's Book page 181*

- 1 A germ is a microbe that cause diseases.
- 2 Your toilet (provided it is washed every day)
- 3 Not unless the bacteria present are harmful
- 4 False
- 5 Our immune systems recognise the virus that causes chicken pox from the first attack. When the virus enters our bodies a second time, our immune system quickly produces the antibodies to destroy the virus.
- 6 Bacteria and fungi cause food to break down or decompose, and in the process toxic substances are produced that can make us sick.

## Unit 9.1: What is a microbe?

### Activity 1: Fun with fomites

*Learner's Book page 182*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To observe microbes found on fomites (a fomite is a non-living object, such as a pin, that can carry disease-causing microbes)	<ul style="list-style-type: none"> <li>• agar</li> <li>• sterile Petri dishes</li> <li>• sticky tape</li> <li>• permanent markers</li> <li>• cotton buds</li> <li>• antibacterial soap</li> </ul>	Bacteria are capable of reproducing very fast and in large numbers if conditions, such as availability of food, moisture and right temperature, are favourable. Growing bacteria on agar is a good way of observing bacterial growth. In this activity learners will be able to observe the growth of bacterial colonies, not individual bacteria.	<ol style="list-style-type: none"> <li>1 By comparing the growth of bacterial colonies on the agar plates the learners should be able to quantitatively determine which everyday object has the most bacteria.</li> <li>2 The presence or absence of bacterial colonies on the agar plates shows which objects are 'germ' free.</li> </ol>

### Activity 2: Bacteria and fungi under the microscope

*Learner's Book page 185*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To observe bacteria and fungi using a microscope	<ul style="list-style-type: none"> <li>• mouldy bread</li> <li>• agar plates</li> <li>• microscope and lamp</li> <li>• forceps</li> </ul>	<p>Handle microscopes with care. Carry out the observation yourself before the learners do the activity so you know what you expect the learners to see. Use low power to observe the bread mould fungus and bacterial colonies.</p> <p>Leave out the agar plate from Activity 1.</p>	<ol style="list-style-type: none"> <li>1 Learners should be able to observe the bread mould as consisting of many sporangia and masses of hyphae. Bacteria on the agar give off a bad smell but fungi grow on the agar plate with a mass of hypha.</li> <li>2 The bacteria on the agar plates can be seen as colonies not individual bacterial cells.</li> </ol>

### Activity 3: Observing fungi

*Learner's Book page 185*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To observe a variety of fungi	<ul style="list-style-type: none"> <li>• mushrooms, food mould</li> <li>• yeast solution</li> <li>• microscope</li> <li>• microscope slides</li> <li>• hand lens</li> </ul>	Fungi come in different forms and sizes. Some are big (macro) and can be seen with the naked eye, while others are very small (micro) and can only be seen with a microscope.	<ol style="list-style-type: none"> <li>1 Learners' responses will vary but should include that a mushroom has a cap of spores and mould consists of many sporangia and masses of hyphae.</li> <li>2 The description should point out that the mould consists of many sporangia and masses of hyphae.</li> </ol>

## Activity 4: Pond life

Learner's Book pages 186–187

Processes and skills	Resources	Teacher's support notes	Answers to questions
To observe and identify some protists present in pond water	<ul style="list-style-type: none"> <li>• pond water</li> <li>• droppers</li> <li>• microscope slides</li> <li>• cover slips</li> <li>• monocular microscope</li> <li>• probes</li> <li>• gelatin (3 g in 100 mL water)</li> <li>• neutral red or methylene blue stain</li> </ul>	<p>To get a good sample, you need stagnant water from a pool that has not been flowing well. If you have a swampy area or a creek, it is good to get water from there. Always try to get some debris into your bucket. It would also be good to get water from a strong flowing river. This should allow you to compare. Remember, water from a strong flowing river might not hold many protists.</p> <p>Consider the precautions outlined in the Learner's Book.</p>	<p><b>1</b> Learners should describe what they see in terms of their shape. They should also look for flagellum (tail-like structure), cilia (hair-like structure found around the edge of a protist) or a finger-like structure called pseudopodium protruding from the sides of the organism. These features also can help identify the protists. Refer to Figure 9.1.12 in the Learner's Book.</p> <p><b>2</b> Learners' responses will vary but should include the idea that pond water is not suitable for human consumption because it contains a lot of harmful organisms that can cause humans to become sick.</p> <p><b>3</b> Learners can calculate the size of the protists using the microscope magnification.</p>

## Answers

### Unit questions

Learner's Book pages 187–188

- 1 A microbe is any living organism that is too tiny to be seen with the naked eye. Microbes include bacteria and archaeobacteria, protists, some fungi and even some very tiny animals that are too small to be seen without the aid of a microscope. Viruses are also considered microbes. The term 'microbe' is short for 'microorganism', which means 'small organism'. Microbes are grouped or classified in various ways.
- 2 **a** False; **b** True; **c** False
- 3 Microscope and electron microscope
- 4 Bacteria, protists and viruses are usually not visible to the human eye, while many fungi are visible to the human eye.
- 5 A: ocular lens (eyepiece), B: objective lens, C: Stage, D: Diaphragm, E: Light source, F: Base, G: Arm, H: Coarse adjustment knob, I: Fine adjustment knob
- 6 In the range of 10 000 to 100 000 times
- 7 **a** Bacteria consist of a cell wall, cell membrane and *cytoplasm but have no nucleus*.  
**b** *Not all* bacteria cause disease.  
**c** Bacteria have *many shapes*.
- 8 Three types of bacteria, based on their shape, are: cocci (spherical), spirilla (spiral) and bacilli (rod).
- 9 Three types of fungi are:
  - multicellular filamentous mould—mould on bread
  - macroscopic filamentous fungus that forms a large fruiting body—the mushroom, which is just the part of the fungus we see above ground
  - single-celled microscopic yeast—yeast.

- 10** Fungi get their food from dead and decaying matter.
- 11** Protists are eukaryotes that are not fungi, plants or animals. This group includes a wide variety of organisms. Most protists are unicellular but some are multicellular. Molecular evidence suggests that protists include several different lineages. Some lineages are more closely related to fungi, plants or animals than they are to other protist groups. They live mostly in water.
- 12** Three ways in which protists move:
- Amoeba use pseudopods, or temporary foot-like extensions.
  - Euglena move with a whip-like tail called a flagellum.
  - Paramecium use tiny hair-like threads called cilia to propel themselves along.
- 13** Two protists monitored in drinking water—Giardia and Cryptosporidium—can cause diarrhoea and vomiting.
- 14** **a** True; **b** False; **c** False
- 15** Viruses do not reproduce through cell division, and do not display most of the characteristics of living organisms.

**16**

Characteristics	
Bacteria	Protists
Prokaryotes	Eukaryotes
Have no nuclear membrane	Nucleus contained inside a nuclear membrane
No mitochondria present	Presence of mitochondria
No chloroplasts present	Presence of chloroplasts in some protists

- 17** A virus is capable of building a new virus using its own genetic code, can survive in a host cell and contains DNA or RNA.
- 18** **a** Living cells of paramecium—observe with a light microscope; **b** Bacteria—observe with light microscope; **c** Virus—observe with electron microscope
- 19** This is because we continually touch a computer mouse or phone, so exposing these items to more microbes. While toilets are usually cleaned regularly with detergent, that is not done with phones or a mouse.
- 20** To get rid of any disease-causing microbes that may have landed on your hands.
- 21** **a** Petri dish C shows the highest level of bacteria, Petri dish A shows the second highest and Petri dish B shows the lowest.
- b** The result indicates that the door handle surface is contaminated or has the highest level of bacteria, followed by the desk surface. The pen surface is the least contaminated with bacteria.
- 22** **a** 1 mm = 0.0001 m; **b** 1 mm = 1000 000 nm

### Extension questions

*Learner's Book page 188*

- 1** **a** Learners' timelines will vary but should include some of the following information:
- 1609: Hans Janssen and his son Zacharias and Hans Lippershey invent microscope
  - 1665: Hook invents the modern compound microscope
  - 1930: Invention of the transmission electron microscope
- b** Learners' responses will vary but could include that Robert Hooke in 1665, first saw cells in cork; in 1930, scientists used TEM to observe detail and clear view of specimens.
- 2** Learners' responses will vary.

## Unit 9.2: Reproduction in microbes

### Activity 5: Fungal reproduction

*Learner's Book page 190*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To observe the stages of fungal reproduction	<ul style="list-style-type: none"> <li>• samples of mould</li> <li>• forceps</li> <li>• glass slides</li> <li>• stereo microscopes</li> <li>• disinfectant</li> </ul>	<p>Prepare the microscopes and explain the proper use of the instrument before learners use them. Remind learners to handle the instruments carefully.</p> <p>Collect samples of fungal reproduction the day before you carry out the activity.</p>	<ol style="list-style-type: none"> <li>1 Learners' responses will vary.</li> <li>2 The advantage of fungal reproduction is that the fungi spread quickly and can exist for longer periods of time when they reproduce through spores.</li> </ol>

### Activity 6: Budding yeast

*Learner's Book page 191*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To observe yeast cells reproducing by the process of budding	<ul style="list-style-type: none"> <li>• freshly made yeast and sugar solution</li> <li>• microscope slides</li> <li>• cover slips</li> <li>• probes</li> <li>• dropper</li> <li>• tissues</li> <li>• microscope</li> </ul>	<p>Prepare the equipment to be used during the activity before the class. Care must be taken during this activity because hot water and breakable items will be used. Remind learners to handle the instruments carefully.</p>	<ol style="list-style-type: none"> <li>1 Yeasts are protists.</li> <li>2 Sugar is a source of food for the yeast. Yeast needs sugar in order to grow.</li> <li>3 Learners' responses will vary but should include that yeast reproduces through a budding process.</li> <li>4 Learners' responses will vary but should include that budding reproduction is a very effective method of reproduction, as a very large number of cells can be produced in a very short time.</li> </ol>

## Answers

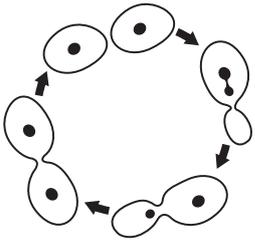
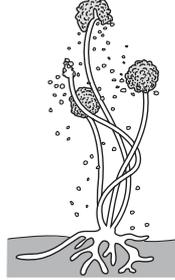
### Unit questions

*Learner's Book pages 193–194*

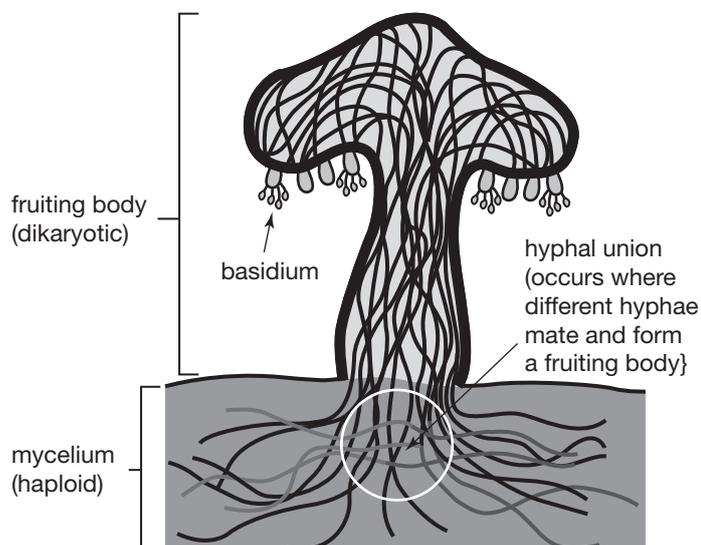
- 1 Parent cell: a cell that divides to give rise to two daughter cells

Daughter cell: a cell formed by division of a parent cell. The parent cell divides to form two daughter cells in the process of asexual reproduction.

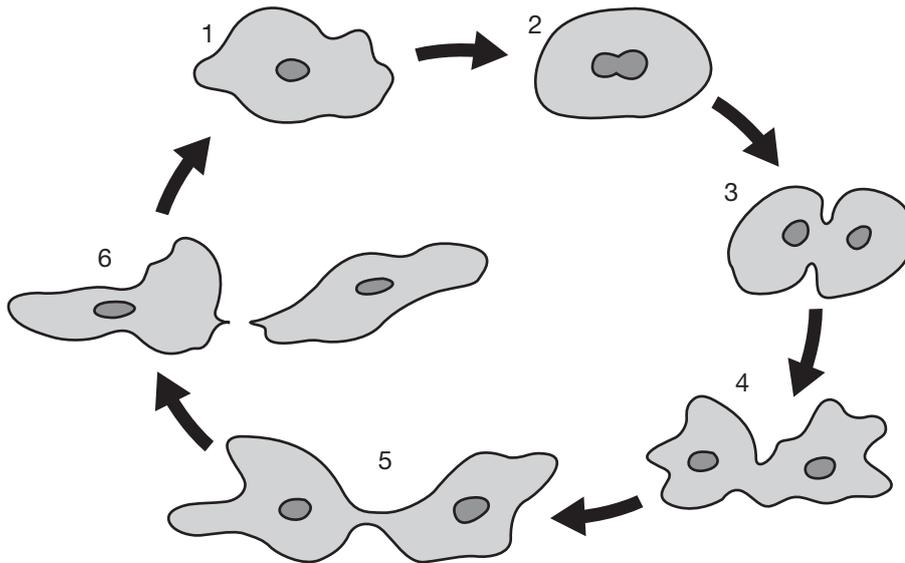
Antibiotic: an agent that inhibits bacterial growth or kills bacteria. The term now denotes a broader range of antimicrobial compounds, including anti-fungal and other compounds.

