

Solomon Islands Science

Year **9**

Teacher's Guide



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Science
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Solomon Islands Curriculum Development Division

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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 9 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.

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 textbook 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 9 Learner's Book. This section shows the entire learning program for one year of Secondary Science course for Year 9.

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 9 program planner

Year 9 Semester 1								
Weeks	Week 1 (1 week)	Weeks 2-4 (3 weeks)	Weeks 5-7 (3 weeks)	Weeks 8-11 (4 weeks)	Weeks 12-15 (4 weeks)	Weeks 16-18 (3 weeks)	Week 19 (1 week)	Week 20 (1 week)
Periods (68)	n/a	12	12	16	16	12	n/a	n/a
		Energy and change 9.1 Magnets and electromagnets Magnetic forces Electromagnetism	Life and living 9.2 Sense and control Sight Hearing Smell, taste and touch Responding	Natural and processed materials 9.3 Materials Metals, non-metals and semi-metals Corrosion of metals Reactions of metals with dilute acids Pure metals and alloys Plastics and fibres	Life and living 9.4 Human body systems Skeleton and muscles Human reproductive systems From gamete to birth Reproductive systems Nervous control Chemical control	Life and living 9.5 Human effects on ecosystems Human effects on ecosystems	Revision program	Examination program

Year 9 Semester 2

Year 9 Semester 2						
Weeks	Week 21 (1 week)	Weeks 22-24 (3 weeks)	Weeks 25-27 (3 weeks)	Weeks 28-29 (2 weeks)	Weeks 30-31 (2 weeks)	Weeks 32-38 (7 weeks)
Periods (40)	n/a	12	12	8	8	n/a
		Earth and beyond 9.6 Environmental issues: Global and local Global warming The ozone layer Nuclear radiation Climate change and Solomon Islands	Natural and processed materials 9.7 More chemical reactions Writing chemical equations Naming compounds	Earth and beyond 9.8 Mining and energy sources in Solomon Islands Minerals and mining Energy sources: Fossil fuels Nuclear and other energy sources	Energy and change 9.9 Communication technology Waves in communication The communication network	Revision and examination programs

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 9 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:** Encourage learners to use English in speaking and writing. In discussions, learners who find it very difficult to communicate in English can use both English and Pijin. 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. 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 9 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 9 Science. The SLO is the curriculum benchmark. The statements in the table are assessment criteria for the SLO 9.3.1.1 (identify the properties of metals: hardness, malleability, ductility, density and conductivity). Each of the six levels describes the achievement of the learner.

Level	Assessment criteria	Judgement criteria	Achievement award
L5	Five properties listed and identified (if present)	Five properties listed and identified (if present)	Achieved (A) Full mastery of learning outcomes
L4	Four properties listed and identified (if present)	Four properties listed and identified (if present)	Partially Achieved (PA4) Substantial mastery of learning outcomes
L3	Three properties listed and identified (if present)	Three properties listed and identified (if present)	Partially Achieved (PA3) Moderate mastery of learning outcomes
L2	Two properties listed and identified (if present)	Two properties listed and identified (if present)	Partially Achieved (PA2) Minor mastery of learning outcomes
L1	One property listed and identified (if present)	One property listed and identified (if present)	Partially Achieved (PA1) Minimal mastery of learning outcomes
L0	No properties listed or identified (if present)	No properties listed and identified (if present)	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 86). 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 87).

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 90).

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 93). However, detailed reports will be used for parent–teacher meetings at the school level (see Appendix 8, page 91). 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. Below 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: Magnets and electromagnets

Strand: Energy and change

Suggested periods: 12

Sub-strand statement

This sub-strand deals with magnets and electromagnets. Magnets exert invisible forces. The forces are strong enough to push or pull without touching. The forces are called magnetic forces. A magnet has two poles, called the north and south poles. A magnetic field is an area around the magnet where a force exists. Magnetic fields attract metals over a short distance only. The Earth is the biggest magnet. Electromagnetism is the creation of a magnetic field by an electric current, or vice versa. Electromagnets attract metals and have many uses in our lives.

General learning outcomes

Learners should:

- 9.1.1** know that magnets have two poles and have attracting and repelling forces
- 9.1.2** be able to show the attracting and repelling forces of magnets
- 9.1.3** be able to show that a magnetic force is a non-contact force
- 9.1.4** be able to show that magnetic fields are areas around a magnet
- 9.1.5** understand that Earth is the biggest magnet
- 9.1.6** be able to show that magnetic fields are caused by electricity, and vice versa
- 9.1.7** appreciate that electromagnets can be found in many useful appliances and equipment that they use in their daily lives.

Specific learning outcomes

Learners should be able to:

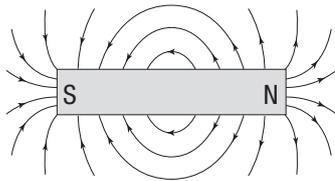
- 9.1.1.1** state that the two ends of magnets are called the north (N) and south (S) poles
- 9.1.1.2** demonstrate, using a magnet, that like poles repel (N–N, S–S) and unlike poles attract (N–S, S–N)
- 9.1.3.1** demonstrate, using iron nails, that a magnetic force is a non-contact force
- 9.1.4.1** demonstrate, using iron filings and paper, the path that a magnetic field takes around a magnet
- 9.1.4.2** demonstrate, using a compass, the direction of the fields
- 9.1.5.1** explain that the needle of a compass always points towards Earth's geographic north pole
- 9.1.6.1** use a simple circuit with a compass to show that a magnetic field is generated when an electric current passes through
- 9.1.7.1** list appliances that use electromagnets: radios, videos, speakers.

Answers

Suggested assessment events

Solomon Islands Years 7–9 Science Syllabus

1



- 2 Learners' responses will vary. Electromagnets turn on when you press the doorbell, and the completed circuit and electromagnet initiate the buzzing sound or bell. In a mobile phone, the electromagnet is used to make the speaker work.
- 3 The mantle and the outer and inner core of the Earth consist predominantly of iron.

Challenge questions

Learner's Book page 1

- 1 Learners' responses will vary but could include the following: stereo, toys, door latch.
- 2 An electromagnetic force is produced by a magnet.
- 3 A needle in a compass is magnetised and because of the way the compass is built, the needle moves to align with north and south. The compass needle pointer is set up to tell you which is north. The magnetism in the Earth pulls the lightweight needle to point north.
- 4 Learners' responses will vary, but could include the following: An electromagnet is a magnet that runs on electricity. Unlike a permanent magnet, an electromagnet can easily be switched on and off.
- 5 Inside a loudspeaker is an electromagnet, which is placed in front of a permanent magnet. The permanent magnet is fixed firmly into position, whereas the electromagnet can move around. As pulses of electricity pass through the coil of the electromagnet, the direction of its magnetic field changes rapidly.

Unit 1.1: Magnetic forces

Activity 1: Attracting and repelling

Learner's Book page 2

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the two poles of a bar magnet	<ul style="list-style-type: none"> • watch-glass • 2 bar magnets 	Learners have an opportunity to see magnets in action. Ask questions as they do the activity to help them be able to answer the questions. Such as 'What is happening?', 'Why is it going that way?', 'What happens to the ends as they get closer?'	<ol style="list-style-type: none"> 1 Rule: Unlike poles attract, like poles repel. 2 The term 'poles' refers to the ends of a magnet.

Activity 2: Getting magnetic

Learner's Book page 3

Processes and skills	Resources	Teacher's support notes	Answers to questions
To make an object magnetic	<ul style="list-style-type: none"> • permanent magnet • large nail • small pins or paperclips • polystyrene, cork or other floating material • bucket or ice-cream container 	<p>This activity can take quite some time. Encourage learners to be patient as they work through the activity to get the nail magnetised.</p>	<ol style="list-style-type: none"> 1 Learners' responses will vary. 2 Learners' responses will vary but nails will work as compasses as long as the number of strokes is enough. 3 There are a few ways to check: <ul style="list-style-type: none"> • Hold it up and see if it moves to the north (check which way is north by using a real compass or checking the position of the Sun). • Hold a new magnet to the nail and see what it does. • Hold the nail to a magnetised nail to see if it makes it move.

Activity 3: Magnetic fields

Learner's Book page 4

Processes and skills	Resources	Teacher's support notes	Answers to questions
To observe magnetic fields	<ul style="list-style-type: none"> • wooden board or bench mat • sheet of waxed lunch-wrap • bar and horseshoe magnet • fine iron filings (preferably in a shaker) • access to a 200–300 W spotlight to be used as a heat source (CAUTION: the spotlight will be extremely hot) 	<p>Explain to learners how a magnetic field is formed. Carry out the experiment to create a permanent record of the magnetic field of the magnet. Encourage learners to observe and identify where the magnetic field is the strongest.</p>	<ol style="list-style-type: none"> 1 Learners are likely to see a field of iron filings that looks like Figure 1.1.6 in the Learner's Book. The magnetic field is strongest close to the poles. 2 In the centre there will be fewer filings than at the poles. 3 The strength of the field reduces further away from the magnet.

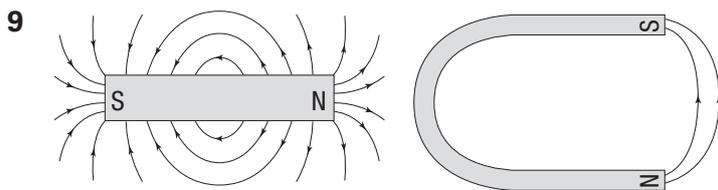
Answers

Unit questions

Learner's Book page 5

- 1 Magnets originate from rock called magnetite (or lodestone). Magnetite contains a lot of iron.
- 2 Magnetic forces are non-contact forces because they exert an invisible force strong enough to push or pull without touching.
- 3 Three metals that can be attracted to magnets are iron, nickel and cobalt.
- 4 A pole is the end of a magnet. The two poles found on the magnets are south and north poles.
- 5 Like poles push away, or repel each other. Unlike poles pull together, or attract each other.
- 6 The term 'domain' refers to small magnetic particles found around all magnets, iron and steel.
- 7 This can be done by:
 - stroking the piece of iron or steel repeatedly, in the same direction, with another magnet
 - lining up a piece of iron with the north and south poles of the Earth and gently tapping it
 - leaving the iron in the core of an electromagnet.

8 Refer learners to Figure 1.1.4 in the Learner's Book.



10 Magnetic fields are strongest at the magnet's poles and become weaker as we move further away from them.

11 Compasses are small magnets that are allowed to move. The compass needle points along the Earth's field-lines and can be used to find north or south.

12 The mantle, outer and inner core of Earth consist predominantly of iron.

13 a The north pole of a magnet will *repel* other north poles.

b Compasses are actually small magnets.

c The area around a magnet is called its *magnetic* field.

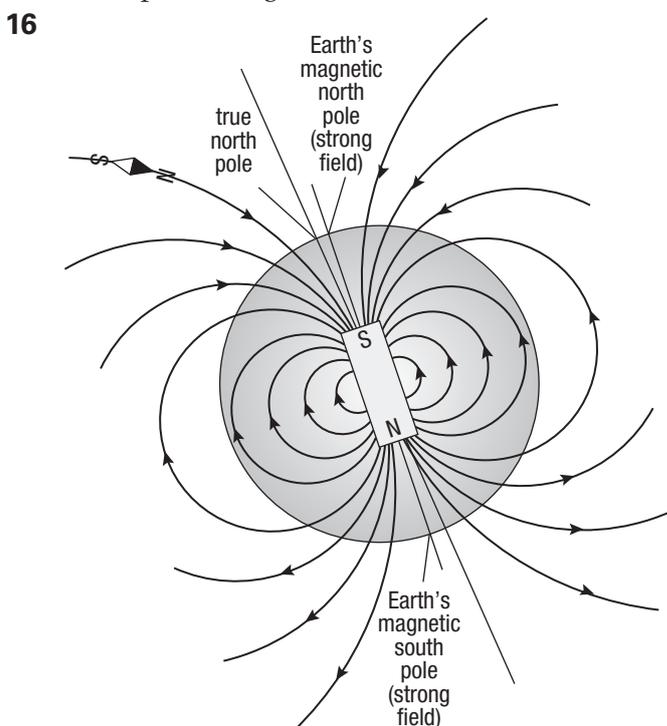
d The ends of a magnet are called its *poles*.

e Domains must be aligned for a piece of iron to be a magnet.

f The Earth *does have a magnetic field*.

14 Store magnets in a cool place where they are unlikely to be knocked or placed near other magnets, ensuring that the domains remain aligned. Using iron spacer bars across their ends and arranging the magnets 'head to tail' with other magnets will ensure that the field is in a direction that will maintain the alignment of the domains.

15 Steel ships are hammered and knocked while in one orientation for the months or years it takes to build them. Some alignment of the domains in the steel of the hull may occur, giving rise to partial magnetism.



Extension questions

Learner's Book page 5

1 If a substance is ferromagnetic, it can become magnetised.

2 a Aluminium, nickel and cobalt

b Aluminium, nickel and cobalt

c Aluminium, nickel and cobalt have magnetic properties.

- 3 A compass points to the Earth's magnetic poles, not its geographic poles.
- 4 Learners' responses will vary. For example, learners may explore the use of magnetism to produce and duplicate sound in tapes. In recording the sound onto the tape, a current affects the small electromagnet, whose field affects the tape being recorded. Loud sounds produce stronger magnetic fields than soft sounds.