2 Some methods of asexual reproduction	
<p>Binary fission involves an equal division of the organism cytoplasm and the nucleus to form two identical organisms.</p> <p>The diagram of the protist at the right is an example of this.</p>	
<p>Budding involves one parent dividing its nucleus (genetic material) equally, but cytoplasm unequally.</p> <p>The diagram of a yeast at the right is an example of this.</p>	
<p>Sporulation (spore formation) is reproduction involving specialised single cells coming from one parent. The diagram of mould spores being formed at the right is an example of this.</p>	

- 3 Two individual cells are formed, each identical to the parents; Fast increase in population (exponential increase), identical to parents (same genes)
- 4 Moisture, warmth and food
- 5 Structure of a fungus:

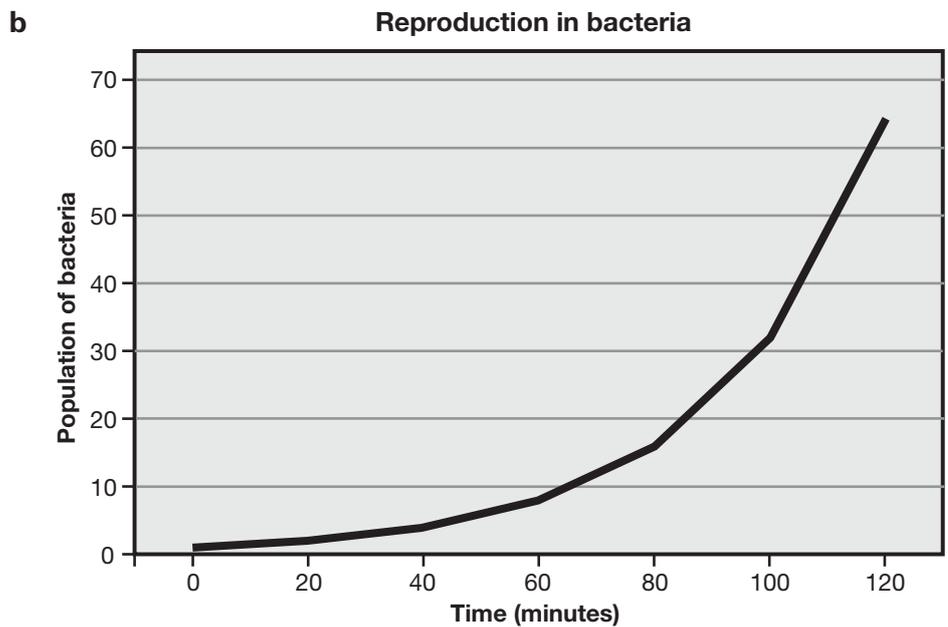


- 6** A hypha (plural: hyphae) is a long, branching filamentous cell of fungus. In fungi, hyphae are the main mode of vegetative growth, and are collectively called a mycelium.
- 7** Two ways in which fungi reproduce are by budding and by sporulation. Spores are produced that are like eggs—these are released and grow into new fungi, or pieces can break off and grow into new fungi.
- 8** The parent forms a bud which elongates, the parent's nucleus divides, and one nucleus migrates to the bud which separates as a new cell.
- 9** **a** Protists reproduce by a process known as binary fission.  
**b** Water that contains giardia is not safe to drink.
- 10** Flow diagram of how amoeba reproduce:



- 11** A host cell is a cell that harbours foreign organisms such as viruses or other microbes. Viruses are commonly found in host cells.
- 12** **a** False; **b** True; **c** True; **d** False
- 13** **a** After getting chicken pox for the first time, your body creates antibodies that attack the chicken pox virus if you come into contact with it again. The chicken pox virus is killed before it can make you sick again.  
**b** Vaccination involves injecting your body with a disabled or modified version of a particular virus. Your body responds to this by making antibodies to kill the real virus if you come into contact with it.
- 14** Microbes have survived over billions of years because they are able to evolve with changing environments. For example, they can survive in very extreme environments, such as very hot or cold weather. Their mode of reproduction has also enabled them to increase in population. For example, the asexual means of reproduction is very effective and can increase a population exponentially. Also, this means of reproduction enables microbes to retain good genes from their parent.
- 15** In the right conditions—a favourable temperature and sufficient nutrients—microbes can reproduce as often as every 20 minutes. This is not a simple serial process of one replacing another, but an exponential one, where there is a population explosion of microbes. This multiplication process can produce something the size of a sugar cube within a day or so. If allowed to continue, this exponential growth would result in a ball of microbes the size of the Earth within something like a week. However, in practice, the death and destruction rates of the microbes and the limit imposed by the availability of nutrients stops the microbial population getting out of hand. This is why the planet is not completely overrun.

- 16** a False; b False; c True
- 17** Bacteria contain the genetic blueprint and all the tools needed to reproduce themselves. However, viruses contain their own genetic blueprint but need to reproduce inside a host cell.
- 18** Most of the mushroom exists as hyphae growing into the food source. The part we see is only the small part called the sporangium.
- 19** a To compare the effectiveness of three mouthwashes in reducing oral bacteria  
 b Mouthwash 2 was not effective, as there was no reduction in the number of colonies counted after using this mouthwash.  
 c The mouthwash was contaminated with bacteria. Perhaps someone had been drinking it directly out of the bottle.  
 d Mouthwash 1 was the most effective as it reduced the level of bacteria the most.
- 20** a It will produce 64 bacteria in 2 hours (20 mins = 2 bacteria, 40 mins = 4 bacteria, 60 mins = 8 bacteria, 80 mins = 16 bacteria, 100 mins = 32 bacteria, 120 mins = 64 bacteria).



- c** Populations of bacteria increase very fast so if you have one bacterium in your body, this graph shows that you will have hundreds of them in a few hours.
- d** Learners will have to extrapolate the graph to find out how many bacteria there will be in 5 hours.

**Extension questions**

*Learner's Book page 194*

- 1** a The presence of food and moisture assists microbes to grow to a level that can cause food poisoning. Most foods are moist, so microbes grow well.  
 b Food usually becomes contaminated from poor sanitation or preparation. Food handlers who do not wash their hands after using the bathroom or have infections themselves often cause contamination. Improperly packaged food stored at the wrong temperature also promotes microbial growth. Food allowed to sit in sunlight for a long time; for example, fish for sale in the markets without proper storage (in ice) can easily become contaminated. When people buy contaminated food, they get food poisoning.  
 c Food must be properly stored, either in the freezer or away from flies or any carriers of microbes.
- 2** Learners' responses will vary.

## Unit 9.3: Friend or foe?

### Activity 7: Bread making

Learner's Book page 198

Processes and skills	Resources	Teacher's support notes	Answers to questions
To identify a suitable temperature for the action of yeast in bread making	<ul style="list-style-type: none"> <li>• yeast suspension</li> <li>• sugar</li> <li>• flour</li> <li>• a range of beakers</li> <li>• measuring cylinders</li> <li>• stopwatch</li> <li>• balance</li> <li>• graph paper</li> </ul> <p>(Yeast, sugars and flour are available in most shops.)</p>	<p>Before the learners begin this activity, perhaps a home economics teacher could show the class how to bake bread.</p> <ol style="list-style-type: none"> <li><b>1</b> Break the class into groups and allow each group to mix the yeast and sugar at a certain temperature. For example, one group can use room temperature, another 40°C, another 50°C and so on. Ensure that learners keep the following in equal amount: sugar, flour, yeast and volume of water to mix the dough. The only thing that changes is the temperature of the water used to mix the yeast and sugar.</li> <li><b>2</b> Learners mix the yeast with the flour just as they would for baking bread, then allow the flour to rise.</li> <li><b>3</b> Learners need to observe how long it takes the flour to rise. The faster the flour rises, the better the temperature at which they mixed the sugar and yeast.</li> <li><b>4</b> At the end of the activity, each group writes their results; that is, the temperature they used and how long it took for the flour to rise.</li> </ol>	<b>1–6</b> Learners' responses will vary.

## Answers

### Unit questions

Learner's Book page 199

- 1** **a** False; **b** True; **c** True
- 2** Learners' responses will vary but could include producing food and medicine, modifying organisms by genetic engineering, increasing soil fertility and decomposing waste.
- 3** **a** Learners should list two of the following: yeast, *Penicillium notatum* and truffles or mushrooms.  
**b** Yeast is used for making bread and alcohol, *Penicillium notatum* for making antibiotics. Truffles or mushrooms are used for food.
- 4** **a** Penicillin is an antibiotic that is produced by a *fungus*.  
**b** Alcohol is produced by *anaerobic respiration of yeast on grapes*.  
**c** Thrush, tinea and ringworms are caused by *different fungi*.
- 5** **a** Glucose + oxygen → carbon dioxide + water + energy  
**b** Glucose → alcohol + carbon dioxide + energy  
**c** Anaerobic respiration is also called fermentation.
- 6** Viruses can be used in genetic engineering to modify plant or animal genes. They can also be used to help cure cancers in the brain.

- 7** Anaerobic respiration uses no oxygen and produces alcohol, water, carbon dioxide and energy. Aerobic respiration uses oxygen and produces water and carbon dioxide and energy. Both require glucose to make energy.
- 8** Grapes are left to ferment in the absence of oxygen at 37°C. Yeast on the grapes feeds on the sugar in the grapes and produces alcohol as a waste product.
- 9**
- a** Yeast causes bread to rise by producing carbon dioxide gas.
  - b** Yogurt is made by bacteria that sour the milk.
  - c** Yeast causes fermentation, creating flavours and ethanol (and carbon dioxide in champagne).
  - d** Bacteria break down waste and make it safe. They recycle the waste and nutrients are released for other organisms.
  - e** Bacteria and fungi break down food scraps and release nutrients for other organisms to use.
- 10** Yeast is feeding on sugar in the bread dough and carbon dioxide is produced as a waste product. The bubbles of carbon dioxide are trapped in the dough and cause it to rise and look frothy.
- 11** Bacteria could consume the oil as food, turning it into a safe product.
- 12** The virus enters the cancer cell; it uses it as a host cell to reproduce. The cell is killed in the process and the new viruses go on to kill other cancer cells.
- 13** The bubbles in wine are allowed to escape. Champagne is fermented in the bottle so the bubbles are trapped.
- 14** Different bacteria produce different types of cheeses. Also, the length of time the bacteria are allowed to grow can affect the style and flavour of the cheese.
- 15**
- a** Disease-causing microbes affect society in many ways, such as: making people sick, causing loss of work time and productivity; causing the deaths of many people each year; creating business for drug companies; requiring us to practise good daily hygiene to stop the spread of disease.
  - b** Many answers are possible, such as: the flu (influenza) causes many people to miss work, bacteria and fungi cause many infections that require drugs.
- 16** Learners' responses will vary and either case could be justified as long as sufficient examples are chosen to support the argument.

### Extension questions

*Learner's Book page 199*

- 1** This is an open-ended question.
- a** Cheese is made from the milk of many different types of animals. The exact conditions imposed on the milk from different animals result in different textures and flavours, hence the variety in cheese. All processes that make cheese result from the following five steps:
    - Milk is warmed and a culture of beneficial bacteria is started.
    - A coagulant is added, such as rennet.
    - The milk is left to set, and then is cut, stirred and heated to form particular sized curds
    - The cheese is salted.
    - The cheese is aged.
  - b** Learners' responses will vary. Learners could be asked to research some of the different methods to produce particular types of cheese.
  - c** Learners' responses will vary. Particular fungi are only introduced into certain types of cheeses, for example blue cheese.
  - d** Temperature affects the type of beneficial microorganisms that can survive and multiply in the cheese. As a result, different types of cheese can be produced at different temperatures. Also, if the temperature goes below 4°C, pathogenic organisms can grow in the cheese and cause it to spoil.

- e** Hard and soft cheeses are produced by handling the curd in different ways. Soft cheeses have more whey (mostly water and protein) in them and have to be handled gently. Hard cheeses have more whey expelled. The exact method of having the whey expelled affects the texture and flavour of the cheese.
- 2 a** Making yoghurt is relatively simple. Milk must be boiled and then allowed to cool to about 40–45°C. Add a starter culture of yogurt bacteria (from natural yogurt bought from the store). Stir well, pour into a container and keep warm for 4 hours. Cool in fridge.
- b** In the process of making yogurt, milk is fermented. There are two bacteria used in the process of making milk. These bacteria consume lactose (the sugar in milk) and produce lactic acid. It is this process that makes yogurt thick.
- 3** There are thousands of entries on the United States Centers for Disease Control and Prevention website. These include bacterial, viral and fungal infections, parasites and non-infectious disorders. Important diseases include the common cold, ebola virus, viral or bacterial conjunctivitis, encephalitis, dengue fever, malaria, ear infections, septicemia and athlete's foot.
- 4** Fieldwork. If fieldwork is not possible, perhaps have a laboratory class to make yogurt or cheese; yogurt is much easier.
- 5** Use a nutrient or water agar to grow a number of different bacteria. It is important that each agar plate has only one type of bacterium present. Once pure bacterial colonies are present over much of the agar plates, place the antibiotic test rings onto the centre of the plate. If the antibiotic negatively affects the bacteria, the area around the test ring will become clear.