Unit 1.2: Electromagnetism

Activity 4: Oersted's experiment and the electromagnet

Learner's Book page 6

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the magnetic field around a current-carrying wire	<ul style="list-style-type: none"> • power supply • switch • insulated copper wire (1 m) • tape • small compass • cardboard tube • large iron nail 	Explain to learners that a magnetic field is formed around a current-carrying wire. Allow learners to investigate by undertaking this activity and observing the effect of a magnetic field on a compass.	<p>1 It is the moving current (electricity) that produces the magnetic field. Therefore, as you move further away from the wire, the magnetic field strength becomes weaker.</p> <p>2 Since moving current produces magnetic fields, the greater the current, the greater the magnetic field strength.</p> <p>3 Several coils will reinforce (strengthen) the magnetic field. Increasing the number of coils increases the current moving through the coil, which increases the magnetic field strength.</p> <p>4 An electromagnet is stronger with an iron core. When an iron core is used, its magnetic field will align with the magnetic field-lines produced by the moving current, therefore strengthening the electromagnet.</p> <p>5 At the end of the nail there is less wire coiled, which means less current and therefore weaker magnetic field strength. Furthermore, one end will be acting like the north pole and the other end like the south pole of a magnet.</p>

Activity 5: A simple generator*Learner's Book page 9*

Process and skills	Resources	Teacher's support notes	Answer to questions
To investigate the correlation between magnetism and current electricity	<ul style="list-style-type: none"> • solenoid • bar magnet • connecting wires • galvanometer or microammeter 	Explain to learners the correlation between magnetism and current electricity. Allow learners to investigate by carrying out this experiment so that they have evidence of this correlation.	<ol style="list-style-type: none"> 1 The currents produced in this experiment are likely to be very small. A globe has a high resistance (produced by the coil in the globe) and therefore would not show the currents that are likely to be produced in this experiment. Furthermore, it would not measure how much current is passing through. 2 The magnet itself does not produce the current. The current was produced because of the motion between the magnet and the coil (a moving magnetic field creates current). The magnet or the solenoid (the coil) must move to create current. 3 The moving magnet (magnetic field) creates current. Therefore, increasing the speed of the magnet will increase the amount of current being produced. Decreasing the speed will decrease the amount of current being produced. No movement of the magnet means no current is being produced. 4 When a magnet is moved into a coil of wire (solenoid), a current is produced. When the magnet is withdrawn, current is still produced but in the opposite direction (note that it is the movement of the magnet that creates current). 5 Changing the pole (north or south) that approaches the solenoid will still have the same effect. It is the moving in or out of the solenoid that produces current and changes the direction of the current to produce alternating current—a simple generator. 6 A stronger magnet will produce a stronger magnetic field and therefore produce more current. This will be indicated by the reading on the galvanometer.

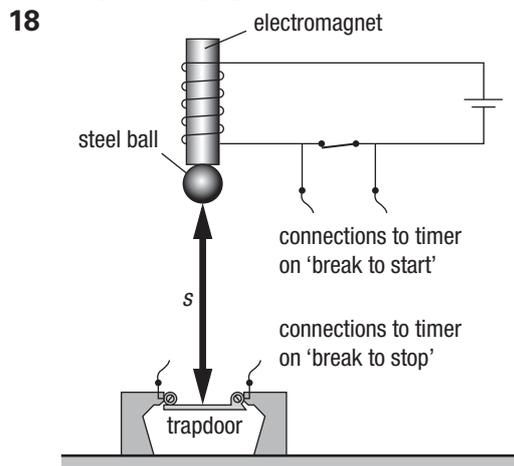
Activity 6: A simple electric motor*Learner's Book pages 10–11*

Process and skills	Resources	Teacher's support notes	Answers to questions
To construct a simple electric motor	<ul style="list-style-type: none"> • 1.5 volt battery ('D' size) • Blu-Tack • 2 rubber bands • 2 paperclips • 1.5 metres of enamelled copper wire • small but strong disc magnet or bar magnet • emery paper • pliers (optional) 	Explain to learners how an electric motor works. Construct the electric motor as shown in this activity so that the learners acquire the skills to make a simple electric motor that actually works.	<ol style="list-style-type: none"> 1 Using several loops will increase the current capacity, thus strengthening the magnetic field strength as well. 2 It will possibly be attracted to the strong magnet, which would distort the purpose of the experiment. 3 Scraping the insulation from the straight ends of the wire allows conduction of current from the terminal of the battery to take place. If the insulated wire is not scraped, the insulation will prevent the flow of current. 4 Refer to the learners' designs for the improvement of the model motor. Ensure that learners' designs are based on the principle that moving current (electricity) creates magnetic fields and vice versa. 5 Refer to the learners' collected electric motors. In comparing them with your electric motor, point out that they are designed to allow the principle of the relationship between electricity and magnetism to work.

Answers**Unit questions***Learner's Book page 12*

- 1 1820
- 2 Refer learners to Figure 1.2.3 in the Learner's Book.
- 3 A solenoid consists of coils of wire mounted on a hollow tube. An electromagnet is a solenoid containing an iron core.
- 4 An electromagnet can be turned on and off.
- 5 **a** Learners' responses will vary (eg bell, speaker, maglev train).
b Learners' responses will vary, depending on the item.
- 6 **a** Placing the magnet in the coil produces a current.
b Removing the magnet from the coil causes current to flow in the opposite direction.
c Continually moving the magnet in and out produces a continuous alternating current.
- 7 Learners' responses will vary (eg a bicycle dynamo, a moving-coil microphone).
- 8 A transformer is used for boosting or reducing voltages.
- 9 Two types of transformer are step-up and step-down.
- 10 A step-up has more secondary coils than primary coils. A step-down has fewer secondary coils than primary coils.
- 11 Power station (generation), step-up transformer, transmission lines, step-down transformer, substation, consumers

- 12 a Laptop computer: step-down
 b Long-distance transmission: step-up
 c Substation: step-down
 d Mobile phone: step-down
- 13 The operation of electromagnetic devices relies upon the magnetism that results from a completed electric circuit. A possible example is the door latch in Figure 1.2.6 in the Learner's Book, which keeps the door closed by magnetic attraction when current flows if the switch is turned on.
- 14 a Yes
 b No
 c Yes
 d Yes
 e Yes
 f Yes
- 15 Much higher voltage is used in power lines than at home—long-distance transmission of electricity is between 220 000 and 500 000 V, whereas in the home it is 240 V.
- 16 Higher voltages result in less power loss in transmission lines.
- 17 High-voltage power lines are deadly.



Extension questions

Learner's Book page 13

1–4 Learners' responses will vary.

Chapter review

Answers

Learner's Book pages 13–14

- 1 Oersted discovered that electricity could cause magnetism.
- 2 Learners' responses will vary but could include industrial processes such as metal scrap yards or everyday uses such as door latches, electric bells and speakers.
- 3 Faraday found that by changing the magnetic field inside a coil, he could generate an electric current. He had produced a simple generator.
- 4 Stroking iron or steel with a permanent magnet, placing iron or steel in the field of an electromagnet, aligning the magnet with the Earth's field and gently tapping it.
- 5 Magnets lose their magnetism by being dropped, knocked or heated.
- 6 Refer to Figure 1.1.6 in the Learner's Book.
- 7 A compass is a small pin that has been made into a magnet.

- 8** The compass would not point any specific way. It would move around, as its desired point would be directly where you are.
- 9** The more windings of copper wire, the stronger the magnetic field created.
- 10** Learners' responses will vary.
- 11 a** The coil will rotate in a clockwise direction.
- b** The commutator changes the alternating current (AC) into direct current (DC) every half-turn as it flows through the coil. This occurs because the first brush contacts the opposite segment that it was touching during the first half-turn while the second brush contacts the segment opposite the one it touched on the first half-turn. In doing this, the brushes keep the current going in one direction.
- 12 a** The primary coil in the transformer receives the voltage or current. If there is no primary coil in the transformer, it will not be possible to step up or step down the voltage or current.
- b** The function of the secondary coil in the transformer is to increase (step up) the voltage or to decrease (step down) the voltage, depending on the situation.
- 13 a** The induced current is produced from the magnet and coil moving closer together. Refer to Figure 1.2.13 in the Learner's Book.
- b** Anticlockwise.
- 14 a** Learners' responses will vary.
- b** Learners' responses will vary. Learners may also like to make comparisons such as how they convert energy differently and which uses the left- and which uses the right-hand rule.

Chapter 2: Sense and control

Strand: Life and living

Suggested periods: 12

Sub-strand statement

Our eyes provide what many would regard as the most important of all our senses. The eye is an organ that allows us to see things. Our ears work by detecting sound waves. They also sense the position of the head, helping us to keep our balance. Nose, tongue and skin are organs that responsible for the sense of smell, taste and touch respectively. Our response allows us to react to changes around us, for example pulling our fingers from hot water or running away from danger.

General learning outcomes

Learners should:

- 9.2.1** know that humans have five senses
- 9.2.2** be able to show the parts of the human body that are responsible for the senses
- 9.2.3** know the function of the main internal parts of the sensor organs
- 9.2.4** know that the tongue has different parts that sense different flavours
- 9.2.5** understand the problems associated with human sense organs.

Specific learning outcomes

Learners should be able to:

- 9.2.1.1** identify the five human senses: sight, hearing, smell, taste and touch
- 9.2.2.1** identify in a diagram the parts of the body that are responsible for our senses: sight—eye, hearing—ear, smell—nose, taste—tongue, touch—skin
- 9.2.3.1** describe the main functions of the parts of the human eye, ear, nose, skin and tongue
- 9.2.4.1** identify taste sensations of the tongue
- 9.2.5.1** identify problems associated with body parts, such as long- and short-sightedness (eyes) and deafness (ears)
- 9.2.6.1** explain the use of different lenses to resolve short-sightedness and long-sightedness
- 9.2.6.2** identify ways to solve hearing problems
- 9.2.7.1** perform and describe a stimulus and response situation (eg put their hands in hot water and pierce the skin with a sharp pin).

Answers

Suggested assessment events

Solomon Islands Years 7–9 Science Syllabus

- 1** Refer to Figure 2.1.6 in the Learner's Book for the parts of the eye.
- 2** The functions of the following parts of the ear are as follows.
 - The eardrum is the beginning of the middle ear and is made of a thin sheet of muscle and skin. Its function is to vibrate in response to sound energy that comes through the auditory canal and passes onto the middle and inner ear.
 - Semicircular canals help us to keep our balance. They are in three sections that are perpendicular to each other (like two walls and a floor that meet at the corner of a room). These sections contain fluid, which moves when we do. Nerves send messages to the brain, which in turn signals muscles to help us keep our balance.

- The ossicles are made up of three bones in the middle ear called the hammer, anvil and stirrup. They vibrate as they receive sound energy from the eardrum. Their function is to amplify (increase) the sound before it passes on to the parts of the inner ear and later to the brain for interpretation.
- 3 An ear infection may upset our sense of balance because it is likely to cause a blockage of the Eustachian tube, which causes the semicircular canal not to function effectively.

Challenge questions

Learner's Book page 15

- 1 The five senses are sight, hearing, smell, taste and touch/feel.
- 2 The biggest organ of the human body is the skin, which weighs about 11 kilograms.
- 3 Having two eyes allows us to judge distances more accurately. Each eye sees a slightly different view. The brain combines the two images to create a three-dimensional view that gives us more information about how far away an object is. This is called binocular vision.
Having two ears help us to determine the direction of a sound. If a sound reaches both ears at the same time, our brain interprets this to tell us that the source of the sound is directly in front of, behind or above us. If a sound reaches, say, the left ear before the right ear, the brain tells us that the source of the sound is to our left.
- 4 For example breathing, blinking eyes, producing saliva when we see a plate of fried chicken meat with rice.
- 5 It is dangerous to dive into water of unknown depth because we can experience an uncomfortable 'blocked ear' sensation. This happens as a result of a pressure difference between the outer ear and the middle ear. If we continue to dive more deeply, the pressure difference may increase and permanently damage the eardrum, possibly resulting in permanent deafness.

Unit 2.1: Sight

Activity 1: Eye tests

Learner's Book page 16

Process and skills	Resources	Teacher's support notes	Answers to questions
To construct a mini eye chart and to find your eye's blind spot	Pen and paper or card	<p>This experiment is made up of three parts. Part A: Your yellow spot, Part B: Your blind spot and Part C: Distance perception.</p> <p>The yellow spot (fovea) of the eye is the section of the retina directly behind the pupil that contains a large number of colour-sensitive cells.</p> <p>The blind spot is where blood vessels and the optic nerve join the eyeball, and there are no light-sensitive cells to detect image information.</p> <p>Remember that learners' results will vary, as each learner is unique. Ensure that this activity does not diminish the learners' self-image.</p> <p>Remind learners how to calculate an average: the sum of all data divided by the number of all data.</p>	<p>1 a Learners' responses will vary. b The class average will vary.</p> <p>2 a Learners' responses will vary. b The class experience will vary.</p> <p>3 Learners' responses will vary.</p>

Answers

Unit questions

Learner's Book page 22

1 Similarities between the human eye and a camera:

- Both have convex and transparent lenses.
- Both use light to capture images.
- Images produced by light onto the retina of the human eye and camera appear to be upside down.
- Both of the lenses of the human eye and the camera produce converging rays.
- Both of the lenses of the human eye and the camera can be adjusted and refocused to see distant objects clearly.

Differences between the human eye and a camera:

- The human eye focuses by using the ciliary muscles to change the shape of the lens, while a camera is focused on an image by each lens being moved backwards and forwards.
- The human eye occurs in nature, while the camera is made by humans.

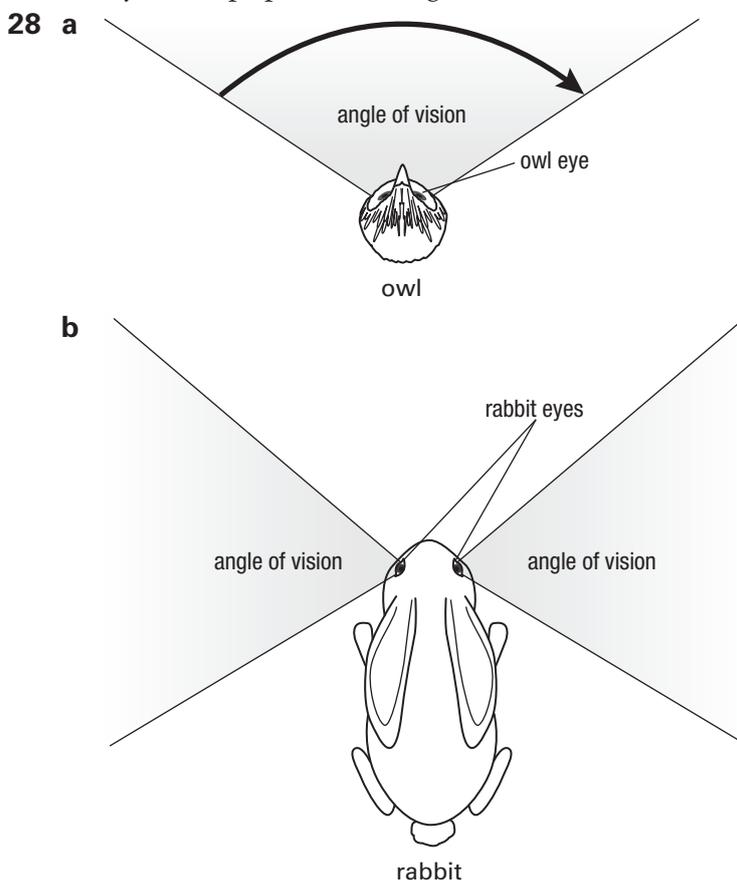
2

Part	Description/function
Conjunctiva	A thin, clear layer covering the front of the eye
Cornea	A clear 'window' in the sclerotic layer that allows light to enter the eye
Pupil	The hole in the centre of the iris. When conditions are dark, the pupil increases in size to let more light in, and is said to be dilated
Aqueous humour	The watery liquid that fills the space between the cornea and the lens. It helps to maintain the shape of the eye
Iris	Located just in front of the lens. It changes size to control how much light enters the eye. It also gives the eye its colour
Ciliary muscles	Change the shape of the lens to bring images of a distant object into focus
Suspensory ligament	Holds the lens of the eye in place
Lens	The clear transparent convex object located just behind the pupil. It helps to focus an image on the back surface of the eye
Optic nerve	Joins the eye to the brain, allowing image information to be processed so we see images the right way up
Blind spot	Point where the blood vessels and the optic nerve join the eyeball, and there are no light-sensitive cells to detect image information
Yellow spot (fovea)	A section of the retina directly behind the pupil that contains a large number of colour-sensitive cells. This is why we should look directly at an object to see it most clearly
Retina	A layer behind the eye that contains over 100 million light-sensitive cells that transmit messages to the brain
Choroid	A black layer that forms part of the inside lining behind the lens, and prevents light from reflecting all around the eye
Vitreous humour	A jelly-like substance that fills the rest of the eye. It helps to maintain the shape of the eye
Sclerotic layer	A tough, white-coloured protective layer that surrounds the eye and helps maintain the shape of the eye

3 There are a number of features that naturally help to protect our eyes. Our eyebrows and eyelashes help to keep dust out, and tear ducts produce tears to flush out any foreign particles. Our eyes are set back in depressions in our skulls called orbits, to give our eyes some protection from injury.

- 4 a** The light receptor in the retina that detects light or dark is called a rod. It also helps us to detect shapes.
- b** The light receptor in the retina that detects colours is called a cone. Cones need a lot of light to be activated and they come in three types. Each type detects the colours red, blue and green.
- 5** People who lack one or more types of cone cells cannot easily tell the difference between some colours, most notably red and green. They are said to be colour blind.
- 6** Some examples from the Learner's Book are:
- A rabbit's eyes are positioned on the sides of its head so that it can see most of its surroundings without moving its head and attracting attention.
 - The eagle has excellent eyesight and can detect a rabbit from 3 kilometres away.
 - Owls have both eyes at the front to allow better judgement of distance when swooping on prey.
 - Insects may have multiple lenses to provide an all-round view.
 - Spiders have four, six or eight eyes, and scorpions have between six and twelve.
 - A chicken's eyes are on the opposite sides of its head. Therefore to judge distance it needs to see an object with both eyes.
- 7** A tapetum is a mirrored lining at the very back of a cat's eye. It reflects light through the rods and the cones a second time, giving the cat more chance of seeing objects even in very dim conditions. The tapetum is what makes the cat's eyes shine at night.
- 8** The common name for hyperopia is long-sightedness (ability to see distant objects, but not closer ones). The common name for myopia is short-sightedness (the ability to focus on objects a short distance away but not on distant objects).
- 9** Presbyopia is a condition in which a person loses the ability to focus at short distances (eg when reading) due to ageing. People with presbyopia often use reading glasses.
- 10** A short-sighted person cannot see a distant object because the focus point falls short of the retina.
- 11** To correct the focus of the short-sighted person, a concave lens can be used. The concave lens extends the focus point to the retina, thus enabling the person to see the object. Refer to Figure 2.1.16 in the Learner's Book.
- 12** Most bending of light rays occurs specifically in the lens of the eye.
- 13** The choroid is black because it is made to absorb light. Without the choroid, light would be reflected all around inside the eye.
- 14** There are no light-sensitive cells in the blind spot, thus it does not detect any image information. An image needs light for its formation—when there is no light, there is no image formation.
- 15** When we are outside in bright sunlight, the pupil of the eye becomes very small to allow only a minimum of light in. When we suddenly enter a dark room, the pupil takes a while to widen to allow more light in so that we can see the surrounding objects. During this adjustment time we cannot see clearly.
- 16** We squint when suddenly exposed to bright light because the amount of light suddenly received is far brighter than the amount needed to clearly see the objects.
- 17** If we had only one eye, we would not be able to judge distances very accurately.
- 18** Insects and animals that are active during the day need to see colours to help them identify their food, as well as identify dangers and escape from them.
- 19** An owl's colour vision is likely to be very poor because it is often active at night. Birds that are active at night tend to have very poor colour vision.
- 20** The parts of the eye that involved in focusing are the suspensory ligaments, the lens and the ciliary muscles.

- 21** A recent development in eyesight correction is laser surgery. There are two main methods: PRK (photoreactive keratotomy) and Lasik (laser in situ keratomileusis). The differences between these two methods are as follows:
- PRK involves removing a layer of cells from the surface of the cornea and remodelling the shape of the cornea using a laser.
 - In the Lasik treatment, a thin flap of the cornea is lifted up, but not removed, and a laser is used to reshape the cornea before the flap is replaced over the laser-treated area. Patients undergoing Lasik surgery often feel less discomfort and their healing time is reduced.
- 22** The purpose of blinking is to protect the eye from foreign objects. Blinking enables our eyebrows and eyelashes to keep out dust and also produces tears to flush out any foreign particles.
- 23** **a** Robert may have long-sightedness or hyperopia.
b People with this condition can see long distances away, but cannot focus on close-up objects.
- 24** Each of the lenses in an insect's eye is tiny, so not enough light focuses on one spot to do damage. An insect may not have lenses always aimed at the Sun.
- 25** In humans, colour vision is made possible because of the special cells in the retina called the rods and cones. The cones are the cells that help us to see different colours. However, they can only be activated when there is an abundance of light available. When there is not enough light, our ability to see colours is limited.
- 26** No, others may see colours differently—at present there is no way to tell for sure.
- 27** Two eyes allow us to judge distance more accurately. Each eye sees a slightly different view. The brain combines the two images to create a three-dimensional view that gives us more information about how far away an object is, which helps us to function in our daily lives. If we had only one eye, we would not be able to judge distances accurately and therefore our ability to escape potential dangers would be limited.



Unit 2.2: Hearing

Activity 2: Hearing tests

Learner's Book page 23

Process and skills	Resources	Teacher's support notes	Answers to questions
To examine the directional ability of our ears in detecting sounds	Blindfold	<p>This activity will improve learners' ability to follow instructions.</p> <p>Organise learners into groups.</p> <p>Learners may have different hearing abilities, so may not all achieve the same results. This activity provides an opportunity to identify learners with hearing problem, who can be referred to doctors for further medical attention.</p> <p>Note: Teachers must ensure that this activity does not diminish the learners' self-image.</p>	<p>1 The further away the sound source, the quieter the sound.</p> <p>2 With two ears we can determine the direction of sound. If a sound reaches both ears at the same time, our brain interprets this to tell us the direction and relative distance of the sound. When one ear is covered, the sound will reach only one ear, which will prevent the brain from accurately determining the direction and distance of the sound.</p> <p>3 Learners' evaluations should be based on the fact that two ears help us to determine the direction of sound.</p>

Answers

Unit questions

Learner's Book page 26

- When a sound wave reaches the ears, the vibrations travel through the auditory canal and cause the eardrum to vibrate.
- The unit used to measure the loudness of sound is the decibel (dB).
-

Part	Description/ function
Pinna	Fleshy ear flap, collects sound
Auditory canal	Connects the outer ear with the eardrum or tympanic membrane
Eardrum (tympanic membrane)	The beginning of the middle ear, made of a thin sheet of muscle and skin that vibrates in response to sounds
Hammer	Group of tiny bones, known as the ossicles, that make up the middle ear. By the time the sound reaches the stirrup, it has been amplified to about 30 times louder than at the eardrum
Anvil	
Stirrup	
Oval window	Vibration from the stirrup in the middle ear causes vibration to be passed through the oval window to the cochlea
Cochlea	Tube filled with fluid, which passes vibrations to a layer of tiny hairs connected to auditory nerves
Auditory nerve	Sends vibration messages to the brain that are then interpreted as sounds
Semicircular canals	Situated above the cochlea. These contain fluid that moves when we do. Nerves send messages to the brain, which in turn signals muscles to help us keep our balance
Eustachian tube	Does not actually play a role in the hearing process. However, it helps to maintain normal air pressure. Differences in pressure due to infections (such as colds) and high or low altitudes cause a 'blocked ear' sensation. It's a warning sign to do something about the pressure differences.

- 4 The part of the ear that is filled with fluid is called the cochlea. It is located in the inner ear.
- 5 The three small bones in the middle ear are called the hammer, anvil and stirrup. They are collectively known as the ossicles.
- 6 The auditory nerves attach to the cochlea, which is located in the inner ear.
- 7 Most sound amplification happens in the middle ear, especially due to the stirrup, one of the tiny bones that make up the ossicles.
- 8 When a sound arrives at your right ear just before it reaches the left, the direction of the sound is on the right.
- 9 Damage can be done to your hearing in the following ways:
 - Prolonged exposure to loud sounds can flatten the hairs of the cochlea, which then affects the vibration that produces sound in the ear, resulting in partial or complete deafness.
 - A blow to the head or a very loud sound (eg an explosion) can rip the eardrum, which interferes with its vibration and so affects your ability to hear properly.
- 10 Ear wax may be:
 - a useful in that it prevents entry of dust and bacteria into the auditory canal
 - b a hindrance in that it stop the eardrum from vibrating correctly, causing temporary deafness.
- 11 Three common activities in which some form of ear protection is advisable are when operating noisy machinery, using a lawnmower and using power tools.
- 12
 - a The sound of a moving train can warn of danger.
 - b The sound of a loud thunderclap or a jumbo jet on take-off could be harmful to our ears.
 - c The punching of a laptop key is a quiet sound.
- 13 Sound becomes hazardous to hearing at 80 dB.
- 14 When a sound reaches both ears at the same time, the brain is able to recognise whether the source of the sound is directly in front of, behind or above us.
- 15 An example of a task that involves mainly hearing is listening to music and service messages on the radio.
- 16 During take-off and landing, air pressure differences can cause the Eustachian tubes to become blocked. Chewing on lollies helps to open up the Eustachian tubes, which causes air to rush in, enabling a normal level of hearing again.
- 17 Large ears help these animals to pick up the noises of predators as they approach to attack them.
- 18 Two ears are more valuable than one for survival because two ears help you determine the direction of the source of sound. This helps you to escape from oncoming traffic or a falling tree.
- 19 Ear infection may jam the ear ossicles, reducing the vibrations that are passed onto the cochlea. This affects the normal vibration of the fluid in the cochlea, which then affects the fluids in the semicircular canals, upsetting your sense of balance.
- 20 The horizontal tube in children does not allow wax to drain out as readily as it does from the vertical tube in adults.
- 21 Caleb possibly has a partial blockage of the ear due to wax build-up. 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 away—70 dB; not harmful
 - e Normal level of music through headphones—70 dB; but depends on the volume
 - f Classroom chatter—60 dB; not harmful

Unit 2.3: Smell, taste and touch

Activity 3: Smell fatigue

Learner's Book page 27

Process and skills	Resources	Teacher's support notes	Answers to questions
To investigate the phenomenon of smell fatigue	<ul style="list-style-type: none"> a safe, strong-smelling substance (eg aftershave, soap or perfume) a watch a small container (eg a film canister and lid) 	<p>Check if learners are allergic to any of the substances that are going to be used in the experiment. Any substances to which a learner is allergic must not be used in the experiment at all.</p> <p>Guide learners to draw a graph. The x-axis should be labelled 'Strength of smell', while the y-axis should be labelled 'Time in seconds'.</p>	<ol style="list-style-type: none"> The smell becomes weaker. Learners' responses will vary.