## Chapter review

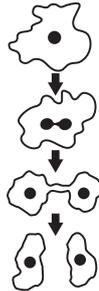
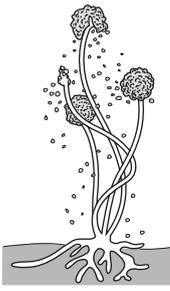
### Answers

Learner's Book page 200

1	Terms	Definition
	Microorganism	An organism of microscopic or sub-microscopic size, in the group of bacteria, protists, fungi or viruses
	Budding	A method of reproduction that occurs in yeast
	Binary fission	A method of reproduction that occurs in bacteria
	Fermentation	The anaerobic conversion of sugar to carbon dioxide and alcohol by yeast
	Antibiotics	A medicine (such as penicillin or its derivatives) that inhibits the growth of or destroys microorganisms
	Mould	Growth of hyphae of fungi that happens usually in moist conditions, especially on rotting woods or even old food
	Flagella	A very thin thread-like structure found in many protists that helps them to move or swim
	Fomite	Any non-living organism (eg towel or clothing) that is capable of transmitting infectious organisms such as bacteria or fungi
	Decomposition	Any organism such as a bacterium or fungus that breaks down dead tissues, enabling the constituents to be recycled in the environment

- 2 a** Protists are *single-celled organisms*.
- b** Light microscopes *cannot* be used to study viruses.
- c** Yeast reproduces by means of *budding*.
- 3** Anaerobic respiration is the ability of an organism to produce energy in the form of adenosine triphosphate (ATP) without using oxygen. Instead, sulfate, nitrate or sulfur is used. Organisms that use anaerobic respiration to produce energy start the process with glucose. Glucose is sugar, and the same sugar from the photosynthesis equation  $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$ . Organisms take glucose, and produce ethanol or lactic acid and  $\text{CO}_2$ , and energy.
- Glucose  $\rightarrow$  ethanol + carbon dioxide + energy
- $\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2 + \text{energy}$

4 Fungal reproduction:

<p>Budding involves one parent dividing its nucleus (genetic material) equally, but cytoplasm unequally. The diagram of a yeast at the right is an example of this.</p>	
<p>Sporulation (spore formation) is reproduction involving specialised single cells coming from one parent. The diagram of mould spores being formed at the right is an example of this.</p>	

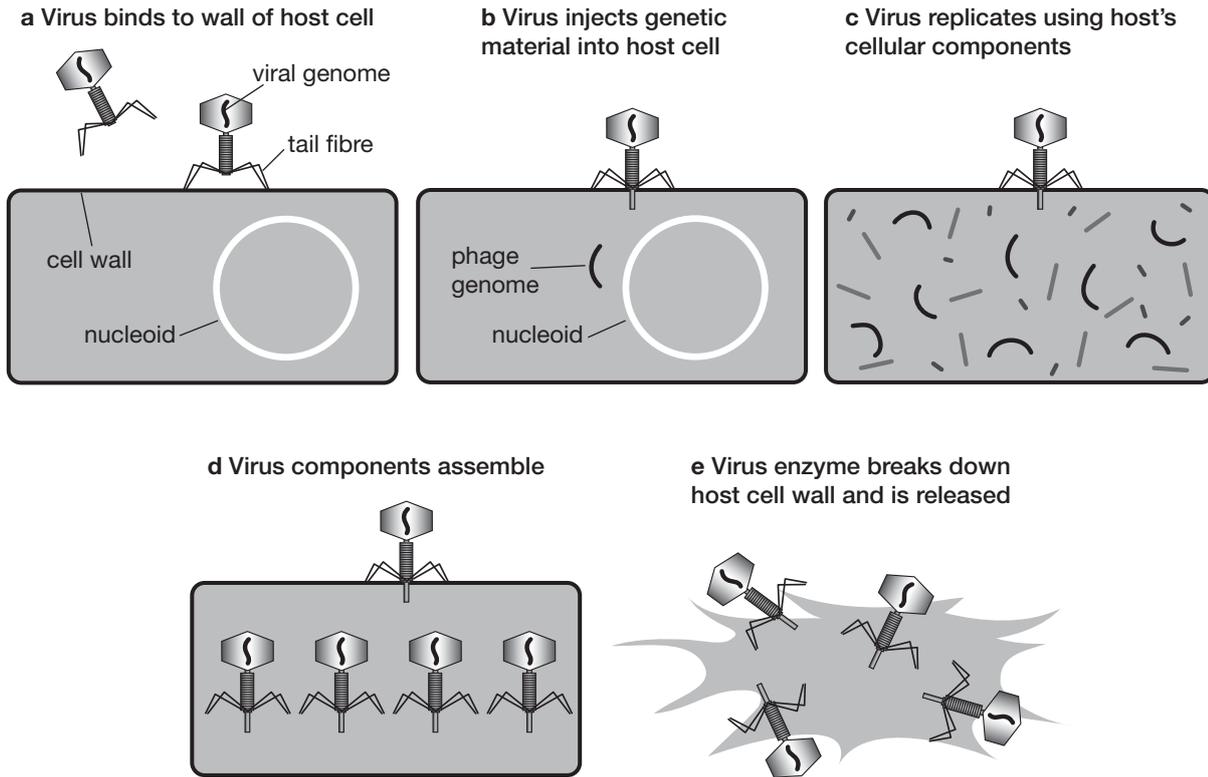
- 5 Wash hands with good detergent after experiment, wear mouth mask during experiment, use a fume cupboard.
- 6 Many answers are possible, eg penicillin made from mould.
- 7 A light microscope and a compound microscope

8

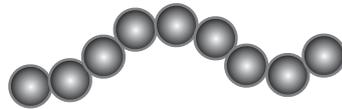
Microbe type	Example	Method of reproduction
Bacteria	<i>E. coli</i>	Binary fission
Fungi	Yeast	Budding
Protist	Amoeba	Binary fission
Virus	Influenza	Through host cells

- 9 *Paramecium*, amoeba
- 10 a Microbes floating around may land on the chicken and reproduce. Some of them might be disease-causing. Chicken is also a good medium for microbes to grow in.  
b Cold temperature can kill most microbes, therefore they cannot reproduce.
- 11 Warm temperature is a good condition for microbes to grow. So, if fish or meat is left in sunlight for a while, it will attract microbes, which will grow and increase in population.
- 12 a False; b False
- 13 Many examples: bacteria can be used to make food such as cheese and yogurt, but also cause many diseases, such as food poisoning.
- 14 Spa temperatures are usually around 35°C, which means that bacteria can reproduce very quickly in a spa. Chlorine levels therefore need to be checked regularly to ensure bacteria are controlled.
- 15 Binary fission needs only one cell, and daughter cells are identical to parent cell. It is also a very fast way to reproduce.
- 16 A cold is a viral infection, and once the virus has been in your system, you become immune to it if you have a healthy immune system. If you are exposed to the same virus, it will have no effect because your body already has defences against it. However, common cold viruses mutate quickly into new forms. The virus may change only a bit, but technically, you may contract a cold each year through a mutated strain of the same cold virus, or a different one of the many hundreds of cold viruses around at any given time.

17



- 18** Basic shapes of bacteria are:  
Cocci, which is a sphere-shaped bacterium



Bacilli, which is a rod-shaped bacterium

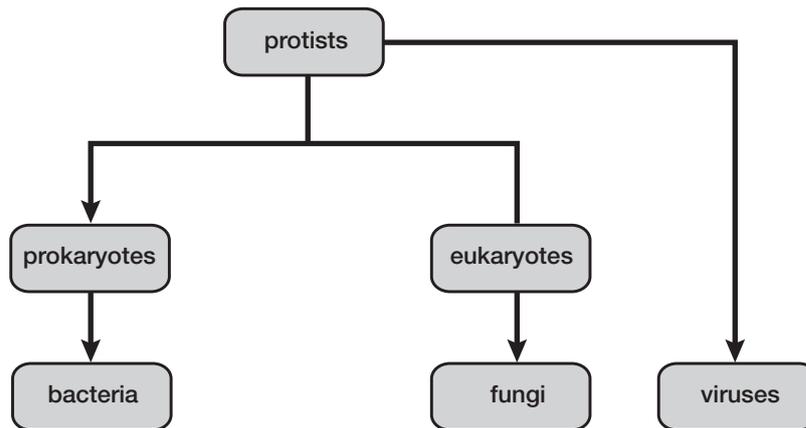


Spirilla, which is like a rod but can be squiggly



- 19** Yeast is used in baking as a leavening agent—it converts the fermentable sugars present in the dough into carbon dioxide. This causes the dough to expand or rise as the carbon dioxide forms pockets or bubbles. When the dough is baked it sets and the pockets remain, giving the baked product a soft and spongy texture. The use of sugar in a bread dough accelerates the growth of yeasts. Salt and fats such as butter slow down yeast growth. The majority of the yeast used in baking is the same species commonly used in alcoholic fermentation. In bread making, the yeast respire aerobically at first, producing carbon dioxide and water. When the oxygen is used up, anaerobic respiration is used, producing ethanol as a waste product. However, this is evaporated off during the baking process.
- 20** Bacteria are decomposers and break down organic substances. Many forms of rubbish that could release bad smells are broken down by bacteria.

21 Classification of four classes of microbes:



22 Using the scale given in the Learner's Book, 1 cm = 25 μm:

1 nm = 0.001 μm; Length of *Paramecium* = 7 cm

Therefore 7 cm × 25 μm = 175 μm

Change to nm: 175 μm/0.001 = 175 000 nm

23

Microbe type	Benefit	Problems and cost to society
Bacteria	Making food such as yogurt and cheese	Many are disease-causing and people can die from them. Cost to society as a lot of money for hospitalisation and medicine.
Fungi	Making bread (eg yeast)	Cause disease to humans. Cost to society in terms of medicine.
Protist	Many are photosynthetic and produce large amount of oxygen	Can cause disease to humans, eg amoeba. Cost to society in terms of medicine.
Virus	No benefits	Cause many diseases and illnesses that kill many people every year. Cost to society in medical research.

# Chapter 10: The periodic table

## Strand: Natural and processed materials

**Suggested class time: 16 periods**

### Sub-strand statement

This sub-strand introduces the periodic table to the learners. The periodic table is very important in the study of chemistry. The arrangement of the elements in the periodic table is special. Elements are placed in their column or row because of their properties. Columns in the periodic table are called 'group numbers', while rows are 'period numbers'. 'Mass number' indicates the total number of protons and neutrons in an atom. 'Atomic number' indicates the number of protons in an atom.

## General learning outcomes

Learners should:

- 8.10.1** know that the periodic table contains all elements found on Earth
- 8.10.2** know the background history of the periodic table
- 8.10.3** know the general arrangement of the periodic table
- 8.10.4** know the mass number and atomic number of an atom
- 8.10.5** show the arrangement of the electrons around the nucleus of an atom
- 8.10.6** understand that atoms combine to form molecules or compounds
- 8.10.7** appreciate that all materials around us are made of the elements listed in the periodic table.

## Specific learning outcomes

Learners should be able to:

- 8.10.1.1** explain that the periodic table is a special table, with names (symbols) of all the elements found on Earth
- 8.10.2.1** state that Dmitri Mendeleev first published the periodic table in 1869
- 8.10.3.1** state that, in the periodic table: **i** columns are 'group numbers'; **ii** rows are 'period numbers'; **iii** metals are generally on the left and non-metals are on the right
- 8.10.4.1** state that the mass number of an element is the number of protons plus the number of neutrons in an atom
- 8.10.4.2** state that the atomic number is the number of protons in an atom
- 8.10.5.1** draw the structure of the first twenty elements and write the electronic configuration of the atoms
- 8.10.6.1** explain the formation of simple molecules or compounds (using simple examples such as hydrogen  $H_2$ , oxygen  $O_2$ , carbon dioxide  $CO_2$  and water  $H_2O$ )
- 8.10.7.1** express that all things both living and non-living are made up of atoms.

		Group																	
		1	2											13	14	15	16	17	18
		I	II											III	IV	V	VI	VII	VIII
Period 1	1	H	2											5	6	7	8	9	2
		hydrogen												boron	carbon	nitrogen	oxygen	fluorine	helium
Period 2	3	Li	4											13	14	15	16	17	10
		lithium	beryllium											aluminium	silicon	phosphorus	sulfur	chlorine	neon
Period 3	11	Na	12											13	14	15	16	17	18
		sodium	magnesium											aluminium	silicon	phosphorus	sulfur	chlorine	argon
Period 4	19	K	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
		potassium	calcium	scandium	titanium	vanadium	chromium	manganese	iron	cobalt	nickel	copper	zinc	gallium	germanium	arsenic	selenium	bromine	krypton
Period 5	37	Rb	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
		rubidium	strontium	yttrium	zirconium	niobium	molybdenum	technetium	ruthenium	rhodium	palladium	silver	cadmium	indium	tin	antimony	tellurium	iodine	xenon
Period 6	55	Cs	56	57-71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
		caesium	barium	lanthanides	hafnium	tantalum	tungsten	rhenium	osmium	iridium	platinum	gold	mercury	thallium	lead	bismuth	polonium	astatine	radon
Period 7	87	Fr	88	89-103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
		francium	radium	actinides	rutherfordium	dubnium	seaborgium	bohrium	hassium	meitnerium	darmstadtium	roentgenium	copernicium	ununtrium	flerovium	ununpentium	livermorium	ununseptium	ununoctium
			Lanthanides																
			Actinides																

13	AI	aluminium
----	----	-----------

atomic number — 13  
symbol — AI  
name — aluminium

Transition

57	La	lanthanum
89	Ac	actinium

67	Ho	holmium
68	Er	erbium
69	Tm	thulium
70	Yb	ytterbium
71	Lu	lutetium

99	Es	einsteinium
100	Fm	fremium
101	Md	mendelevium
102	No	nobelium
103	Lr	lawrencium

**KEY**

- Non-metals
- Metals
- Metalloids

The latest periodic table is reproduced on page 114 of this Teacher's Guide for teachers to copy or write up on the board. This periodic table is more recent than the table in Figure 10.2.2 of the Learner's Book. It includes two new elements, livermorium and flerovium.

The periodic table in this Teacher's Guide also shows the groups numbered in roman numerals (I to VIII), as well as the more universally used Arabic numerals (1 to 18):

- Group I = Group 1
- Group II = Group 2
- Group III = Group 13
- Group IV = Group 14
- Group V = Group 15
- Group VI = Group 16
- Group VII = Group 17
- Group VIII = Group 18

The Arabic numerals are to be preferred.

Note that the transition metals are not specifically labelled in Figure 10.2.2 in the Learner's Book, so make sure that learners understand where these metals are located on the periodic table.