Activity 4: Skin receptors

Learner's Book page 29

Process and skills	Resources	Teacher's support notes	Answers to questions																
To investigate the sensitivity of your skin in various areas	<ul style="list-style-type: none"> toothpicks tape ruler blindfold cloth 	<p>Consider the cultural implications of this activity for learners in rural areas, especially when partners are male and female. Take any necessary measures (eg team up males with males, and females with females).</p> <p>Create a rating chart for the class. For example, 1 = low, 5 = medium and 10 = maximum. Draw up a table like the table below and ask learners to fill in their own results.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Area of the skin</th> <th>Sensitivity rating</th> </tr> </thead> <tbody> <tr> <td>Back of the hand</td> <td></td> </tr> <tr> <td>Palm</td> <td></td> </tr> <tr> <td>Inside forearm</td> <td></td> </tr> <tr> <td>Back of forearm</td> <td></td> </tr> <tr> <td>Leg</td> <td></td> </tr> <tr> <td>Foot</td> <td></td> </tr> <tr> <td>Back of neck</td> <td></td> </tr> </tbody> </table>	Area of the skin	Sensitivity rating	Back of the hand		Palm		Inside forearm		Back of forearm		Leg		Foot		Back of neck		<ol style="list-style-type: none"> Learners rate their own sensitivities. Learners compare their results with their classmates to identify similarities. Some areas of the skin are more sensitive than others because of the greater concentration of the pain/touch receptors in these areas.
Area of the skin	Sensitivity rating																		
Back of the hand																			
Palm																			
Inside forearm																			
Back of forearm																			
Leg																			
Foot																			
Back of neck																			

Answers

Unit questions

Learner's Book page 29

- True
 - True
- Refer to Figure 2.3.1 in the Learner's Book.
- Papillae are not the same as taste buds. The taste buds are embedded between the papillae on the surface of the tongue.

- 4 When we eat, our senses of smell and taste work together to detect flavour. As much as 80 per cent of what we perceive as flavour is the smell. Flavour largely results from the smell of gases emitted from food that has just been taken out of the mouth. We can more easily eat a food or vegetable we don't really like by pinching our noses.
- 5 Starting from the surface, the layers of the skin are epidermis, dermis and fatty layer.
- 6 The five types of touch receptors are the pain receptor, light contact receptor, pressure receptor, cold receptor and heat receptor.
- 7 Learners' responses will vary.

8

Sense	Sense organ
Sight	Eye
Hearing	Ear
Smell	Nose
Taste	Tongue
Touch/feel	Skin

- 9 The sense of smell makes it easier to detect a gas leak.
- 10 The senses of smell and taste are important for a chef, who needs to smell and taste food.
- 11 When the body is hot, the sweat glands produce sweat, which, on reaching the surface, removes heat from the body as it evaporates. This enables the body to cool down.

Unit 2.4: Responding

Activity 5: Sweet and salty

Learner's Book page 30

Process and skills	Resources	Teacher's support notes	Answers to questions
To identify the threshold of a stimulus	<ul style="list-style-type: none"> • 12 new small paper cups • 2–3 mL each of solutions of sugar of varying concentrations (0.001%, 0.005%, 0.01%, 0.05%, 0.1%, 0.5%) • 2–3 mL each of solutions of salt (0.001%, 0.005%, 0.01%, 0.05%, 0.1%, 0.5%) • waste jar for rinsing • bottled water for rinsing mouth 	<p>The minimum intensity (amount) that causes a response is known as the threshold for the stimulus. In this case, the stimuli are the sweetness and the saltiness. The threshold is the point when the sweetness and the saltiness of both substances are able to be identified.</p> <p>Learners may have different thresholds for sweetness and saltiness because of the uniqueness of every individual in the class.</p>	<ul style="list-style-type: none"> 1 Learners' thresholds will vary. 2 Learners' thresholds will vary. 3 The differences in learners' thresholds will vary. 4 Having thresholds enables us to identify any potential danger at the earliest stage and escape from it before it causes harm to the body. For example, the threshold for heat receptors helps us to escape any potential burning of the skin. 5 a Learners' responses will vary. b Learners' responses will vary. Learners first need to identify any problems and identify what to do about them.

Answers

Unit questions

Learner's Book page 32

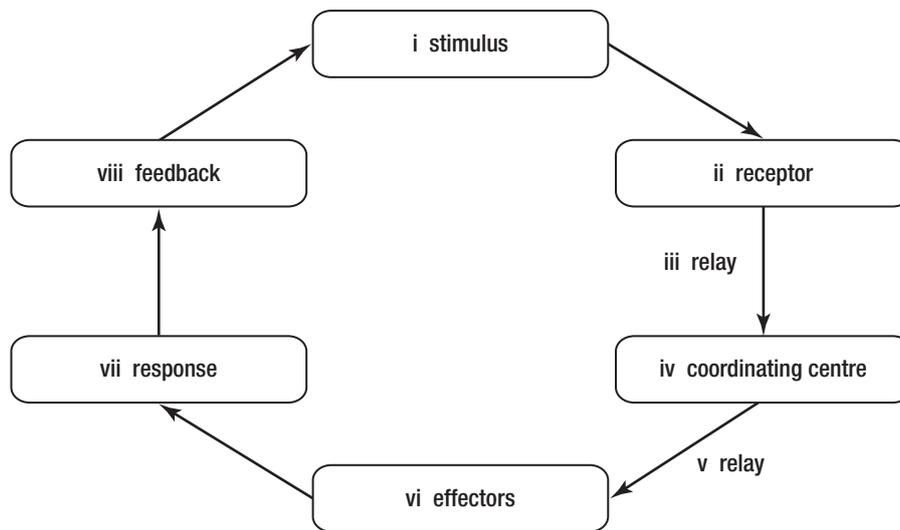
- 1 **a** Homeostasis is the maintenance of a constant internal environment despite changes in the surroundings.
- b** Homeostasis is necessary because humans are mammals and need a constant body temperature regardless of the surrounding temperature. For example, body temperature needs to stay at approximately 37°C, and blood acidity or pH at around 7.38, regardless of where we may be in the world (the hot deserts of Africa, the temperate weather of Solomon Islands or the cold of the South Pole). Homeostasis enables cells to keep working efficiently, maintaining temperature, glucose and water levels within strict limits.
- 2 The three substances are water, glucose and carbon dioxide.
- 3 **a** The approximate value of the body temperature of a healthy human is about 37°C.
- b** The approximate value of the pH level in the blood of a healthy human is around 7.38.
- 4 A receptor is a regulator (control) in the parts of the body that detect stimuli. A stimulus is something that acts on a receptor, causing a change in the activity of an organism. Stimuli include heat, light, pressure, touch, sound, chemicals and water levels. Our body contains receptors to detect all these stimuli. For example, our body contains pain receptors. An effector is an organ, such as a gland or a muscle. When a receptor receives a stimulus, a message is sent to the effector, which then causes a response to take place. For example, when your hand is cut by a knife, the pain receptors relay the message to the arm muscle (effector), and the muscle responds by contracting to withdraw the hand from the knife.

5

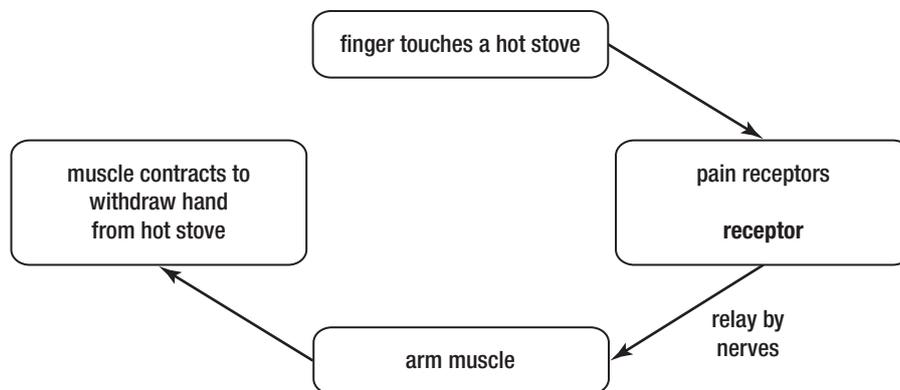
Receptor	Stimulus
Cells of the retina	Light
Cells of the inner ear	Sound
Taste buds	Chemicals
Osmoreceptors in the brain	Water levels
Semicircular canals in the ear	Gravity
Thermoreceptors in the skin	Heat

- 6 **a** Feedback is when a stimulus (eg a high temperature) stimulates a receptor (eg thermoreceptor in the skin). Feedback of information is then given to an effector (eg the sweat gland) to produce sweat on the surface of the skin to cool the body.
- b** Coordination of several parts of the body is required for the total response of an organism to a stimulus.
- 7 **a** The receptors that would detect this increase are located in the cells of the main arteries.
- b** The coordinating centre that would receive these messages is in the brain.
- c** The structures that would act as effectors are the diaphragm and chest muscles.
- d** The response we would notice is the increase in the breathing rate, which is likely to lower the carbon dioxide level in the blood.
- 8 Learners may list any information they may think they are currently receiving from their surroundings. However, it is important to note that these pieces of information are being received because of their senses; for example the smell of a classmate's perfume, the sound of primary-school children singing in their classroom or the sensation of hot or cold temperature as a result of the weather.
- 9 The most usual response is to move away from the stimulus.

10



11



Extension questions

Learner's Book page 32

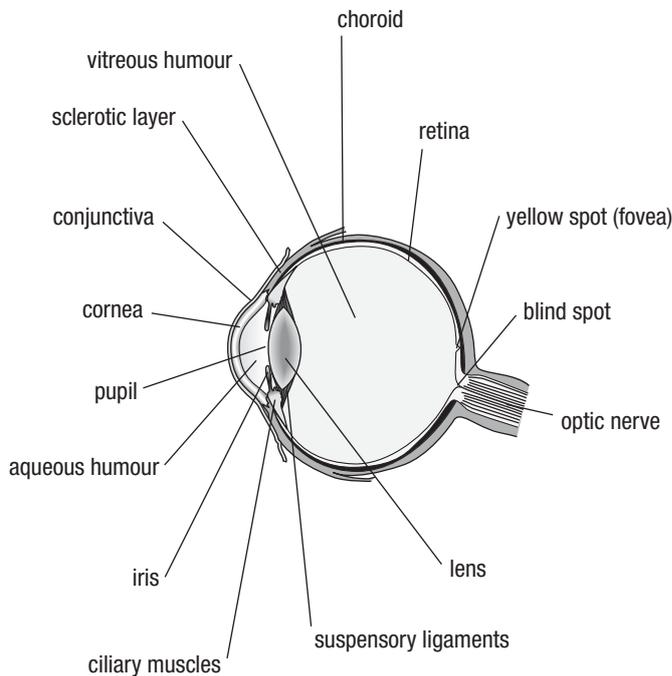
- 1
 - a In the case of hyperthermia (increase in body temperature), symptoms would include involuntary sweating and increased blood flow to the skin (making us look 'flushed'). The most likely cause would be that of wearing too many clothes on a hot day. Hypothermia (fall in body temperature) may also occur. Its symptoms would be a shivering body and body hairs standing up. This can happen when we don't put on enough clothes on a cold day or wear wet clothes for a long period of time.
 - b To avoid hyperthermia, wear fewer clothes during hot weather conditions and drink plenty of cold water. To avoid hypothermia, wear warm clothes on cold days and always take off wet clothes as soon as possible.
- 2
 - a According to the standardised pH scale for measuring acid, alkaline or neutral solutions, the blood pH of 7.38 would be described as almost neutral.
 - b Learners' responses will vary but should include respiratory causes (such as something that makes you breathe more quickly or slowly) or metabolic causes (diabetes, toxins, lactic acid or kidney failure). The body's response is to breathe at a different rate, or for the kidneys to pump different acids/bases to keep the pH levels balanced.