## Answers

### Suggested assessment events

*Solomon Islands Years 7–9 Science Syllabus*

- 1 Mass number equals the number of protons plus the number of neutrons. Atomic number is the number of protons.
- 2 Learners could focus on a range of differences: metals and non-metals are in different sections of the periodic table. They have different properties, such as their conductivity and malleability.

### Challenge questions

*Learner's Book page 201*

- 1 Learners' responses will vary. They may include aluminium, lead, tin, silver, copper. Learners may also mention alloys such as steel.
- 2 Learners' responses will vary. A correct image may be like Figure 10.1.1 on page 202 of the Learner's Book.
- 3 Learners' responses will vary. There are 118 known elements but only 98 of these occur naturally—the rest are synthetic and must be made in a laboratory.
- 4 Symbols are a universal language for elements and it is simpler to write in balanced equations.
- 5 These are based on Latin names. For example, Fe, the symbol for iron, is based on the Latin word for iron, *ferrum*.
- 6 H<sub>2</sub>O is water. H<sub>2</sub>O<sub>2</sub> is hydrogen peroxide. Hydrogen peroxide is dangerous and completely different chemically. Fish swim in water.
- 7 They were mixing chemicals in an attempt to create different substances, often valuable substances such as gold. Their activity was often related to magic or powers, not scientific research.

## Unit 10.1: Atoms and elements

### Activity 1: Making a compound

Learner's Book page 204

Processes and skills	Resources	Teacher's support notes	Answers to questions
To prepare the compound carbon dioxide	<ul style="list-style-type: none"> <li>• 2 test tubes</li> <li>• test-tube rack</li> <li>• drinking straw</li> <li>• two 1-hole rubber stoppers with glass tubing</li> <li>• limestone/coral</li> <li>• 2M hydrochloric acid</li> <li>• safety glasses</li> </ul>	<p>Carbon dioxide can be produced by reacting an acid with a carbonate. In this activity, coral or limestone is used as the source of calcium carbonate.</p> <p>NB: If rubber stoppers with glass tubing are not available, learners can simply pour the carbon dioxide produced into the test tube containing the limewater (being very careful that they don't spill the acid).</p> <p>If safety glasses are not available, ensure that learners take extra care when handling acid. If it does spill on their fingers they must wash them in plenty of water.</p> <p>In schools that don't have continuous running water in the laboratory, ensure that extra water is available before you carry out the experiment. And let the learners know where you have placed the extra water.</p> <p>In this activity teachers should remain in the laboratory until the experiments are done. Learners must not be allowed to do the experiment by themselves.</p>	<p><b>1</b> Carbon dioxide</p> <p><b>2</b> The gas produced in parts A and B turns the limewater milky. This shows that the gas produced is the same.</p> <p><b>3</b> Carbon dioxide gas is a compound. Its components cannot be separated by physical means. The components, carbon and oxygen atoms, are also combined in a definite ratio.</p>

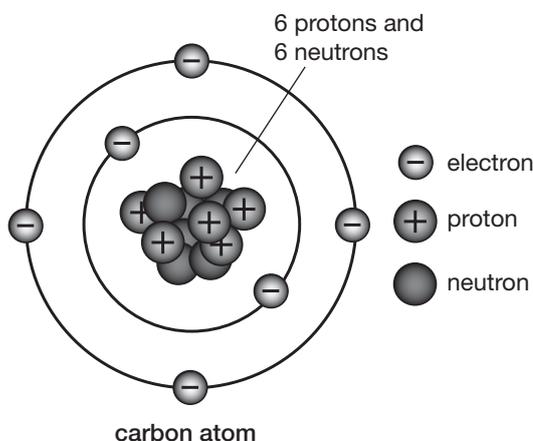
### Answers

#### Unit questions

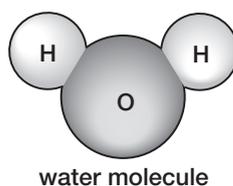
Learner's Book pages 205–206

- 1** a  $e^-$ ; b  $p^+$ ; c n; d  $e^-$ ; e  $p^+$  and n; f  $e^-$
- 2** An atom is made up of a central core called the nucleus, containing protons and neutrons. Electrons move around the nucleus in orbits.
- 3** The number of protons in an atom is equal to the number of electrons.
- 4** a The atomic number of an element is equal to the number of protons in an atom of that element.  
b The mass number is equal to the sum of the protons and neutrons.  
c The nucleus is the central core of an atom.
- 5** Fe: 26 protons, 26 electrons, 30 neutrons  
Ni: 28 protons, 28 electrons, 31 neutrons  
Cu: 29 protons, 29 electrons, 35 neutrons  
Au: 79 protons, 79 electrons, 118 neutrons

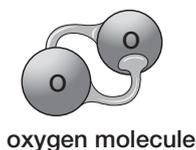
- 6** You need to know the atomic number and mass number of that element.
- 7** The smallest unit of an element is an atom. Atoms contain subatomic particles called protons, neutrons and electrons.
- 8 a** Dalton's atomic theory is outlined as follows:
- All matter is made up of atoms.
  - The atoms cannot be split into smaller particles.
  - An element is made up of one type of atom only.
  - Atoms join together in definite ratios.
- b** Dalton's second point above was found to be incorrect, as the atom can now be split into its subatomic particles.
- 9** An atom is the smallest unit of an element that can exist on its own. A molecule is made up of two or more atoms joined together.
- 10 a** An atom of carbon. Carbon usually does not exist in nature as single carbon, but as graphite or diamond.



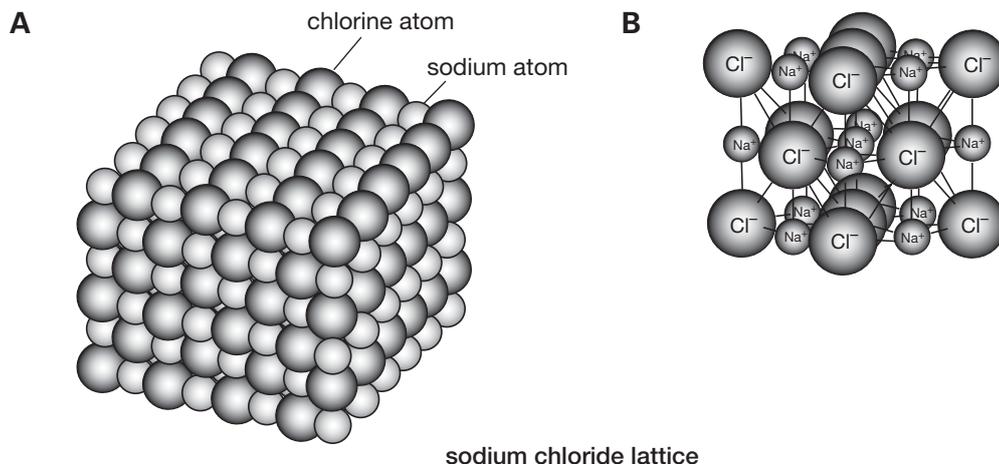
- b** A molecule of water. The water molecule is one of the most stable molecules in existence and is called a universal solvent because of its ability to dissolve many compounds.



- c** A molecule of oxygen. The oxygen molecule is a diatomic molecule. Oxygen is very important for all living cells. Organisms need oxygen for cell respiration, and without it, cannot survive.



- d** The lattice of sodium chloride. The bigger ball is the chlorine atom and the smaller one is the sodium atom. They are held together by a strong electrostatic force, as in diagrams A and B.



- 11** Compounds are formed when the atoms of two or more elements are joined together during a chemical reaction.
- 12 a** Examples of compounds are water, sugar, carbon dioxide.  
**b** Water: Rivers, streams, lakes, oceans, fruits  
 Sugar: Fruits, sweet drinks, cake, ice-cream  
 Carbon dioxide: Air
- 13** A mixture can be identified if the components can be separated by evaporation, distillation, decantation, filtration etc. For example, a mixture of fresh water and salt can be identified by boiling the mixture. The water will evaporate and the salt will remain behind.
- 14** A chemical formula shows the ratio in which the atoms of different elements are combined. A glass of cordial is a mixture. There is not a definite ratio in which the atoms are combined, hence a formula could never be written.
- 15 a** The mass number is usually bigger than the atomic number of an *element*; **b** Statement is correct; **c** Statement is correct; **d** Statement is correct; **e** A molecule is *not* the same as a lattice.
- 16 a** Lead, Pb: element, contains only one type of atom; **b** Nitric acid,  $\text{HNO}_3$ : compound, can't be separated by physical means; **c** *Note: this question number has not been used in Learner's Book*; **d** Ammonia,  $\text{NH}_3$ : compound, can't be separated by physical means; **e** Peanut butter: mixture, can be separated by physical means; **f** Sea water: mixture, can be separated by physical means
- 17 a** Compound; **b** Lattice; **c** Atom; **d** Molecule; **e** Mixture

- 18 a** An element is made up of one type of atom only, while a compound is made up atoms of two or more elements joined together.
- b** The element iron contains millions of iron atoms, while an atom of iron refers to a single atom.
- c** The compound water contains millions of water molecules, while a molecule of water refers to a single molecule of water.
- d** A compound is made up of two or more elements combined, while a mixture is made up two or more substances mixed together.
- e** Different atoms make up a molecule.
- 19 a** 1 atom of sulfur, 2 atoms of oxygen
- b** 2 atoms of hydrogen, 1 atom of sulfur
- c** 12 atoms of carbon, 22 atoms of hydrogen, 11 atoms of oxygen
- d** 2 atoms of hydrogen, 1 atom of sulfur, 4 atoms of oxygen
- e** 2 atoms of carbon, 4 atoms of hydrogen, 2 atoms of oxygen

**20**

Atoms	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Symbol for atom
Carbon	6	12	6	6	6	$^{12}_6\text{C}$
Sulfur	16	32	16	16	16	$^{32}_{16}\text{S}$
Sodium	11	23	11	12	12	$^{23}_{11}\text{Na}$
Oxygen	8	16	8	8	8	$^{16}_8\text{O}$
Fluorine	9	19	9	10	9	$^{19}_9\text{F}$
Iodine	53	127	53	74	53	$^{127}_{53}\text{I}$

- 21** Learners build the models using pieces of different fruit joined together by toothpicks.

### Extension question

*Learner's Book page 206*

Learners use any canned food/soft drinks and food packages available in the local store.

Ingredients in Weet-Bix shown in Figure 10.1.9 of the Learner's Book are:

Element	Compound	Mixture
Iron	Wheat Sugar Salt Vitamins	Malt extract

## Unit 10.2: Arranging the elements

### Activity 2: Comparing elements

*Learner's Book page 209*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To examine the physical and chemical properties of some common elements	<ul style="list-style-type: none"> <li>• samples of sulfur, aluminium, carbon, silicon, tin, zinc, lead, magnesium, calcium and iron</li> <li>• steel wool</li> <li>• 3 to 4 test tubes and rack</li> <li>• power pack about 2 V or 2 V × 1.5 V dry cells</li> <li>• wires with alligator clips</li> <li>• light globe</li> <li>• safety glasses</li> </ul>	The apparatus can be set up as shown in the Learner's Book if power pack and ammeter are available. However, you can improvise by connecting two 1.5 V dry cells together and using a light bulb to test for the conductivity of the materials.	<p><b>1</b> Learners' responses will vary. They should find that elements in the same group have some similarities. In the metals (aluminium, tin, zinc, lead, magnesium and iron) there would be some properties that you expect to be similar. These include:</p> <ul style="list-style-type: none"> <li>• shiny when polished</li> <li>• sinks</li> <li>• good conductor of electricity</li> <li>• hard</li> <li>• malleable.</li> </ul> <p><b>2</b> Learners' responses will vary. In the non-metals (calcium, sulfur, carbon and silicon) some properties that you would expect to be similar are:</p> <ul style="list-style-type: none"> <li>• dull</li> <li>• floats</li> <li>• bad conductor of electricity</li> <li>• brittle.</li> </ul> <p>However, silicon is a metalloid, so it may slightly conduct and have some properties that cross over.</p>

### Answers

Make sure that learners understand the preferred periodic table group numbering (Arabic numerals) before they attempt the unit questions. Revise the transition metals with them also. Refer to the periodic table on page 114 of this Teacher's Guide.

### Unit questions

*Learner's Book page 210*

- John Newlands, Dmitri Ivanovich Mendeleev, Henry Moseley
  - John Newlands: Arranged the elements in order of increasing atomic number.  
Mendeleev: Arranged the elements in order of increasing atomic mass and put known families in vertical columns.  
Henry Moseley: Refined the periodic table. He suggested that the physical and chemical properties of the elements were related to the atomic number rather than the mass number.

- 2 Mendeleev left some gaps in his periodic table to accommodate elements with properties that fitted into that particular family of elements but were yet to be discovered.
- 3 **a** Horizontal rows in the periodic table are *periods*.  
**b** Vertical columns are called *groups*.  
**c** The most reactive metallic atom is *francium, Fr*.  
**d** The most reactive non-metallic atom is fluorine, F.  
**e** The transition elements are all metals.
- 4 Cl: chlorine, non-metal  
 Na: sodium, metal  
 Ar: argon, non-metal  
 Si: silicon, semi-metal  
 Cu: copper, metal  
 Ge: germanium, semi-metal
- 5 Boron, silicon, germanium, arsenic, antimony, tellurium, polonium, astatine
- 6 C, N, O, F, P, S, Cl, Se, Br, I
- 7 Iron, copper, zinc, tin, lead, nickel
- 8 Groups 1, 2 and 13
- 9 Appearance, melting point, boiling point, density, hardness
- 10 **a** Oxygen, sulfur, selenium; **b** Sodium, magnesium, aluminium; **c** Any three elements in Groups 1, 2, 13, 14, 15, 17 or 18 **d** Any three elements that are not mentioned in the groups mentioned above, such as helium, neon and krypton, which are all in Group 18.
- 11 **a** Copper; **b** Gold; **c** Tungsten; **d** Bromine; **e** Lead
- 12 Fe. It is derived from the Latin word *ferrum*.
- 13 From the Latin name *plumbum* for the metal lead. Lead was once used to make plumbing pipes.
- 14 **a** Mass number 4; **b** Mass number 37; **c** Mass number 58
- 15 Learners' responses will vary but they should be encouraged to create a timeline or table as shown below and fill it out with information from page 207 of the Learner's Book and/or other sources.

Year	Name of scientist	Contribution to development of the periodic table
1864	John Newlands	Arranged the 60 or so known elements in order of increasing atomic mass
1869	Dmitri Ivanovich Mendeleev	Arranged the known elements in order of atomic mass, putting the known 'families' into vertical columns
etc.		

## Extension questions

*Learner's Book page 210*

- 1 The element named after Mendeleev is Mendeleevium. Learners should summarise aspects of his life and his discoveries.
- 2 Learners could choose any element. More obscure elements have been discovered more recently and may have less information.
- 3 Encourage learners to choose some specific elements and choose some specific properties to look up, such as conductivity, reactivity, malleability, acidity and solubility. Learners could be provided with a table to create information in as they go.
- 4 Learners can compare any of the features, including how the groups and periods are linked and what elements are missing.

## Unit 10.3: Discovery of the elements

### Answers

#### Unit questions

*Learner's Book page 213*

- 1** Learners' responses should focus on the lack of knowledge about chemistry and elements in 1750. Elements had not been defined at this stage and the background of chemical make-up was not understood.
- 2** Water turbines
- 3**
  - a** Quantitative: a measurement is based on numbers or calculations, not on a description or classification.
  - b** The relative atomic mass is also called the atomic weight. This is calculated as one-twelfth of the mass of the carbon-12 atom.
- 4**
  - a** Discussions may include comments such as: some elements are less common than others; some are used for less common purposes; some are only found during extensive mining and therefore not easily visible; some might be only found in trace quantities within other compounds.
  - b** These lists might include aspects such as: how the element exists; what it is in; whether it can be extracted using mining techniques; whether it is ever found in a pure state.
- 5** Research could include any of the scientists listed in this chapter so far (some of the following are from Unit 10.2): Dmitri Mendeleev, John Newlands, Henry Moseley, Julius Lothar Meyer, Alessandro Volta, Sir Humphry Davy, Robert Boyle, Antoine Lavoisier.

## Unit 10.4: The role of electrons

### Activity 3: Ions get together!

Learner's Book page 216

Processes and skills	Resources	Teacher's support notes	Answers to questions
To construct models of ionic compounds using an ion jigsaw	Photocopy or redraw jigsaw pieces (Figure 10.4.4 of Learner's Book)	Copy the image onto light cardboard, so the pieces are less likely to be damaged when they are cut up. You will need multiple copies of each to make sets. Provide three pages for each learner.	<p><b>1</b> Overall charge in each case when matched should be neutral.</p> <ul style="list-style-type: none"> <li>Sodium fluoride: 1 of each puzzle will mean neutral charge</li> <li>Sodium oxide: <math>\text{Na}_2\text{O}</math>—2 sodium for each oxygen will mean a neutral charge overall</li> <li>Sodium nitride <math>\text{Na}_3\text{N}</math></li> <li>Magnesium fluoride <math>\text{MgF}_2</math></li> <li>Magnesium oxide <math>\text{MgO}</math></li> <li>Magnesium nitride <math>\text{Mg}_3\text{N}_2</math></li> <li>Aluminium fluoride <math>\text{AlF}_3</math></li> <li>Aluminium oxide <math>\text{Al}_2\text{O}_3</math></li> <li>Aluminium nitride <math>\text{AlN}</math></li> </ul> <p><b>2</b> The formula can be worked out from the following:</p> <ul style="list-style-type: none"> <li>The metal is written first. This is the element that has a positive charge.</li> <li>The non-metal is written second—element with the negative charge.</li> <li>The number of elements to use is the opposite of each.</li> <li>For aluminium oxide there is a 3+ charge on aluminium and a 2- charge on oxygen. The amount needed of each is the opposite number (so 2 aluminium and 3 oxygen needed).</li> </ul>

### Answers

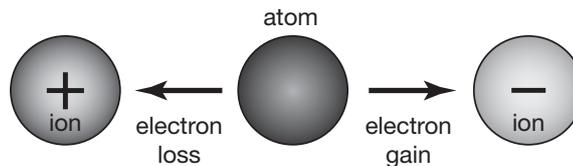
Make sure that learners understand the preferred periodic table group numbering (Arabic numerals) before they attempt the unit questions. Revise the transition metals with them also. Refer to the periodic table on page 114 of this Teacher's Guide.

### Unit questions

Learner's Book pages 217–218

- Energy levels are shells in which the electrons spin.
- There are four electron shells. The first shell can have a maximum of 2 electrons, the second shell a maximum of 8, the third shell a maximum of 18 but happy with 8, and the fourth shell a maximum of 32 but happy with 8.
- The electron configuration of an atom shows how the electrons are arranged in the shells surrounding the nucleus of the atom.

- 4 For an atom of magnesium, 2 electrons occupy the first shell, 8 electrons the second shell and 2 electrons the third shell.
- 5 **a** Atoms in the same group all have the same number of electrons in their outermost shell.  
**b** Atoms in the same period all have the same number of shells filled with electrons.
- 6 Elements in Group 18
- 7 Atoms that react do not have the outermost shell completely filled with electrons, while atoms that do not react have an outermost shell completely filled with electrons.
- 8 A chlorine atom is neutral. The number of protons is equal to the number of electrons. A chlorine ion is negatively charged. It has gained an electron. There is one more electron than protons. Chlorine becomes a negative ion after losing its ion to a sodium atom.
- 9 A sodium ion forms when the sodium atom loses an electron. It is positively charged.
- 10 Atoms become positive ions when they lose electrons. They become negative ions when they gain electrons.



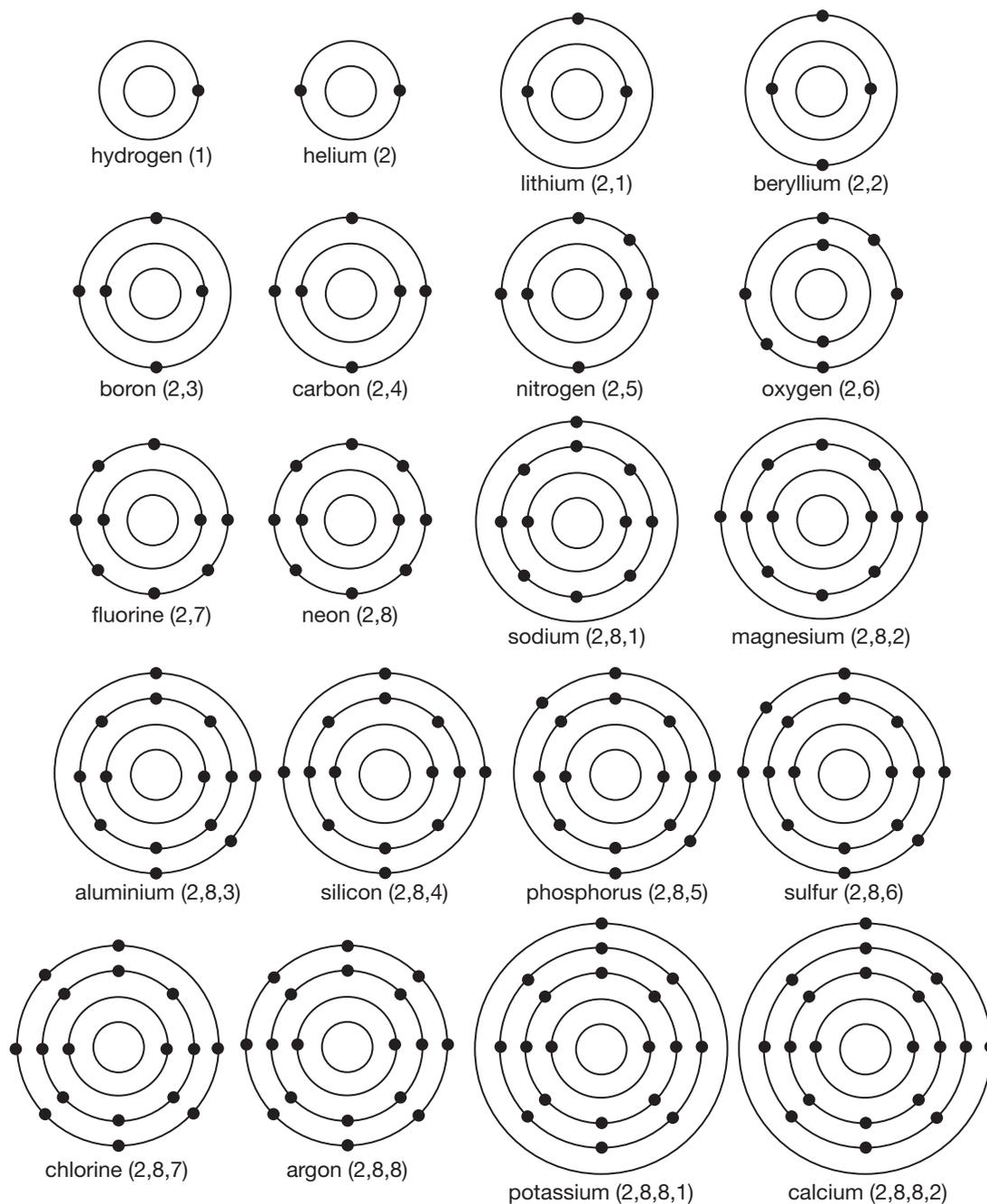
11	Positive ions	Symbol
	Sodium	Na <sup>+</sup>
	Calcium	Ca <sup>2+</sup>
	Magnesium	Mg <sup>2+</sup>
Negative ions		
	Chlorine	Cl <sup>-</sup>
	Oxygen	O <sup>2-</sup>
	Fluorine	F <sup>-</sup>

- 12 Noble gases neither gain nor lose electrons.
- 13 Sodium chloride has no overall charge because the positive sodium ion cancels out the negative chlorine ion.
- 14 **a** Period 2, Group 14; **b** Period 3, Group 16; **c** Period 2, Group 15; **d** Period 3, Group 15; **e** Period 3, Group 2; **f** Period 2, Group 18 (This question might be best done in class, as learners may find it difficult.)
- 15 **a** 2,6; **b** 2,8,8; **c** 2; **d** 2,8,2; **e** 2,8,6 (This question might be best done in class, as learners may find it difficult.)
- 16 The neutrons are neutral. They do not have charges; therefore they do not affect the overall charges of ions.
- 17 **a & b**

Atomic number	Element (name and symbol)	Number of protons	Number of electrons
7	Nitrogen (N)	7	7
8	Oxygen (O)	8	8
18	Argon (Ar)	18	18
3	Lithium (Li)	3	3
19	Potassium (K)	19	19
9	Fluorine (F)	9	9
12	Magnesium (Mg)	12	12
15	Phosphorus (P)	15	15
13	Aluminium (Al)	13	13

Name of element	Electronic configuration	Ionic charge
Oxygen	2,6	-2
Argon	2,8,8	No charge
Lithium	2,1	+1
Potassium	2,8,1	+1
Fluorine	2,7	-1
Magnesium	2,8,2	+2
Phosphorus	2,8,5	-3
Aluminium	2,8,3	+3

d



**18** The completed table is below. Here is some information you may use to assist learners as they fill it out.

- Overall charge depends on the number of electrons and the number of protons.
- When the number of protons is greater than the number of electrons, the overall charge is positive.
- When the number of protons is less than the number of electrons, the overall charge is negative.
- When the proton number is equal to the electron number, the overall charge is zero (0).
- If overall charge is zero, it is an atom.
- If overall charge is either positive or negative, it is an ion.
- Symbol is obtained from the atomic number or the number of protons—since the atomic number is equal to the number of protons.

Number of protons	Number of neutrons	Number of electrons	Overall charge	Is it an atom or an ion?	Symbol
8	6	8	Neutral	Atom	O
10	10	10	Neutral	Atom	Ne
11	10	10	+1	Ion	Na <sup>+</sup>
17	16	18	-1	Ion	Cl <sup>2-</sup>
15	15	18	-3	Ion	P <sup>3-</sup>
19	18	18	+1	Ion	K <sup>+</sup>
20	19	18	+2	Ion	Ca <sup>2+</sup>
8	7	10	-2	ion	O <sup>2-</sup>

### Extension question

*Learner's Book page 218*

Help learners by building simple models together or in groups. Ask leading questions as you do the activity: How do you know this goes here? What do you need in this shell for this element? How many shells do you need? To physically build the model, learners should work together to make sure the parts hang where they should.

## Chapter review

Make sure that learners understand the preferred periodic table group numbering (Arabic numerals) before they attempt the chapter review questions. Revise the transition metals with them also. Refer to the periodic table on page 114 of this Teacher's Guide.

### Answers

*Learner's Book pages 218–219*

- 1 Refer to Figure 10.2.2. Learners should create a periodic table with the basic elements they need to know in this stage of their education and colour the groups in for the four parts (transition, semi-metals, non-metals and noble gases).
- 2 The first holds up to 2 electrons, second holds 8, third holds up to 18 but often only fills to 8, and fourth holds up to 32 but often only fills to 8.
- 3 Period number = number of shells used; group number = number of electrons in outer shell

	Metal	Non-metal
Electrical conductivity	High	None or limited
Heat conductivity	High	None
Shine	Lustrous	Dull
Able to be bent	Malleable	Crumbles
Melting/boiling points	Relatively high	Low

- 5 A chlorine atom is neutral, with equal numbers of protons and electrons. A chloride ion is a chlorine atom that has gained an electron and is now charged.
- 6 **a** +3; **b** -1; **c** -2; **d** 0; **e** +2; **f** -3
- 7 **a** False; **b** False; **c** False; **d** True; **e** True; **f** False; **g** False; **h** False; **i** True; **j** True; **k** True; **l** False; **m** False; **n** True
- 8 Elements in the same group have the same number of electrons in their outer shell, will form similar ions and can be expected to act in a similar way in chemical reactions.
- 9 Non-metals have higher electronegativity than metals.