Chapter review

Answers

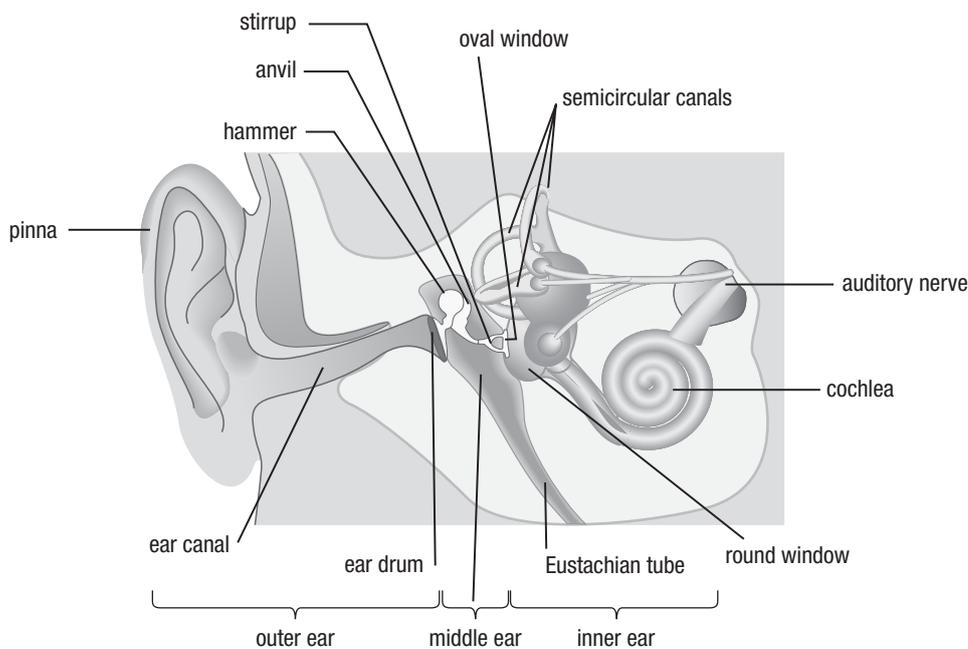
Learner's Book pages 33–34

1



- 2 The functions of the following parts of the eye are as follows.
- Iris—changes size to control how much light enters the eye. It also gives the eye its colour.
 - Lens—helps to focus images.
 - Retina—layer of the eye that contain over 100 million light-sensitive cells that transmit messages to the brain.
 - Choroid—a black layer that forms part of the inside lining behind the lens, and prevents light from reflecting all around the eye.
- 3 **a** The three main regions of the ear are the outer ear, middle ear and inner ear.
b The outer ear is filled with air; the middle ear is filled with air; and the inner ear is filled with fluid.
- 4 The function of each of the following parts of the ear is as follows.
- Eardrum—vibrates in response to sound been collected by the pinna and funnel through the auditory canal.
 - Ossicles—amplify sound and pass it to the cochlea via the oval window.
 - Semicircular canals—help in keeping our balance.
- 5 Skin, eye, tongue, nose and ear
- 6 Refer to Figure 2.3.3 in the Learner's Book.
- 7 When we smell something, a few tiny chemical particles of that thing enter the nose and dissolve in its moist lining. The dissolved substance triggers nearby nerve cells in the upper part of the nasal cavity, called olfactory cells. Impulses in the olfactory nerve send messages to the brain so we can smell the substance.

8



- 9 a Organisms need to be responsive to their surroundings to escape potential threats and obtain food.
 b A response to a stimulus may be complex and require actions from several parts of the body. These need to be coordinated.
- 10 Learners may come up with variety of situations, such as:
 a a stimulus—something that acts on a receptor, causing a change in the activity of the organism, for example when your finger is cut by a knife
 b an effector—an organ such as a gland or a muscle that causes a response, for example your arm muscle
 c a receptor—a part of the body that detects stimuli, for example the pain receptor detects the pain and relays the message through the nerves to the muscle (effector)
 d a response—a change in the activity of an organism as a result of a stimulus, for example when the muscle contracts to pull your finger away from the knife.
- 11 Learners may come up with variety of stimuli. Here are some examples.

Stimulus	Type and location of receptor
Heat or cold	Thermoreceptors in the skin
Water levels in the blood	Osmoreceptors in the brain and large arteries
Pressure and touch	Mechanoreceptors in the skin
Sound	Cochlear cells in the inner ear
Light	Photoreceptors in the retina of the eye
Chemicals	Chemoreceptors on the tongue and in the nose
Gravity	Semicircular canals in the ears

- 12 A pupil will dilate (increases in size) in dark conditions. This is to let in more light to help the eye see more clearly in the dark.
- 13 Myopia or short-sightedness is a condition in which the eye can focus on objects a short distance away but not on distant objects. Myopia can be corrected by concave lenses that move the focus point of the image back onto the retina.
- 14 Our senses of smell and taste work together to detect flavour. When the nose is blocked, our sense of smell is not as good as usual. To reduce the sensation of taking an unpleasant medicine, we can pinch our nose and the medicine will be tolerable.
- 15 Learners' responses should emphasise the fact that our senses help us to live a normal life, escape dangers and enhance our chances of survival in this world of potential dangers. Without our senses, the chances of human survival in this world would have been very limited.

Chapter 3: Materials

Strand: Natural and processed materials

Suggested periods: 16

Sub-strand statement

Metals are conductors, non-metals are insulators. Semi-metals behave like metals and non-metals. Metals can react with air—this is called rusting—and also react with acid to produce a salt and hydrogen gas. Plastics and fibres are non-metallic substances that are made mainly of carbon atoms. Plastics are found in many manufactured products that we use in our daily lives.

General learning outcomes

Learners should:

- 9.3.1** know that metals, semi-metals and non-metals have unique properties
- 9.3.2** be able to show that the corrosion of metals is caused by environmental factors
- 9.3.3** be able to show rates of reaction between dilute acids
- 9.3.4** know the different uses of alloys in the community
- 9.3.5** know the two main types of plastics
- 9.3.6** be able to give examples of plastics
- 9.3.7** be able to give examples of fibres
- 9.3.8** appreciate the different uses of plastics in the community.

Specific learning outcomes

Learners should be able to:

- 9.3.1.1** identify the properties of metals: hardness, malleability, ductility, density and conductivity
- 9.3.1.2** identify properties of non-metals: poor conductors, dull, brittle, low melting and boiling points
- 9.3.1.3** understand that semi-metals have both metallic and non-metallic properties
- 9.3.2.1** demonstrate the corrosion process using iron nails (in water, oil and air)
- 9.3.3.1** perform reactions between metals and dilute acids and compare the rates of reaction (metals: Na, Mg, Al, Ca, Fe and Zn; dilute acids: hydrochloric acid, sulfuric acid and nitric acid [0.1 M]. Use any acid that is available.)
- 9.3.4.1** identify different types of alloy materials found around the school and community and state the metals they are made of and uses of the alloys
- 9.3.5.1** name the two main types of plastics: thermoplastic and thermosetting plastic
- 9.3.5.2** name the materials used to make the plastics
- 9.3.6.1** provide examples of thermoplastic plastic and thermosetting plastic
- 9.3.6.2** draw the structures of the two types of plastics
- 9.3.7.1** provide examples of textile fibres
- 9.3.8.1** state the advantages and disadvantages of using plastics.

Answers

Suggested assessment events

Solomon Islands Years 7–9 Science Syllabus

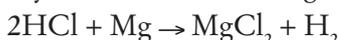
- 1** Properties of metals: high electrical conductivity, high heat conductivity, lustrous shine, malleable, relatively high melting/boiling points.
Properties of non-metals: no or limited electrical conductivity, no heat conductivity, dull shine, crumbles rather than bends, low melting/boiling points.

- 2 Learners' responses will vary according to their experience. Their tables might look something like this:

Advantages of plastics	Disadvantages of metals
Easy to create, manipulate and use	Non-renewable resources
Can be human-made	Harder to mine
Inexpensive to make	Expensive to mine
Disadvantages of plastics	Advantages of metals
Not biodegradable	Natural resources, so safer for the environment
Do not conduct electricity	Conduct electricity

- 3 Learners' responses will vary. Example response:

Hydrochloric acid + magnesium → magnesium chloride + hydrogen



Challenge questions

Learner's Book page 35

- Gold can be found as a nugget because it cannot react, whereas sodium is very reactive.
- Slag is waste material or residue that is left after metal has been removed from rocks (metal ore).
- Plastic objects often have a 'bump' or seam because they are human-made products. They need to be put together; sometimes one part is joined to another part, or they are made in separate sections.
- Nylon does not allow perspiration to evaporate, so a hot, sweaty body stays damp (moist or wet). Cotton allows perspiration to evaporate, allowing the body to cool as the perspiration evaporates.

Unit 3.1: Metals, non-metals and semi-metals

Activity 1: Using metals to make non-metals

Learner's Book page 37

Process and skills	Resources	Teacher's support notes	Answers to questions
To make a non-metal compound from a metal	<ul style="list-style-type: none"> samples of magnesium, iron and copper 2 M hydrochloric acid in a dropping bottle test tubes and rack matches safety glasses 	Some non-metal compounds can be made from metals.	<p>1 a Hydrogen gas b Oxygen c Carbon dioxide</p> <p>2 a H₂, element b O₂, element c CO₂, compound</p> <p>3 The reaction between metals and acids always results in the production of a salt and hydrogen gas.</p>

Answers

Unit questions

Learner's Book page 38

- Metal atoms formed lattices.
- Copper: can be hammered into a sheet; conductor of heat and electricity; shiny when polished
Mercury: remains in liquid form at room temperature; liquid mercury is shiny and silvery-white in colour, has high surface tension and appears rounded when on a flat surface
Magnesium: sinks in water (although lightweight); silvery-white in colour

- 3** Non-metals can exist as single atoms, or molecules containing two atoms, and some form lattices.
- 4** Sulfur: soft, bright yellow solid; faint odour similar to a match
 Bromine (liquid only): non-metal; low melting and boiling points; dull, no shine; brownish-red liquid
 Phosphorus: non-metal; properties vary depending on type and form
 Iodine: very strong smell; corrosive poison; sinks in water
 Carbon: the only non-metal that conducts electricity; low melting and boiling points; dull; brittle
- 5** Non-metals have higher electronegativity.
- 6** **a** Hydrogen has only one electron in its outer shell and so it should be placed in Group 1, because elements in this group have only one electron in their outer shells.
b Hydrogen can form a gas when combined with another hydrogen atom.
c Hydrogen is the only element that has one electron.
- 7** Helium could be placed in Group 2 because it has two electrons in its outer shell.
- 8** Helium is usually placed in Group 18 because its outer-shell electrons have reached the maximum number of electrons (outer shell is full or stable). Group 18 elements are all stable.
- 9** **a** Another name for semi-metals is metalloids.
b Properties of semi-metals: act like non-metals in most ways; have some properties of metals; conduct electricity.
- 10** **a** Na^+ ; **b** S^{2-} ; **c** I^- ; **d** P^{3-} ; **e** Al^{3+}
- 11** **a** Lustrous—shiny when polished or freshly cut
b Malleable—hammered into new shapes without breaking
c Ductile—able to be pulled or stretched into wires without breaking
d Brittle—hard but fragile and easily broken
e Electronegativity—the strength with which an atom holds its electrons
f Semi-metal—material having the properties of non-metals and metals
- 12** **a** Mercury; **b** Boron, aluminium; **c** Carbon, silicon; **d** Beryllium, magnesium
- 13** **a** Boron, carbon, silicon, phosphorus, sulfur
b One (bromite)
c Oxygen, nitrogen, argon, chlorine
- 14** **a** Oxygen, nitrogen, argon and chlorine
b Carbon and silicon
c Silicon, phosphorus, sulfur, chlorine and argon
d Fluorine
e Fluorine, neon, phosphorus, silicon, chlorine and argon
- 15** Group 1 charge +1; Group 2 charge +2; Group 13 charge +3; Group 15 charge -3; Group 16 charge -2; Group 17 charge -1; Group 18 no ions formed

16

Properties of metals	Properties of non-metals
Ductile	Normally gas or liquid
Dense	Brittle
Malleable	Dull
Lustrous	Poor conductors
Excellent conductors	
Normally solid	

Unit 3.2: Corrosion of metals

Activity 2: Corrosion of iron

Learner's Book pages 40–41

Process and skills	Resources	Teacher's support notes	Answers to questions
To investigate factors affecting the corrosion of iron	<ul style="list-style-type: none"> • 5 iron nails (not galvanised) • copper wire • magnesium ribbon • distilled water • salt (sodium chloride) solution • fine sandpaper or steel wool • 4 test tubes • test-tube rack • Bunsen burner • bench mat and matches • 250 mL beaker • peg or tongs • marker pen 	Metals react with other substances such as air (oxygen) and water. As a result of this type of reaction, metal becomes corroded.	<ol style="list-style-type: none"> 1 Heat and salt 2 Heat speeds up the rate of rusting. 3 Magnesium, iron, copper 4 Test number 4, because magnesium is more reactive than iron and will react instead of the iron 5 Because the metal that sacrificed itself is more reactive than the other, it reacts instead of the gas.

Answers

Unit questions

Learner's Book page 41

- 1** Required for rusting: iron, air and water (as either liquid or vapour)
- 2** Equation for rusting: $4\text{Fe} + 3\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$
- 3** Heat and salt speed up rusting.
- 4** Ways to protect iron and steel: corrosion-resistant alloy, galvanise, sacrificial protection
- 5** Sacrificial protection is when a more reactive metal is coated on or attached to a metal of importance (usually iron). The metal will corrode instead of the iron.
- 6** Aluminium oxide
- 7** $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$
- 8** Rusting refers to the corrosion of iron. Zinc and other metals will corrode but never rust.
- 9** When scratched, the exposed iron will begin to rust. After a short time the rust will flake, allowing more water to enter into the deeper layers of the car body and to the steel on either side of the scratch, including parts still covered with paint. Any paint on a rust-flake will lose its adhesiveness and will flake off with it.
- 10**
 - a** The iron of the steel will rust when in contact with the water, salts and acids of foods and drinks. A protective layer of non-toxic and unreactive plastic or tin will keep the contents away from the steel.
 - b** A dent or scratch may crack the protective plastic or tin layer, exposing the food to iron and, after a short while, rust. The food or drink will develop a strange taste and may begin to react itself.
- 11** Zn, Al, Mg, Ca, Na and K would all provide sacrificial protection to iron. The last two would react far too quickly to provide much protection, however.
- 12** Galvanising protects iron as long as some zinc remains on the surface. Scratches can occur, but rusting won't. Paint, however, needs to provide a perfect layer without chips, cracks or scratches, to protect iron adequately.