10

Atom	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Atomic symbol
Sulfur	16	32	16	16	16	${}_{16}^{32}\text{S}$
Hydrogen	1	1	1	0	1	${}_{1}^1\text{H}$
Beryllium	4	9	4	5	4	${}_{4}^9\text{Be}$
Iodine	53	127	53	74	53	${}_{53}^{127}\text{I}$
Nickel	28	59	8	1	8	${}_{28}^{59}\text{Ni}$

- 11 Helium has outer shell electrons like Group 2 elements, but has properties like the inert (noble) gases in Group 18. It can sometimes be placed in both positions on the periodic table. Hydrogen has one outer shell electron, similar to elements in Group 1, but has different properties as it is a very light atom and a gas.
- 12 The size and weight of elements increase as we move down any group.
- 13 Assist learners to construct a table like the one below and complete it with information from page 177 of the Learner's Book and/or other information sources.

Year	Name of scientist	Contribution
350 BC	Ancient Greeks	Believed that atoms were solid balls of matter
1808	John Dalton	Supported the idea of atoms as solid balls
1864	John Newlands	Arranged 60 elements in increasing atomic mass
1869	Dmitri Mendeleev	Arranged elements in order of atomic mass and created families with vertical columns
1868–69	Julius Lothar Meyer	Constructed a table to compare physical properties of elements
	Henry Moseley	Created the final modern periodic table

- 14 **a**  $17\text{p}^+$ ,  $17\text{e}^-$  and  $18\text{n}$   
**b**  $1\text{p}^+$ ,  $1\text{e}^-$  and  $2\text{n}$   
**c**  $79\text{p}^+$ ,  $79\text{e}^-$  and  $118\text{n}$
- 15 *Note: this question number has not been used in Learner's Book.*
- 16 If a potassium atom meets a fluorine atom, the potassium atom will probably lose an electron to the fluorine atom, becoming the ions  $\text{K}^+$  and  $\text{F}^-$ . They form a lattice,  $\text{KF}$ .
- 17 The outer electrons are exposed to attack from other atoms and thus will control what the atom does in a chemical reaction.
- 18 Carbon forms a molecule,  $\text{CCl}_4$ , so family resemblances suggest that the compounds  $\text{SiCl}_4$ ,  $\text{GeCl}_4$ ,  $\text{SnCl}_4$  and  $\text{PbCl}_4$  would form.

# Chapter 11: Electricity

## Strand: Energy and change

**Suggested class time: 12 periods**

### Sub-strand statement

This sub-strand deals with electricity. An object is electrically charged when it has more electrons than protons. Rubbing materials together causes electrons to move between the materials. Charged objects generate electrical force. Electrical charges move in a complete circuit. Most household appliances use electricity. It is important to take great care when using household appliances to avoid electrical accidents.

## General learning outcomes

Learners should:

- 8.11.1** know that an object can be electrically charged by friction
- 8.11.2** understand that electrons move in a wire in a circuit
- 8.11.3** appreciate that safety is very important in handling electrical appliances
- 8.11.4** be able to show that electricity is very expensive in Solomon Islands.

## Specific learning outcomes

Learners should be able to:

- 8.11.1.1** state that static electrical charge is produced by rubbing different materials together:  
**i** comb and hair; **ii** ruler and arm
- 8.11.2.1** explain the flow of electrons in a simple electric circuit
- 8.11.2.2** illustrate the flow of electrons using a simple circuit
- 8.11.3.1** state safety measures for handling household appliances: **i** TV and video deck; **ii** urn or heater; **iii** radio and amp speakers; **iv** rice cooker; **v** hair clipper
- 8.11.4.1** determine the average cost of using electricity for a month in several households in Honiara and other provincial centres: **i** obtain a reading from an electricity bill; **ii** obtain a reading from 'cash power'.

## Answers

### Suggested assessment events

*Solomon Islands Years 7–9 Science Syllabus*

- 1** The components of a circuit are: battery, wires, bulb, ammeter, voltmeter.
- 2** We have to be very careful in using electricity as it may cause fires. There is great danger of electrocution from handling live wires carelessly. In most homes, accidents are due to defective wiring, defective electrical appliances and improper use of electrical equipment. Note:
  - Faulty electrical appliances and equipment must be properly handled and repaired promptly.
  - Proper maintenance of electrical wiring and fuses is essential. Fuses should not be replaced with ones of higher amperage or with thick wires or tin foils.
  - Disconnect electrical gadgets when not in use.
  - Store all electrical appliances properly in a safe place and guard them from children.
  - Faulty electrical wires or cords should never be used.
  - Electrical gadgets should be repaired only by a qualified person.
  - Appliances such as electric irons should be switched off when not being used.

- Ventilation holes in a television set should never be covered, as this could generate enough heat to cause a fire.
- Short-circuiting in electrical wires may also start a fire.
- In case of a fire caused by electricity, first the current should be cut off and only then steps taken to extinguish the fire.
- All adults should learn how to use the main switch for the electricity supply to their house.
- Children should be given proper training in the handling of electrical appliances.
- Electrical equipment should never be touched with wet hands.
- When working with electricity, you should not stand on metal, wet concrete or wet ground. It is wiser to stand on a rubber mat or a dry wooden platform.
- Broken electrical wires caused by storms can be dangerous. You should stay away from them until the current is switched off or disconnected, and call for help.

### Challenge questions

*Learner's Book page 220*

- 1 Electricity is a collection of charges that move. Charges are carried by wires or cables and used to provide heat.
- 2 Sometimes you get zapped (shocked) when you rub your shoes on carpet because you become charged. Rubbing removes electrons from shoes, making them positively charged, while the carpet gains electrons, becoming negatively charged.
- 3 Lightning is caused by a large amount of charge moving between the clouds or between clouds and the ground. When the electrostatic attraction is strong in the charge build-up between the water droplets and air molecules, the area between the clouds and the Earth's surface acts as a conductor. That allows the charges to move down from the clouds and causes the lightning we see and the thunder we hear.
- 4 A wet cell battery consists of sulfuric acid and plates or electrodes made of lead and lead oxides.  
A dry cell battery consists of wet manganese dioxide, ammonium chloride jelly and a carbon rod.
- 5 AC is alternating current, DC is direct current.  
AC current flows forwards and backwards, 50 times every second. DC current flows one way.
- 6 False. You do not necessarily need a lot of electricity to be electrocuted.
- 7 Insulated switches, double insulated cables, insulated plugs and adaptors

## Unit 11.1: Static electricity

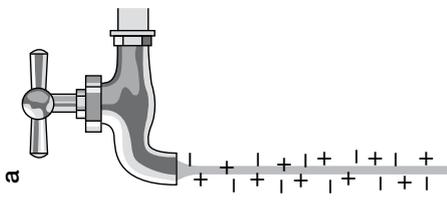
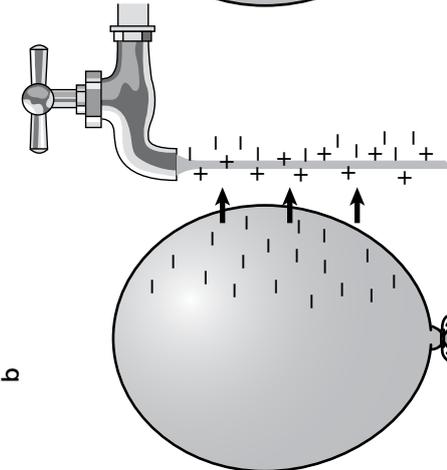
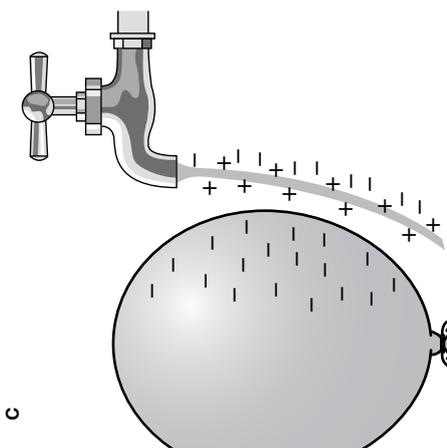
### Activity 1: Positives and negatives

*Learner's Book page 221*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate static electricity	<ul style="list-style-type: none"> <li>• 2 perspex (acetate) and 2 polythene rods or strips</li> <li>• 2 dry woollen cloths</li> <li>• watch-glass</li> <li>• Blu-Tack or plasticine</li> </ul>	Static refers to stationary charges. They only move upon disturbance, such as when rubbing one object with another object.	<ol style="list-style-type: none"> <li>1 Combination that produced attraction: perspex–polythene Combination that produced repulsion: Like charges attract and unlike charges repel each other.</li> <li>2 <b>a</b> Negative; <b>b</b> Negative; <b>c</b> Positive</li> <li>3 The use of a new cloth with the polythene rod is important to ensure that polythene does not have the same charge as perspex. The cloth must not be charged. New cloth is neutral.</li> </ol>

### Activity 2: Static magic

Learner's Book page 223

Processes and skills	Resources	Teacher's support notes	Answers to questions
<p>To electrostatically charge a balloon and pen</p>	<ul style="list-style-type: none"> <li>balloon</li> <li>plastic pen</li> <li>woollen scarf or other garment</li> <li>tap (a thin stream of running water)</li> </ul>	<p>Electricity works because electric charges push and pull on each other. There are two types of electric charge: positive and negative. Similar charges repel each other. This means that if you put two positive charges close together and let them go, they will move apart. Two negative charges also repel. But different charges attract each other. This means that if you put a positive charge and a negative charge close together, they will smack together. A short way to remember this is the phrase 'opposites attract, likes repel'.</p> <p>A charged balloon will stick on the smooth wall because of the attraction of the charged balloon and the neutral wall. A charged pen can also attract a thin stream of running water.</p>	<p><b>1</b> When a balloon is rubbed on a woollen garment for a minute the balloon becomes charged. It attracts the smooth wall when let go. In the same way, when a pen is rubbed against a woollen garment, the pen becomes charged. It also attracts a thin stream of running water.</p> <p><b>2</b> Learners draw diagrams to support their answers to Question 1. For example:</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p><b>a</b></p>  <p>neutrally charged stream of water</p> </div> <div style="text-align: center;"> <p><b>b</b></p>  <p>negatively charged balloon pushes away negative charges in water leaving one side more positively charged</p> </div> <div style="text-align: center;"> <p><b>c</b></p>  <p>stream of water is then attracted towards the balloon</p> </div> </div>
			<p><b>Extension question:</b> If a balloon becomes negatively charged, a way of finding whether the charge produced on a rubbed pen is positive or negative is to place the charged balloon and a pen close to each other and observe any movement. If they attract then the pen is positive; if they repel then the pen is negative. You can also use an electroscope to find the charge on the rubbed pen.</p>

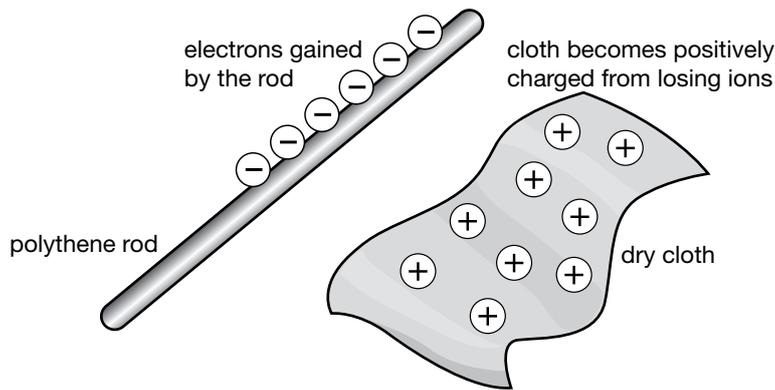
**Activity 3: Making an electroscope***Learner's Book pages 223–224*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To make an electroscope and test for the presence of an electrostatic charge	<ul style="list-style-type: none"> <li>• glass jar</li> <li>• aluminium foil</li> <li>• thick wire</li> <li>• card</li> <li>• tape</li> <li>• various rods (glass, polythene, ebonite)</li> <li>• various cloths (wool, cotton, synthetic)</li> </ul>	An electroscope is used to detect electrostatic charge. Charge can be observed using the leaf of the electroscope.	<p><b>1</b> When the electroscope is charged, it can detect charge on any object. When a charged object is moved close to the cap, the electroscope's indicator (generally called 'the leaves', as the basic model came from the gold-leaf electroscope) will rise or fall to show the charge. Learners' diagrams should look like Figure 11.1.8 in the Learner's Book. Touching a charged object on the cap will charge the electroscope.</p> <p><b>2</b> The rod and cloth that produce the largest electric field will be those for which the indicator moves the most.</p> <p><b>3</b> The electroscope is a simple tool to detect charge. Learners' ideas about what could be used in everyday situations will vary. The electroscope was used to measure charge before more advanced techniques were developed, so they may not be able to come up with many usages for today.</p>

**Answers****Unit questions***Learner's Book pages 226–227*

- 1 a** Negative [-]; **b** Positive [+]
- 2 a** The number of protons is equal to the number of electrons.  
**b** More protons than electrons on a positively charged object  
**c** More electrons than protons on a negatively charged object
- 3** Electrostatic forces are the forces of attraction or repulsion between the charges.
- 4** An induced charge is created in an object when another charged object is nearby or held close but does not actually touch it. The charge is created in the other object because of the charge in the first object. Refer to Figure 11.1.7 in the Learner's Book.

5

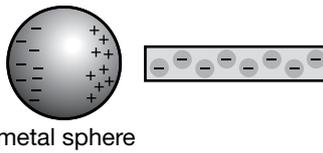


- 6 Static electricity is charge that is not moving. ‘Static’ means ‘not moving’.
- 7 A negative charge is built up at a metal dome. The Van de Graff generator uses a belt to transfer negative charges to the dome.
- 8 Aircraft refuelling and photocopying
- 9 Lightning and carpet static
- 10 A field is the invisible force line surrounding a charged object.
- 11 The direction of an electric field is the direction that a small positive charge would move if it was free to do so. In other words, electric field is always directed from positive to negative charge.

	Positive charge	Negative charge	Neutral
Positive charge	Repel	Attract	No force
Negative charge	Attract	Repel	No force
Neutral	No force	No force	No force

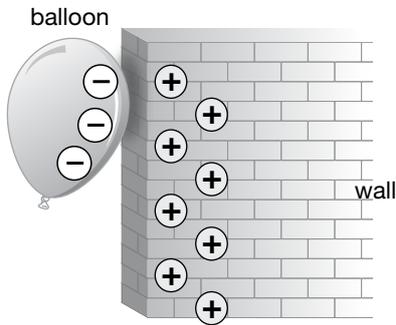
- 13
  - a The point spreads out nicely because of the electrostatic attraction between the positively charged paint and the negatively charged panels.
  - b The paint is given an opposite charge from the metal panel so that the paint will attract the panel.
- 14 Learners’ responses will vary. Two examples of how electric charge may be produced are: rubbing materials together, for example water droplets and air molecules; through a chemical reaction in a battery.
- 15 The mirror becomes charged through the rubbing, and the charge attracts dust.
- 16 When the person touches the metal dome, electrons transfer to the person’s body, where they repel themselves on the hair and make it stand. When the person stands on the rubber mat, electrons leave the body.
- 17 A spark is more likely to jump to your finger than your forehead when you approach a charged Van de Graff generator because charges tend to concentrate on sharp corners and spread out more over flatter surfaces.
- 18 Tearing a polythene shopping bag removes electrons and causes the pieces to be charged. The polythene pieces are negative, and your finger is positive, so they attract.
- 19 Static electricity is lost in water vapour on wet or humid days. On a dry day the static charges have nowhere to dissipate easily, so the static electricity is more obvious.
- 20
  - a A positively charged object contains *more positive charges than negative charges*.
  - b A neutral object *has equal numbers of positive and negative charges*.
  - c Correct statement
  - d An object may become charged *if electrons are rubbed onto or off it*.
  - e Lightning is caused when a build-up of charge within a cloud jumps between clouds or from the cloud to the ground.
- 21 An electric field is the electrostatic force from positive to negative charges, while a magnetic field is the force from north to south.

22

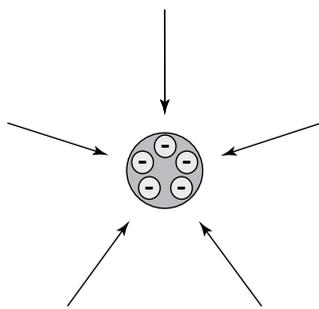


23 The electrons travel along the belt and into the dome, creating a charge in the dome.

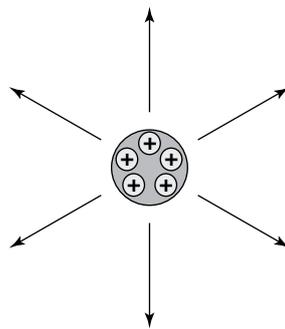
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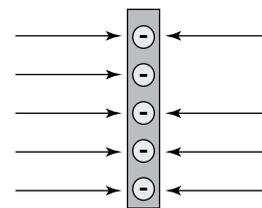
25 a



b



c



## Unit 11.2: Moving electricity

### Activity 4: A lemon cell

Learner's Book page 228

Processes and skills	Resources	Teacher's support notes	Answers to questions
To construct a cell using a lemon	<ul style="list-style-type: none"> <li>galvanometer or microammeter</li> <li>copper and zinc plates</li> <li>lemon</li> <li>2 connecting wires</li> </ul>	A lemon can act as a battery when two electrodes are dipped into it.	<p><b>1</b> In this activity, the acid comes from lemon. The acid is citric acid.</p> <p><b>2</b> In Step 4 of the activity the current will:</p> <p><b>a</b> increase when the copper and zinc plates are pushed further into the lemon</p> <p><b>b</b> decrease when the distance between the copper and zinc plates is increased</p> <p><b>c</b> increase when the lemon is squeezed, either because more charge is generated as more citric acid is available, or because squeezing the lemon creates better contact with the plates.</p> <p><b>3</b> The current will increase because:</p> <p><b>a</b> more ions (charge) will be attracted to the larger area of the plates</p> <p><b>b</b> more ions (charge) are present.</p> <p><b>4</b> Lemons linked together to produce a larger current became a battery, which consists of many cells.</p>

## Activity 5: Conductors and insulators

Learner's Book pages 230–231

Processes and skills	Resources	Teacher's support notes	Answers to questions
To test various materials and classify them as conductors or insulators	<ul style="list-style-type: none"> <li>• 1.5 V cell</li> <li>• 2.5 V mounted globe</li> <li>• 3 connecting wires</li> <li>• various materials, such as a nail, coin, plastic, glass, wood, cloth, metal pieces, paper, rubber and steel wool</li> </ul>	Materials that are made of metal are good conductors while non-metal materials are insulators.	<ol style="list-style-type: none"> <li>1 Materials that make the globe light up are conductors of electricity. Materials that do not make the globe light up are insulators.</li> <li>2 If the light globe does not light up, the material is an insulator, because insulators do not carry charge or ions around a circuit.</li> <li>3 The fact that rubber does not conduct electricity easily means that it is an insulator.</li> </ol>

## Activity 6: A mini water heater

Learner's Book page 232

Processes and skills	Resources	Teacher's support notes	Answers to questions
To construct a mini water heater and observe the heating effect while varying the voltage	<ul style="list-style-type: none"> <li>• Nichrome wire (20 cm)</li> <li>• power pack (12 V)</li> <li>• 250 mL beaker</li> <li>• stopwatch</li> <li>• connecting wires</li> <li>• water</li> <li>• thermometer</li> </ul>	<p>Energy from the power pack (electrical energy) is transferred to water, which is then heated. Electrical power is equal to voltage <math>\times</math> current. Increasing the voltage will increase the power, which also increases electrical energy.</p> $E = VI$	<ol style="list-style-type: none"> <li>1 Most of the energy is transferred to heat the nichrome wire, which in turn transfers to the water through conduction.</li> <li>2 Learners' responses will vary.</li> <li>3 Learners' responses will vary.</li> <li>4 The temperature would remain at 100°C when boiling until all the water changed into steam.</li> </ol>

## Answers

### Unit questions

Learner's Book page 234

- 1 Components needed to get an electric current energy flowing are: energy sources such as batteries, conductors, a globe or motor, and a switch to turn the current on and off.
- 2 TV, light globe, freezer, fan, heater, iron, hi-fi system, video deck, mobile phone charger and rice cooker
- 3 **a** Moving electric charge, the rate of flow of charge  
**b** Amount of energy available to push charge around circuits
- 4 **a** Ammeter; **b** Voltmeter
- 5 Torch light, tape record, mp3 player, TV remote control, portable disc player
- 6 A chemical reaction between the plate and sulfuric acid in a cell or battery provide current.

- 7 A dry cell would be best suited to a heart pacemaker.
- 8 The plates are made of lead, which is heavy.
- 9 The car battery goes flat if the car is not used often because the battery needs charging and is charged when the car is running.
- 10 A conductor is a material that can conduct electricity, eg copper or other metals. An insulator is a material that does not allow the flow of electricity, eg plastic, rubber, wood.
- 11 Oxygen is replaced by other gases in a light globe to avoid combustion. Usually an inert gas such as argon or neon is used.
- 12 Electrons lose most of their energy on the resistor.
- 13 Copper, because it has less resistance than tungsten.

14

Current electricity	Water
Charge	Water particles
Current	Water flow
Batteries	Pump
Connecting wire	Pipe line
Globe	Shower, sink, toilet
Switch	Tap

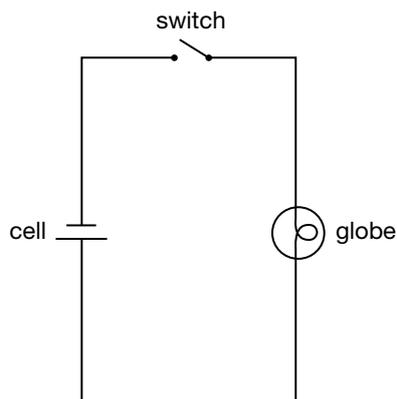
- 15 To prevent current flowing through the tools to their bodies if they accidentally touch a 'live' circuit.
- 16 A cell is a single unit, while a battery is a group of cells connected together.
- 17 a 1.5 V DC; b 240 V AC; c 12 V

18

Good conductor	Good insulator
Aluminium	Wood
Iron	Plastic
Zinc	Rubber
Silver	
Carbon	

- 19 Refer to Figure 11.2.8 on page 231 of the Learner's Book for the answer.

20



- 21 All the circuits in the figure are equivalent when the switch is closed.

### Extension questions

*Learner's Book page 235*

- 1–5 Learners' responses will vary.

## Unit 11.3: Using electricity

### Activity 7: Series and parallel circuits

*Learner's Book page 236*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To construct a series and a parallel circuit	<ul style="list-style-type: none"> <li>• Two 2.5 V globes</li> <li>• 4 connecting wires (eg with alligator clip ends)</li> <li>• 2 connection posts</li> <li>• 1.5 V dry cell</li> </ul>	Connecting the globes in series means the globes will all share the voltage or the power supply. The current is the same no matter how many globes are connected but, because they share the voltage, the brightness of the globes when in series is reduced.	<ol style="list-style-type: none"> <li>1 The brightness of globes in series is much lower or dimmer than that of a single globe. The reason is that the voltage is shared between the globes.</li> <li>2 The brightness of the globes in parallel is much the same as that of the single globe. This is because the voltage is the same.</li> <li>3 <b>a</b> Removing a globe in a series combination will cut the circuit. <b>b</b> Removing a globe from a parallel combination does not affect the other globes.</li> <li>4 In a series circuit the cell will go flat quickly, because the voltage is shared, compared with a parallel circuit, in which the voltage is the same.</li> </ol>

### Activity 8: Connecting ammeters and voltmeters

*Learner's Book pages 237–238*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To measure the voltage and current in series and parallel circuits	<ul style="list-style-type: none"> <li>• Two 2.5 V globes</li> <li>• 6 connecting wires (eg with alligator clip ends)</li> <li>• 1.5 V dry cell</li> <li>• ammeter</li> <li>• voltmeter</li> </ul>	Ammeters are used to measure current and must be connected in series. Voltmeters are used to measure voltage and must be connected in parallel.	<ol style="list-style-type: none"> <li>1 The current will be: <b>a</b> the same; <b>b</b> different at different points.</li> <li>2 The voltage will be: <b>a</b> different; <b>b</b> the same.</li> </ol>

## Answers

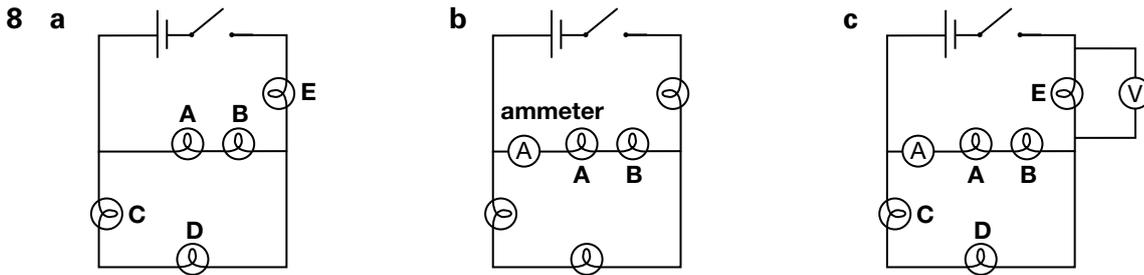
### Unit questions

*Learner's Book pages 239–241*

- 1 In a series circuit, two or three globes are connected or arranged one after the other in line with the batteries.  
In a parallel circuit, two or more globes are connected with separate branches between the same points.
- 2 Missing words: voltage, current, voltage, current
- 3 **a** The lights will still glow; **b** None of the lights will glow.
- 4 **a** True; **b** False; **c** True
- 5 Use insulated plugs and cable; turn off the switch when lifting the heater; unplug the cable before lifting the heater.