- 13** Iron rusts and crumbles because rust is flaky, allowing water to enter the deeper layers. Aluminium is highly reactive but the dull oxide layer formed is tightly bound to the surface, stopping entry of water into the deeper layers.
- 14** When magnesium blocks attached to piers dissolve, new blocks must be attached to continue their role as sacrificial protectors.
- 15** Al, Mg, Ca, Na and K would all protect a zinc structure from corrosion.
- 16** Points supporting the statement 'Iron is the most valuable metal on Earth':
- Iron consumption is nine times that of all other metals put together.
 - Steel is extremely strong, cheap, plentiful and easily worked.
- Points rebutting the statement:
- Other metals are more rare and therefore expensive and valuable.
 - Some have rare properties that make them extremely valuable in specialist roles (eg sodium as a nuclear reactor coolant).
- 17** Copper and tin will act like paint: if scratched, the iron underneath will begin to rust. Magnesium will provide sacrificial protection and the scratch will not rust.
- 18** Because the steel window frames were exposed to the sea water every day and night, causing them to rust easily and quickly
- 19** The surgical-grade metals will not corrode or rust when exposed to the sweat, salt and blood that will surround a piercing. Cheaper metals would corrode and infection would be very likely.

Unit 3.3: Reactions of metals with dilute acids

Activity 3: Metal reactivity

Learner's Book page 43

Processes and skills	Resources	Teacher's support notes	Answers to questions
To compare the reactivity of metals	<ul style="list-style-type: none"> • samples of copper, aluminium, magnesium, iron, zinc • steel wool • dilute hydrochloric acid • 5 test tubes 	Metals usually react at different rates, depending on the number of electrons in their outermost shells.	<p>1 The acid bubbles up.</p> <p>2 Magnesium, steel wool, iron, zinc</p> <p>3 Aluminium and copper</p> <p>4 Magnesium</p> <p>5 Copper</p> <p>6 Magnesium, aluminium, zinc, iron, copper</p>

Answers

Unit questions

Learner's Book page 43

- 1 Not all metals react with water. Tin, lead, copper, silver, gold and platinum do not react with water or steam.
- 2 acid + metal \rightarrow salt + hydrogen (eg nitric acid + calcium \rightarrow calcium nitrate + hydrogen)
- 3 A system of ordering metals by grouping them from most reactive to least reactive
- 4 Most reactive: francium and caesium. Least reactive: gold and silver
- 5 Metals in Groups 1 and 2 can easily lose their valence electrons to form ions and therefore are more reactive than the transition metals.
- 6 The metal loses its negatively charged electrons so that it has fewer electrons than it has protons in its nucleus. When it has more protons the overall charge of the ion is positive.

- 7 a Hydrogen gas forms.
- b Magnesium metal becomes positively charged after it loses its outermost shell electron to become a magnesium ion.
- c Since magnesium ions are positively charged, they will be attracted to the negatively charged chloride ions (unlike charges are attracted to each other).

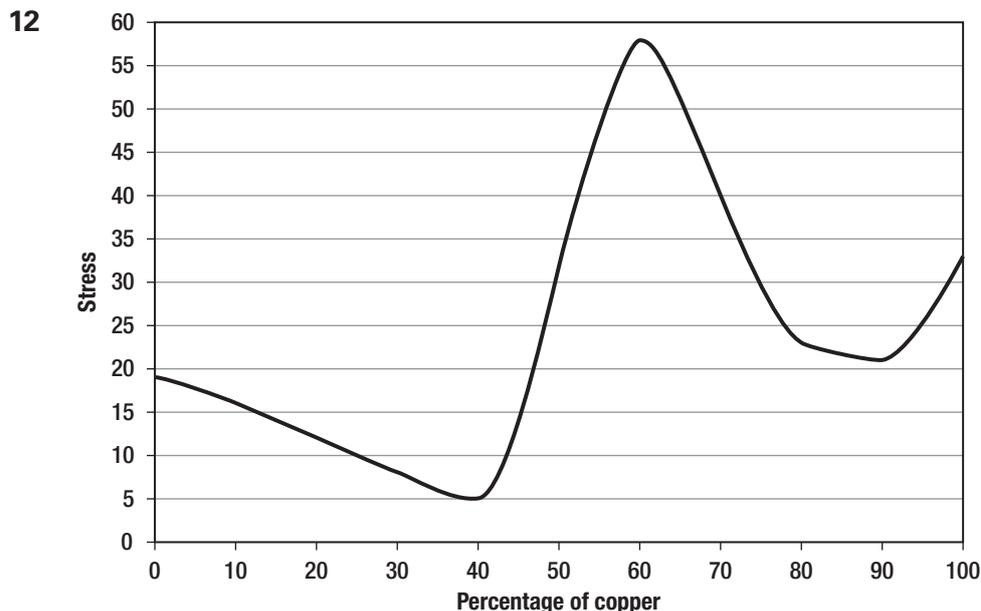
Unit 3.4: Pure metals and alloys

Answers

Unit questions

Learner's Book page 46

- 1 Pure metals are generally too soft to be made into anything useful.
- 2 Copper and aluminium can be used in their pure form.
- 3 An alloy is a mixture of metals.
- 4 An alloy has properties that are different from those of its components. These new properties are usually an improvement over those of the main or base metal in the alloy. For example, brass is more durable than its base metal, copper.
- 5 Coins are alloys: 'gold' coins contain copper, aluminium and nickel, and 'silver' coins are nickel and copper.
- 6 Aluminium is used for these purposes because it is an excellent conductor of heat and electricity, extremely light and non-toxic.
- 7 a It is a pure metal because it is made up of one single element.
b It is an alloy because it is made up of more than one element.
- 8 Dental amalgam is an ideal substance for tooth fillings because it hardens slowly after being mixed, and is strong, hard and durable.
- 9 The base metal in ferrous alloys is iron, Fe.
- 10 Wrought iron: very little carbon. Stainless steel: very little carbon but Cr and Ni added. Mild steel: 0.5% carbon. Hard steel: 1 to 2% carbon. Cast iron: 2.4 to 4.5% carbon
- 11 a A 12-carat gold ring has $12/24 = 1/2 = 50\%$ pure gold.
b A 9-carat gold nose-stud has $9/24 = 3/8 = 37.5\%$ pure gold.
c A 22-carat gold chain has $22/24 = 11/12 = 91.7\%$ pure gold.



- a** The breaking stress of:
- i** a 50/50 alloy of copper/zinc: $32 \times 10^6 \text{ N/m}^2$
 - ii** an alloy of 20% Cu and 80% Zn: $12 \times 10^6 \text{ N/m}^2$
 - iii** an alloy containing 60% zinc: $5 \times 10^6 \text{ N/m}^2$
 - iv** pure copper: $33 \times 10^6 \text{ N/m}^2$
 - v** pure zinc: $19 \times 10^6 \text{ N/m}^2$
- b** Pure copper has a strength of $33 \times 10^6 \text{ N/m}^2$. Any part of the curve that is higher than this represents a copper/zinc alloy that is stronger than pure copper. To be stronger than pure copper, the alloy needs to have a composition somewhere between 52% copper (the remaining 48% being zinc) and 73% copper (27% zinc).
- c** Pure zinc is represented on the graph and in the data as 0% copper. This metal has a strength of $19 \times 10^6 \text{ N/m}^2$. The part of the graph lower than this point represents alloys that are weaker than pure zinc. To be weaker than pure zinc, the alloy thus needs a composition of between 0% copper (pure zinc) and about 47% copper (53% zinc).
- d** The strongest copper–zinc alloy is a 60% copper, 40% zinc mix.
- e** The composition of three alloys that all break at a strain of $25 \times 10^6 \text{ N/m}^2$ are approximately 48% copper (52% zinc), 78% copper (22% zinc) and 98% copper (2% zinc).

Unit 3.5: Plastics and fibres

Activity 4: Identifying plastics

Learner's Book pages 49–50

Processes and skills	Resources	Teacher's support notes	Answers to questions
To identify properties of some common plastics	<ul style="list-style-type: none"> • labelled pieces (each about $2 \times 1 \text{ cm}$) of polythene • polystyrene • PVC • perspex • nylon • 'mystery' plastics • dissection board/ bench mat • scissors • turpentine • nail polish remover • dilute hydrochloric acid (HCl) • detergent • 250 mL beaker • tongs • access to meths burner set-up in fume hood 	<p>Ensure the meths burner is placed in the fume hood for safety. Other items may also smell and affect learners, so make sure there is open space for the use of turpentine, HCl and nail polish remover. Mystery plastics can be from household objects and learner choices. The items may be changed or damaged depending on what is done to them.</p>	<ol style="list-style-type: none"> 1 Learners' responses will vary. 2 Learners' responses will vary. 3 For safety purposes, such as avoiding strong smell of gas from burning of plastic. 4 PVC produces hydrochloric acid fumes when it burns. 5 Plastics will sink if they are dense but not if they are light. They will not react in water. 6 It was a thermoplastic.

Activity 5: Making casein plastics

Learner's Book pages 50–51

Processes and skills	Resources	Teacher's support notes	Answers to questions
To make a polymer called casein from milk. Casein is an early plastic that is still used for buttons and some wood glues. It is hardened industrially with formalin.	<ul style="list-style-type: none"> • full-cream milk • vinegar • Bunsen burner • bench mat • tripod • gauze mat and matches • 100 mL measuring cylinder • 2 × 250 mL beakers • thermometer • glass stirring rod • elastic band • coarse cloth for straining • paper towel/filter paper • assorted moulds (bottle caps) • moulded chocolate trays • fine sandpaper • tongs 	To answer all the questions and to understand more about this process, learners might like to research the process of producing and hardening casein.	<ol style="list-style-type: none"> 1 It was a thermoplastic. 2 The final test, which is burning of the dry casein in the Bunsen flame, is to identify whether it is thermosetting or thermoplastic. If it melts and resets when cooled, then it must be a thermoplastic. However, if it decomposes (chars) when heated, then it must be thermosetting plastic. 3 Guttering and pipes. This is because PVC can be made into different shapes when heated. 4 It is soaked in formalin for a long period of time.

Activity 6: Identifying fibres

Learner's Book page 52

Processes and skills	Resources	Teacher's support notes	Answers to questions
To compare and contrast natural and synthetic fibres	<ul style="list-style-type: none"> • labelled samples of fabrics (wool, cotton, linen, rayon, nylon, polyester) • microscope • microscope slide and coverslip • pins or tweezers • metal tongs • matches • bench mat 	<p>Fabric samples for this experiment can be collected at home or from the Home Economics department.</p> <p>Ensure that each learner knows how to use the microscope, especially using the correct magnification to observe the sampled fabrics.</p> <p>Caution must be taken when using the lit matches. Ensure that learners don't play around with them to avoid any harmful accident.</p>	<ol style="list-style-type: none"> 1 Learners' responses will vary. 2 Learners' responses will vary. 3 Synthetic fibres are human-made and involve processes that give them smooth surfaces. 4 Learners' responses will vary based on the quality of and additives used in the items in the materials. In general, silk and wool will take longer to ignite but will burn when ignited. Cotton and linen will burn faster and are the most likely to catch fire. Nylon will be in between these two categories, but will melt.

Processes and skills	Resources	Teacher's support notes	Answers to questions
			<p>5 Learners' responses will vary but the clothes will swing closer to fires and catch alight more easily. Girls may be more likely to wear clothes that swing, such as dresses and skirts.</p> <p>6 It is not recommended that babies and young children wear loose clothing, as it is more likely to touch on fires. Wool is less likely to burn than cotton but does burn once it ignites. Nylon is also less likely to burn but when it does, it melts and sticks to the skin, making burns even worse. Wool and natural fibres are generally recommended over fibres that melt.</p>

Answers

Unit questions

Learner's Book page 54

- An organic compound is one with a carbon backbone.
- Examples of organic compounds are plastics, drugs, biological molecules, sugars, flavourings and alcohols.
- a** Group 4; **b** Period 2; **c** Outer-shell electrons: 4; **d** Maximum number of bonds: 4; **e** Carbon lattices: diamond and graphite
- A small molecule capable of joining together in a long chain is called a *monomer*. When small molecules join together they form a *polymer*. Small molecules join together in a process known as *polymerisation* and result in the production of *plastics*.
- Thermoplastics soften when heated and can be moulded into shapes easily.
- Thermoplastics are manufactured as powder, pellets or granules.
- Plastics made by thermosetting are hard and rigid because their polymer strands are cross-linked.
- Thermosetting plastics are hard, brittle and rigid.
- a** True; **b** False; **c** False
- In a monofilament, each molecule is the same length as the monofilament, and therefore there are no weak spots. Fishing lines, for example, are stronger when made of a monofilament.
- Desirable properties of plastics: non-reactive (don't rust), strong, light, easily moulded, thermal and electrical insulators.
Undesirable properties of plastics: non-reactive, non-biodegradable, some will dissolve in organic chemicals, brittle when exposed to sunlight, some produce toxic gases and smoke on burning, some will melt at low temperatures.
- Natural fibres have a rough surface and thus a high surface area. They are like a towel in that they can absorb and hold water easily. Synthetic fibres do not absorb sweat because of their smooth surface. If we wear synthetic fibres we will feel wet and clammy. Wool can absorb a lot of water but is very warm.