6 a Circuits A and C; b Circuit B

7 a Globe B; b Globe A; c Globe D; d Globe C; e Globes A, B, C and D



9

Switch 1 at position	Switch 2 at position	Light
A	X	ON
B	X	OFF
A	Y	OFF
B	Y	ON

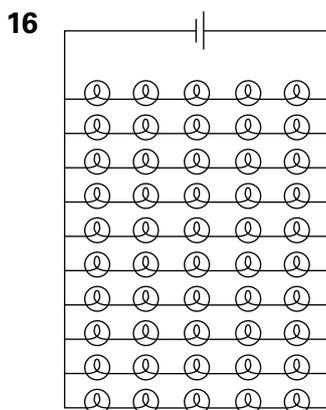
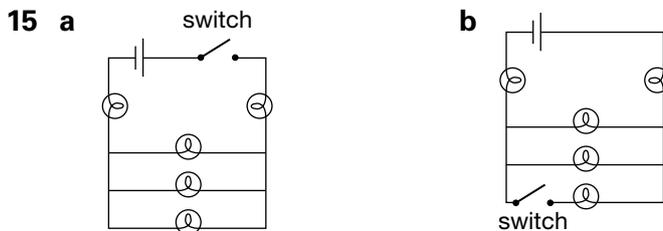
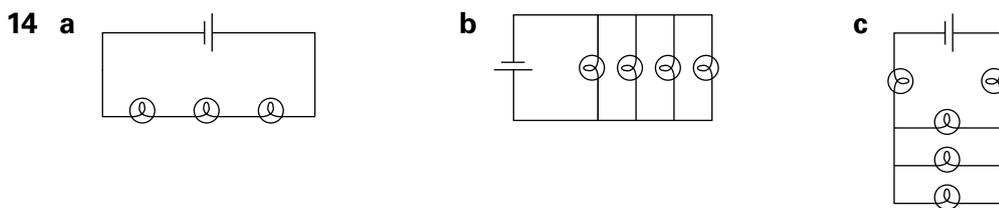
10 B—half the size of the current through point B

11 Globe G uses half of the cell voltage:  $1/2(6\text{ V}) = 3$

12 In the first figure, globe 4 will be brighter than globes 1, 2 and 3. This is because globe 4 has the same voltage as the power supply. The other three globes share the power supply voltage. The three globes are connected in parallel with globe 4.

In the second figure the effect will not be so obvious. They will still be the same.

13 C



## Unit 11.4: Electrical energy calculations

### Answers

#### Unit questions

*Learner's Book page 244*

**1**  $P = 60\text{ W}$   $E = P \times t$

**a**  $t = 1\text{ s} = 60\text{ W} \times 1\text{ s}$

$E = ? = 60\text{ J}$

**b**  $E = P \times t$

$= 60\text{ J} \times 60\text{ s}$

$= 3600\text{ J}$

**2 a**  $P = ?$   $P = VI$

$I = 3\text{ A} = 12\text{ V} \times 3\text{ A}$

$V = 12\text{ V} = 36\text{ W}$

**b**  $E = P \times t$ ,  $t = 10\text{ min} = 10\text{ min} \times 60/1\text{ min} = 600\text{ s}$

$= 36\text{ J/s} \times 600\text{ s}$

$= 21\,600\text{ J}$

**3** The power rating of the heater  $= 2\text{ kW} = 2000\text{ W} = 2000\text{ J/s}$

Time used  $4\text{ h} = 4 \times 3600\text{ s/h} = 14\,400\text{ s}$

$= 288\,000\,000\text{ J}$

**a**  $2\text{ kW} \times 4\text{ h}$

**b**  $28\,800\,000\text{ J}$

$8\text{ kWh}$

**4 a**  $3\text{ kW} \times 5\text{ h} = 15\text{ kWh} = 15\text{ units}$

Cost  $= 15\text{ units} \times \$3.93 = \$58.95$

**b**  $0.06\text{ kW} \times 12\text{ h} = 0.72$

Cost  $= 0.72\text{ units} \times \$3.93 = \$2.83$

**c**  $1.2\text{ kW} \times 0.25\text{ h} = 0.3\text{ kWh} = 0.3\text{ units}$

Cost  $= 0.3\text{ units} \times \$3.93\text{ units}$

$= \$1.18$

**5**  $60\text{ W} = 0.06\text{ kW} \times 4\text{ h} = 0.24\text{ kWh} \times 6\text{ bulbs} = 1.44\text{ kWh}$

For 1 year  $= 1.44\text{ kWh/day} \times 365\text{ days/1 yr} = 525.6\text{ unit/yr}$

Cost  $= 525.6\text{ units} \times \$3.93 = \$2065.61$

$15\text{ W} = 0.015\text{ kW} \times 4\text{ h/day} \times 6\text{ bulbs} \times 365\text{ days/1 yr} = 131.4\text{ units}$

Cost  $= 131.4\text{ units} \times \$3.93 = \$516.40$

Annual saving would be:

$\$2065.61 - \$516.40$

$= \$1549.21$

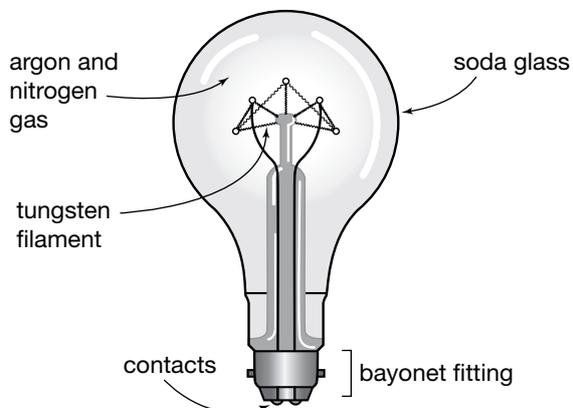
## Chapter review

### Answers

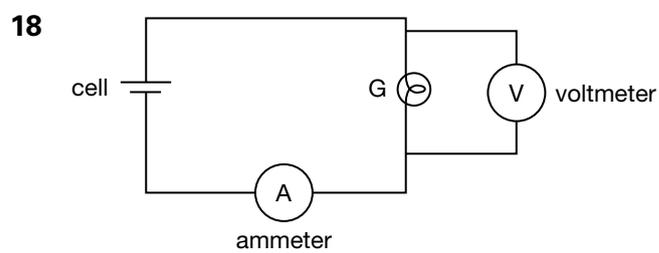
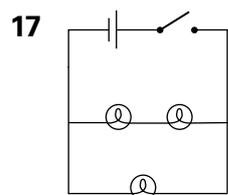
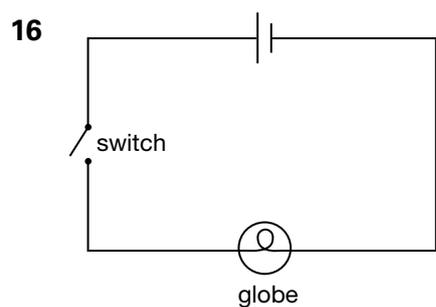
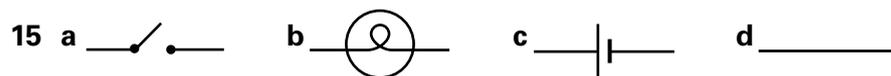
Learner's Book pages 244–245

- 1 **a** False; **b** False; **c** True; **d** False; **e** False
- 2 **a** Current is the flow of *electric* charge.  
**b** Current is measured in *amperes*.  
**c** An *insulator* does not allow charge to flow through it.  
**d** Most *metals* are good conductors.  
**e** *Voltage* is a measure of the energy available to push charges around a circuit.  
**f** A *dry cell* contains a chemical paste and electrodes to produce free electrons.  
**g** It is usually *negative* charges that flow in a circuit.
- 3 **a** False; **b** True; **c** True; **d** True; **e** False; **f** True
- 4 The difference between cells and batteries is that a cell is a single unit that converts chemical energy to electrical energy to deliver a voltage, while a battery is composed of a number of cells in series to get increased voltage. Batteries can, therefore, also be referred to as cells.
- 5 A safety switch monitors the flow of electricity through a circuit by comparing current in and outside a house. If there is a difference (eg caused by an electrical fault), it shuts off the main power. It automatically shuts off the electricity supply when current is detected leaking from faulty switches, wiring or appliances. This stops current flowing through a person to the ground and electrocuting them.
- 6 Electric circuit from power point to jug and back to power point is complete when the switch is turned on, but a nichrome wire acts as a resistor, building up current which is converted to heat.
- 7 A fuse is a short section of wire made from a metal with a lower melting point than the copper wire in the circuit. When a larger current flows the wire melts, breaks the circuit, and prevents an electrical fire or damage to the circuit.
- 8 Rubber-soled shoes prevent current flowing through the wearer's feet and so reduce the risk of electric shock (though it is still possible through other paths in the body).
- 9 **a** Hair/comb; **b** Car body/air; **c** Seal/container; **d** Clothes/chair
- 10 To allow charges produced by friction between air and the car to escape gradually to the ground without sparking.
- 11 Household power supplies alternating current (AC) which flows back and forth (oscillates) whereas the current in batteries flows in one direction only and is called direct current (DC). AC current is easier to generate than DC current.
- 12 Static electricity is stationary, or unable to move, whereas current, by definition, is moving charge.

13



- 14 **a** D and E; **b** A and B; **c** C and F



19 Arrow C

# Appendix 1: Suggested teaching methods

A range of strategies for helping learners to achieve the overall learning outcomes are shown here.



## Appendix 2: Lesson plan format

<b>Name of school:</b>	<b>Class teacher:</b>	
<b>Lesson title:</b>	<b>Date:</b>	
<b>Learning outcomes</b> <ul style="list-style-type: none"> <li>• What are the main things I want learners to learn and be able to do as a result of the lesson? How are lesson outcomes linked to syllabus outcomes?</li> <li>• What other things do I want learners to learn?</li> </ul>		
<b>Lesson content</b> <ul style="list-style-type: none"> <li>• What are the key facts, concepts or procedures that I want learners to understand as a result of this lesson?</li> </ul>		
<b>Introduction</b> <ul style="list-style-type: none"> <li>• How will I get learners motivated, curious and ready to learn? (Allocate 3–5 minutes.)</li> </ul>		
<b>Teacher activities</b> <ul style="list-style-type: none"> <li>• What am I going to do during the lesson in order for learners to achieve the learning outcomes? (Allocate 8–10 minutes.)</li> </ul>	<b>Learner activities</b> <ul style="list-style-type: none"> <li>• What are the learners going to do during the lesson in order for them to achieve the learning outcomes? (Allocate 20–25 minutes.)</li> </ul>	
<b>Conclusion</b> <ul style="list-style-type: none"> <li>• How will I bring the lesson to a logical and meaningful conclusion? (Allocate 5–7 minutes.)</li> </ul>		
<b>Learner assessment</b> <ul style="list-style-type: none"> <li>• How will I know that learners have achieved what I wanted them to achieve?</li> </ul>		
<b>Lesson evaluation</b> <ul style="list-style-type: none"> <li>• How will I evaluate the success of the lesson?</li> </ul>		
<b>Lesson endorsement:</b> (To be signed by Head of Department/Head teacher/Principal)		
<b>Head of Department</b>		<b>Head teacher/principal</b>







## Appendix 6: Sample learner's remedial work form

<b>Learner's name:</b>		<b>Class:</b>		<b>Term/Semester:</b>	<b>Year:</b>
<b>Strand:</b>		<b>Sub-strand:</b>			
<b>Assessment event</b>	<b>Specific Learning Outcomes and benchmarks</b> (use appropriate code)		<b>NA</b>	<b>Remedial work required</b>	<b>Results after remedial work</b>
	<b>Code</b>	<b>Description of outcomes assessed</b>	<b>PA</b>		
<b>Class teacher:</b>				<b>Signature:</b>	<b>Date:</b>



## Appendix 8: Sample learner's classroom report form

<b>Learner's name:</b>	<b>Class:</b>	<b>Semester:</b>	<b>Year level:</b>
<b>Results for formative assessment: The progressive achievement level for formative assessment is _____</b>			
<b>Strand:</b>	<b>Sub-strand:</b>	<b>Achievement level and award</b> Achieved (A), Partially Achieved (PA) or Not Achieved (NA)	
<b>Code</b>	<b>Specific Learning Outcome and benchmark</b> (use appropriate code)	<b>A</b>	<b>PA</b>
			<b>NA</b>
<b>Descriptive remarks:</b> (must include results after remedial work has been completed by the learner)			
<b>Strand:</b>	<b>Sub-strand:</b>	<b>Achievement award</b> Achieved (A), Partially Achieved (PA) or Not Achieved (NA)	
<b>Code</b>	<b>Specific Learning Outcome and benchmark</b> (use appropriate code)	<b>A</b>	<b>PA</b>
			<b>NA</b>
<b>Descriptive remarks:</b> (must include results after remedial work has been completed by the learner)			



## Appendix 9: Sample learner's school report form

<b>TAKWA COMMUNITY HIGH SCHOOL</b>				
Name: _____ Year level: _____				
Reporting period: _____				
<b>Subjects</b>	<b>Score (100%)</b>	<b>Overall achievement level, award and certification</b>	<b>Grade</b>	<b>Comments</b>
English	95%	5, AWE, Gold	A	Well done
Mathematics				
Science	90%	4, AWM, Silver	B	Good work
Social Studies				
Health Education				
Christian Education	60%	3, AWMS, Bronze	C	Satisfactory work
Creative Arts and Culture				
Physical Education	21%	2, ABMS	D	Needs to attend practical sessions in PE
ICT	0%	0, NA	E	Needs to put more effort in ICT
<b>Class teacher comments on learner's attitude, behaviour and character:</b>				
<b>Head teacher/Principal comments:</b>				
<b>Key</b> 95%–100%: Achieved With Excellence (AWE), Gold 80%–94%: Achieved With Merit (AWM), Silver 50%–79%: Achieved (A), Bronze 20%–49%: Not Achieved (NA) 1%–19%: Not Achieved (NA) 0%: Not Achieved (NA)				

# Solomon Islands Science Year 8

## Teacher's Guide

The *Solomon Islands Science Year 8 Teacher's Guide* provides support material to the *Solomon Islands Science Year 8 Learner's Book*. The Teacher's Guide is designed to assist teachers in helping students to learn the key knowledge, skills, understanding and attitudes contained in the Science syllabus, which was developed during the Solomon Islands curriculum reform of 2005–2012.

This guide provides teachers with tailored lesson plans designed to support the teaching of each unit in the Learner's Book, as well as detailed plans for each practical activity, which include:

- the processes and skills covered in the activity
- a list of resources
- teacher support notes
- answers.

This guide also contains syllabus links, answers to all of the Suggested Assessment Activities in the syllabus and answers to all of the Unit, Challenge and Extension questions in the Learner's Book.