- 13 a** The surface of a natural fibre is rough while the surface of a synthetic fibre is smooth.
b A monomer is a single, small molecule. A polymer is made up of many monomers linked together.
c Thermoplastic means that the plastic can be melted and remoulded into new shapes. Thermosetting plastics cannot be remoulded.
- 14 a** Synthetic polymers: nylon, terylene, Lycra, polyesters, acrylics
b Natural polymers: wool, silk, cotton
c Thermoplastic polymers: PVC, acrylic, polythene, nylon
d Thermosetting polymer: Bakelite
e Monofilament: nylon in fishing lines, Kevlar
- 15** If a train represents a polymer, then a single carriage would represent the monomer from which it is built.
- 16** Thermoplastics have only weak forces holding the long chains next to each other. When heated they can slip over each other easily, filling any new mould. On cooling, the weak forces become re-established, holding the chains in the new shape.
- 17** Once a thermosetting plastic powder was made it would remain a powder, because it could never be moulded into new shapes.
- 18** The longer the molecule, the stronger the fibre.
- 19** Fibres tend to break at weak spots. This will often be at the end of a molecule.
- 20** Care must be taken when drying and pressing synthetic fibres because the heat may soften the thermoplastic polymer, allowing it to melt or adopt new shapes.
- 21** Cross-links hold the polymer chains together. When heated, the chains cannot slip easily over each other. Heat will eventually break the bonds within the polymer chain and between chains, causing the plastic to decompose and char.
- 22** Many answers are possible. Following are some examples:
Plastics have had a great effect on society. They have become one of the most widely used materials and have found uses in nearly all environments and societies on Earth. They are used for storage, packaging, clothing, insulation and food preparation, and to make the structural components of tools, toys, furniture, buildings and cars, as well many other uses.
The use of plastics has become so widespread because the properties of plastics can be developed to suit various applications. For example, they can be hard and heat-proof when used for saucepan handles, lightweight and flexible when used for bags, and strong and waterproof when used for pipes. It is difficult to imagine life without plastics, as they make up many of the items we rely on for daily living.
The effects of plastics on the environment are more problematic, as most plastics are non-biodegradable; that is, they stay in the environment for many years (possibly more than a thousand years) before decomposing. Some new plastics are being made to break down faster by the action of bacteria or sunlight, and this may in time lessen the adverse effects of plastics on the environment. The recycling of plastics is also a key factor in reducing their impact on the environment.
Controlling the disposal of plastics and recycling are important, as plastics have many impacts on the environment. For example, plastics (plastic bags especially) can be mistaken for food by marine animals such as dolphins and whales. Many animals are also killed each year by getting tangled in plastic waste in rivers, lakes and oceans. In order to overcome some of these problems, we must find ways to reduce our use of plastics, and recycle all plastics produced. Purchasing products made of recycled plastics may help to promote better use of this non-sustainable resource.

Chapter review

Answers

Learner's Book page 55

- 1 Any alloy and its parent metal from the table of alloys on page 45 of the Learner's Book is acceptable.
- 2 The additives in alloys are usually metals but are sometimes the non-metals carbon or silicon.
- 3 Elements with some properties of both metals and non-metals. They might be shiny, but brittle. They might be dull, but conduct electricity.
- 4 Potassium is more reactive than magnesium because it is an alkali metal.
- 5 Carbon content:
 - a Cast iron: 2.4 to 4.5%
 - b Tool steel: 1%
 - c Mild steel: 0.5%
- 6 Pure gold is 24 carat.
- 7 18-carat gold is $18/24 = 3/4 = 75\%$ pure gold.
- 8
 - a Aluminium: water tank, overhead electricity cables, saucepans, cans, aluminium foil, base metal for alloys
 - b Zinc: coating of iron/steel in galvanised iron
 - c Cast iron: iron lace, some heavy cookware
 - d Duralumin: aircraft frames
 - e Bronze: statues, ornaments, bells
 - f Haematite: iron oxide (Fe_2O_3), the ore from which iron is extracted
- 9
 - a Alloy of copper: brass, bronze, cupronickel
 - b Alloy of iron: any steel, cast iron
 - c Common impurity in iron: carbon
 - d Common pure metal: aluminium, copper
 - e Ore: any of bauxite, chalcopyrite, galena, gold, haematite, pitchblende, rutile, sphalerite
 - f Native metal: any of gold, silver, platinum, copper
 - g Natural fibre: any of silk, wool, cotton, linen, coir, fur, hair
 - h Synthetic fibre from wood: any of rayon, viscose, acetate, triacetate, paper
 - i Monofilament: nylon fishing line, Kevlar
 - j Organic solvent: turpentine, petrol, nail polish remover, methylated spirits
- 10 Special name given to the corrosion of iron is 'rusting'.
- 11 A thermosetting plastic is hard, brittle, rigid, will char but not soften, and cannot be remoulded.
- 12 Stainless steel is strong and will not corrode once implanted in the body.
- 13
 - a After all the zinc coating has corroded off galvanised iron, the iron itself will rust.
 - b After a few years the sheets will need to be replaced, since it is not economical to re-dip them.
- 14 Although car bodies are galvanised, paint gives them further protection. The galvanising will not be needed until the paint is scratched or dented. Painting is also done for appearance.
- 15 Unless specifically designed to break down in sunlight, plastic shopping bags do not rot, dissolve or decay once thrown out. We can instead use paper bags, string bags, backpacks etc. to carry our shopping in.
- 16 Figure 3.2.5 shows that there is a strong aluminium oxide layer that forms over the aluminium metal. Oxygen and water are unable to penetrate this layer.

Chapter 4: Human body systems

Strand: Life and living

Suggested periods: 16

Sub-strand statement

The human body is made up of different systems that work together for normal body functions. The skeletal system consists of bones and muscles; it supports the body and enables it to move. The human reproductive system makes the continuation of life possible. When gametes from male and female parents combine, a new offspring is formed. The nervous system controls and coordinates all the parts of the body. It is the most complex of all the body systems. The endocrine system uses chemical messages called hormones to transfer information around the body.

General learning outcomes

Learners should:

- 9.4.1** know that the human skeleton is made up of different parts
- 9.4.2** understand the function of the human skeletal system
- 9.4.3** know that joints and muscles enable the movement of the human body
- 9.4.7** appreciate the functions of ‘antagonistic’ muscles, which produce movements of certain body parts
- 9.4.8** know the different parts of the human reproductive systems
- 9.4.10** understand that when children reach puberty their bodies undergo physical changes
- 9.4.11** understand the phases of the menstrual cycle in the female reproductive system
- 9.4.12** understand the processes that occur from the formation of the gamete to birth
- 9.4.13** know the problems associated with the reproductive systems
- 9.4.14** understand the main features of the human nervous system
- 9.4.17** understand the role of the human brain and reflex arc
- 9.4.18** know that the endocrine system passes messages in the form of chemicals (hormones) to the target organs of the human body
- 9.4.19** understand the function of each hormone produced by the endocrine glands.

Specific learning outcomes

Learners should be able to:

- 9.4.1.1** identify five parts of the skeletal system: skull, limbs, ribcage, girdles, vertebral column
- 9.4.2.1** describe the three main functions of the human skeletal system: support, protection and movement
- 9.4.3.1** identify and describe the three types of joints of the human skeletal system: hinge (elbow and knee), ball and socket (shoulder and hip), pivot
- 9.4.4.1** state that muscles are joined to the bone by tendons
- 9.4.4.2** state that bones are joined to each other by ligaments
- 9.4.5.1** explain that muscles contract and relax to produce movements
- 9.4.6.1** demonstrate that lifting of the arm is an antagonistic muscle movement
- 9.4.7.1** explain that muscles work in pairs, with one contracting while the other relaxes
- 9.4.8.1** identify the parts of the male and female reproductive organs: male—penis, testicle, urethra, prostate and bladder; female—vagina, cervix, uterus, fallopian tube and ovary
- 9.4.9.1** describe the functions of the parts of the male and female reproductive organs: male—testicle, urethra, prostate and bladder; female—cervix, uterus, fallopian tube and ovary

- 9.4.10.1** explain the physical changes occurring in male and female bodies at puberty due to the release of hormones (testosterone and oestrogen)
- 9.4.11.1** draw a diagram to describe the menstrual cycle and explain the three main phases: follicle, ovulation and luteal
- 9.4.12.1** draw a diagram to describe the reproductive stages from fertilisation to birth
- 9.4.13.1** identify the problems associated with male and female reproductive systems: diseases, infertility, cancer and cysts
- 9.4.13.2** describe ways to avoid reproductive problems
- 9.4.14.1** describe the main parts of the nervous system
- 9.4.15.1** describe the functions of the brain, spinal cord, sensory receptor and nerves
- 9.4.16.1** illustrate using a diagram the difference between sensory neurons, motor neurons and interneurons
- 9.4.17.1** demonstrate a simple reflex arc: tap just below the knee cap of a friend sitting on a table with their leg hanging down
- 9.4.18.1** define the following terms: hormones, endocrine glands, endocrine system, target organs
- 9.4.19.1** identify from a diagram and describe the functions of endocrine glands and the hormones they produce: pituitary, thyroid, adrenal, pancreatic, ovary, testes, liver.

Answers

Suggested assessment events

Solomon Islands Years 7–9 Science Syllabus

- 1** Support, protection, movement
- 2** The male hormone, testosterone, stimulates the development of the genital organs and secondary sexual characteristics. The female hormone, oestrogen, causes the egg to mature, the lining of the uterus to thicken with blood and the development of secondary sexual characteristics.
- 3** Antagonistic muscles work in pairs, with one contracting while the other relaxes.
- 4** The response of the body is controlled by both the nervous and the endocrine systems when a person is frightened.

Challenge questions

Learner's Book page 56

- 1** The bigger you are, the bigger your heart is. Your heart is about the size of your fist. Your heart and fist will grow at about the same rate.
- 2** Your pulse can be felt where an artery passes close to the skin, such as your neck or wrist.
- 3** No. Heartburn is a form of indigestion felt as a burning sensation in the chest.
- 4** Veins appear blue because when we look at them underneath our skin, more blue light is reflected into our eyes than red light.

Unit 4.1: Skeleton and muscles

Activity 1: Joints in the body

Learner's Book page 59

Processes and skills	Resources	Teacher's support notes	Answers to questions
To classify the joints in the human body	Diagram or picture of a human skeleton	Learners should refer to Figures 4.1.4, 4.1.5 and 4.1.6 in the Learner's Book to help them identify the types of joints.	1 Refer to page 58 of the Learner's Book. 2 The ball and socket joints are the most common.

Answers

Unit questions

Learner's Book page 61

- Three types of skeleton are endoskeleton (internal), exoskeleton (external and shell-like) and an internal liquid-filled skeleton.
- Support, protection, movement
- Our bones are alive, otherwise they could never repair themselves in an accident.
- Hardness: calcium phosphate
 - Elasticity: collagen
- Bone marrow makes new blood cells.
- Three types of bone joints are: hinge (knee, elbow), ball and socket (hip), and pivot (bottom of skull).
- Synovial fluid is in the joints. It reduces friction between the bones.
- Muscles are attached to bones by special fibres called tendons.
- When discussing muscles, the opposite of 'contract' is 'relax'.
- An antagonistic pair is a pair of flexors and extensors that always contract to move a bone.
- Voluntary muscles are muscles that we make a conscious decision to use, for example our arm muscles. Involuntary muscles work without our making a decision to use them, for example diaphragm, heart.
- Osteoporosis affects more females than males.
- Two types of arthritis are osteoarthritis and rheumatoid arthritis.
- Skull: brain
 - Pelvis: parts of small and large intestines, bladder, ovaries in women, prostate in men
 - Ribs: heart, lungs
- Ligaments are strong fibres holding bones in place. Tendons attach muscles to bones. Cartilage is found in joints, protecting the bones and making the joints more slippery.
- Stretching and warming up before playing sport minimises the possibility of damaging muscles or groups of tendons such as the hamstring.

Extension questions

Learner's Book page 61

- Kneecap: patella
 - Shoulder blade: scapula
 - Collar bone: clavicle
 - Thigh bone: femur
- Fibula: lower leg
 - Radius: forearm
 - Tarsals: foot
 - Tibia: lower leg or shin

Unit 4.2: Human reproductive systems

Activity 2: Changes in male and female reproductive organs

Learner's Book page 65

Processes and skills	Resources	Teacher's support notes	Answers to questions
To identify the parts of the male and female reproductive systems	<ul style="list-style-type: none"> • large sheet of paper • crayons or coloured pens 	<p>Learners may benefit from the outline being provided to them rather than drawing the organs from scratch.</p> <p>The topic can be sensitive for some learners.</p>	<p>1 Underarm hair, pubic hair, growth spurt, change in hormones</p> <p>2 Males: sperm production, muscle growth, penis lengthens and widens, voice deepens, facial hair growth</p> <p>Females: onset of menstruation, breasts increase in size, hips widen</p>

Answers

Unit questions

Learner's Book page 65

- The location of the testes outside the body maximises sperm production by keeping the testes cool.
- Prostate, seminal vesicle, Cowper's glands
- Semen consists of sperm and fluid.
- About 500 000 are present at birth but only a few hundred of these ever become fully formed.
- Hormones regulate the menstrual cycle.
- The egg is fertilised in the fallopian tube, or oviduct.
- The blastocyst produces a hormone that tells the body not to menstruate.
- The lining consists of blood, mucus and cell debris.
- Menopause usually occurs between 40 and 50 years of age and during this period no more eggs are released.
- Puberty is the time when a person becomes capable of reproduction.
- Males: grow taller, muscles develop, body hair grows and voice deepens. Females: breasts develop, hips widen, body hair grows.
- The male hormone is testosterone and the female hormone is oestrogen. Testosterone causes many changes in a boy, such as a growth spurt, increases in muscle and bone mass, growth of facial hair. Oestrogen causes a girl's eggs to mature and the lining of her uterus to thicken with blood. Oestrogen is also responsible for the outward changes seen in females at puberty.
- About 125 cm
 - About 140 cm
 - Girls: 11–13; Boys: 13–15
 - True. The graph shows that boys are taller than girls from about age 14.

Unit 4.3: From gamete to birth

Answers

Unit questions

Learner's Book page 70

- 1 Copulation is sexual intercourse.
- 2 Millions of sperm are released.
- 3 Only one sperm penetrates the egg.
- 4 **a** The two types of twins are fraternal twins and identical twins.
b Fraternal twins result when two separate eggs are fertilised and identical twins result when a single fertilised egg splits in two.
- 5 **a** The pill, condoms, cap and diaphragm, IUD (intrauterine device)

Contraceptive	Advantages	Disadvantages
Pill	Easy to use, and can protect against problems such as cervical cancer. May make periods lighter and improve acne.	Some shouldn't be used by smokers or people with circulatory problems as there is a risk of blood clots. This risk is reduced with some newer types of pill. The implantable kind can produce irregular bleeding. No protection against sexually transmitted infections.
Condom	No side-effects, although rare allergic reactions do occur. Protects against many sexually transmitted infections.	Reduced sensation and spontaneity.
Cap and diaphragm	Few side-effects	Reduced spontaneity. Increased risk of bladder infections. No protection against sexually transmitted infections.
IUD (intrauterine device)	Once inserted, no further maintenance is required.	Can result in infection and heavier, painful periods. No protection against sexually transmitted infections.

- 6 A zygote is one cell, a morula is about 80 cells and a blastocyst is a lot more cells (in a fluid-filled ball).
- 7 The foetus is protected by the amniotic fluid.
- 8 Learners' responses will vary, but may include drugs, infections, stress, poor nutrition, alcohol, antibiotics, rubella (German measles).
- 9 Ultrasound scanning and amniocentesis
- 10 Folate helps prevent neural tube defects.
- 11 Poor circulation results in the foetus getting a poor supply of nutrients, which prevents it from developing well. Smoking may reduce birth weight and/or intelligence in a baby.
- 12 It means their lungs are working.

- 13 a Seminal duct
 b Because sometimes sperm still get through
- 14 a Between 4 and 8 weeks gestation, so probably about June the year before.
 b Missed period, urine test, blood test

Unit 4.4: Reproductive problems

Answers

Unit questions

Learner's Book page 73

- 1 Abstinence, condom use, having few partners
- 2 Oral, genital and anal sex spread it. Antibiotics treat it.
- 3 Infection, radiation
- 4 More than one embryo is implanted at the same time to maximise the chance of success.
- 5 The prostate is commonly affected by cancer.
- 6 The breasts and cervix are commonly affected by cancer.
- 7 Some diseases may not produce symptoms, so it is best to have a medical check.
- 8 Increased number of partners, people becoming sexually active earlier, increasing population. Some types of contraception do not prevent STDs. There may be more education and information available about contraception than about STDs.
- 9 Contraception controls population growth, prevents unwanted pregnancies and helps families to control and manage their family size.

Extension questions

- 1 Learners' responses in this poster should include the issues that can occur and what can be done to prevent them.
- 2 Some reproductive problems that could be researched: ovarian cysts, polycystic ovary syndrome, endometriosis, high rates of miscarriage, male infertility. Learners' research information should include what the problem is, if there are any natural or medical treatments that can help and what advice a doctor may give a woman (or man).
- 3 Learners' responses may begin with the table on page 71 and extend to answering more of the questions about the one disease they are investigating.

Unit 4.5: Nervous control

Activity 3: Memory I

Learner's Book page 78

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate how we memorise words	Three lists of words, each printed on separate cards	<p>Prepare 10-word lists on cards A, B and C. Card A should be the easiest, so choose short or easy words, or words that rhyme, or words that are related, or can be made into a sentence. Card B should be more difficult, and card C more difficult again.</p> <p>Each group will need to have the same set of cards, so you will need to make multiple sets.</p> <p>Each group must select a group member as the subject for the activity.</p> <p>Give the first card to each group. The subject does not look at the words until the activity begins.</p> <p>Make sure that the subject has memorised the words before moving onto the next card.</p> <p>For Question 4, encourage answers that personalise the experience and help learners to recognise their strengths and limitations with rote learning.</p>	<p>1 Card A will probably be memorised most quickly.</p> <p>2 Learners' responses will vary. However, the quickest will probably be the one with the shortest or easiest words, or if the words can be made into a full sentence or if they have some rhyme or rhythm that enables learners to connect them.</p> <p>3 Learners' responses will vary. However, some things that might help are: the subjects' familiarity with the subject matter, their language and vocabulary knowledge, and their ability to spell/read/recognise unknown or known words quickly.</p> <p>4 Learners' responses will vary.</p>

Activity 4: Memory II

Learner's Book page 78

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the effect of distractions on memory	Two stanzas of a poem, printed on separate cards	<p>The stanzas need to be similar in length, rhythm/rhyme, so the test is equal.</p> <p>This activity requires clear instruction by the teacher.</p>	<p>1 Learners' responses will vary, but it is likely that the task will take longer when there are distractions.</p> <p>2 Learners' responses will vary. Distractions will make it harder to memorise accurately.</p> <p>3 Learners' responses will vary. If the poems are familiar to them the learners may memorise them more quickly. Some learners may be able to filter out the distractions, depending on the way they learn.</p> <p>4 Learners' responses will vary. Studying in a quieter environment will probably be more successful.</p>

Answers

Unit questions

Learner's Book pages 78–79

- 1 a** The two main parts of the nervous system are the central nervous system (CNS) and the peripheral nervous system (PNS).
- b** The CNS consists of the brain and spinal cord, and PNS consist of the sensory receptors and nerves. The CNS is the control centre and the PNS provides information to the CNS and transmits decisions from the CNS to effector organs.
- 2 a** A neuron is similar to other cells in the body in that it has a nucleus, cell membrane and cytoplasm.
- b** Neurons have cytoplasmic threads called axons and dendrites. Neurons can transmit messages via electrical impulses.
- 3** A nerve is a bundle of neurons.
- 4** Sensory neurons have specialised endings sensitive to stimuli, and they transfer messages to the CNS. Motor neurons transfer messages from the CNS to effectors. Interneurons transfer messages within the CNS.
- 5** Neurotransmitters are chemicals that carry the message from one neuron to another across the synapse.
- 6 a** Synapses allow neural messages to be directed to appropriate places.
- b** Synapses are susceptible to chemical interference and they slow messages through the nervous system.
- 7 a** The three main structural parts of the brain are the cerebrum, the cerebellum and the medulla.
- b** The cerebellum controls complex muscular movements. The medulla controls involuntary activities such as breathing. The cerebrum controls complex thoughts and memories, receives and interprets messages from sense organs and controls muscles.

- 8 a Cerebrum; b Cerebellum; c Medulla; d Spinal cord
- 9 a Cerebrum; b Medulla; c Cerebrum
- 10 The brain is protected from injury by the skull, layers of connective tissue called meninges and the cerebrospinal fluid (CSF).
- 11 Coughing, sneezing and blinking are reflex actions.
- 12 a Pupils narrow; b Coughing; c Saliva production; d Sweating
- 13 a Motor neuron
b i Cytoplasm; ii Nucleus; iii Dendrite; iv Myelin; v Axon
- 14 A bright light is shone in the eye THEN receptors detect change in light intensity THEN an impulse is sent along a sensory neuron to the brain THEN an impulse is sent along a motor neuron to iris muscles THEN iris muscles contract, causing the pupil to narrow.
- 15 The left side of the brain controls logical thought and is the side of our cerebrum that is helping us answer these questions.
- 16 'Automatic' conscious acts that can appear to be reflex actions: playing a musical instrument, playing sport, driving a car, riding a bike, snowboarding, surfing.

Extension question

Learner's Book page 79

Teacher notes for extension activity:

Caffeine acts as a stimulant to the central nervous system. It speeds up the processing in the central nervous system.

Marijuana acts as a hallucinogen, affects memory and behaviour and can leave an individual anxious. It acts as a depressant to the central nervous system (it slows it down).

Alcohol acts as a depressant to the central nervous system. To create a role-play, learners may need to research further specific symptoms. Note that variations in the level of intake of each item will vary the response. Role-plays could include variety based on the amount of intake.

Unit 4.6: Chemical control

Activity 5: Plant tropism

Learner's Book page 84

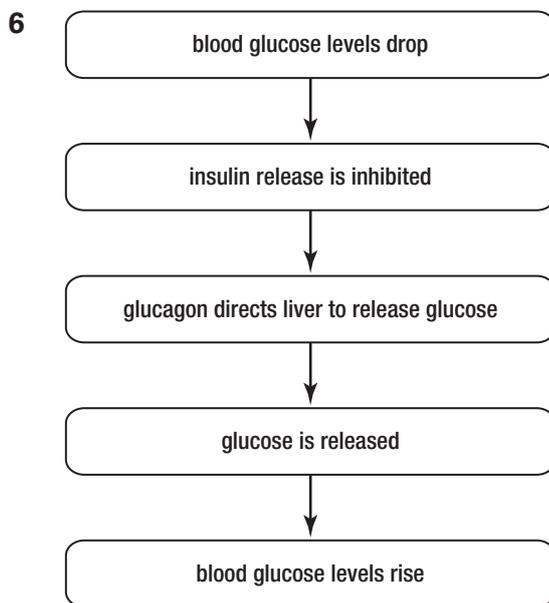
Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate tropism in plants	<ul style="list-style-type: none"> • 6 shoots of the plant <i>Tradescantia</i> • 6 test tubes • melted paraffin wax • water • darkened area and a well-lit area to place plants 	<p>In this practical exercise, learners will need to use chemicals, equipment and instruments responsibly and safely.</p> <p>Guide the learners when they do this experiment so that they achieve the required result.</p> <p>They will need to present their results using an appropriate data presentation format and comment on the nature of the experimental errors.</p>	<p>1 Learners' sketches should show that shoots in the well-lit area have begun to grow upwards towards the light source, and shoots in the darkened area have not moved.</p> <p>2 The experiment demonstrates a phototropism, as it shows a change in response to a light stimulus.</p> <p>3 The tubes in the light allow a comparison to ensure that the only variable is light.</p>

Answers

Unit questions

Learner's Book page 86

- 1 **a** Hormones are chemical messengers.
b They are produced by the endocrine glands.
c They are carried in the bloodstream.
- 2 A hormone recognises its target cell because each hormone has a specific shape that fits into a receptor on the target cell's membrane, a little like a jigsaw puzzle.
- 3 In frightening situations both the nervous system and the endocrine system (via adrenalin release) work to prepare the body for fight or flight.
- 4 The pituitary gland could best be called the 'master' gland. It releases not only hormones that directly affect other organs, but also hormones that instruct other glands to release hormones.
- 5 Thyroxin controls the speed of cell reactions and thus influences growth. Human growth hormone influences total body growth.



- 7 Diabetes is caused by a defective pancreas that does not produce enough insulin (Type I diabetes), or by having cells that do not respond correctly to insulin (Type II).
- 8 A pheromone is a chemical that influences the behaviour of animals, particularly behaviours involving sex. Pheromones act directly on the CNS, producing immediate behavioural changes. Hormones are chemical messengers that are produced by the endocrine glands and carried by the bloodstream.
- 9 Auxin stimulates plant cells to elongate, or grow longer. It is produced by the tips of growing shoots but is destroyed when exposed to light. This means that the hormone in a shoot will live and elongate cells if it is in the shade, but will be destroyed if in sunlight. Cells on the shady side will elongate more rapidly than on the sunny side, causing the shoot to bend and grow towards the light.
- 10 **a** M; **b** O; **c** L; **d** K; **e** N; **f** P

11	Nervous system	Endocrine system
Nature of message produced	Coordination between control centre (brain and spinal cord) and sensory receptors and nerves	Hormones produced by endocrine gland are specific to target cells only
How message is distributed	Neurons transmit and receive message in the form of electrical impulse	Hormones transfer information around the body
Speed of delivery	Between 1 and 100 metres per second	Minutes, hours or even days
Length of response reproduced	Very fast	More slowly and over a longer period

Extension questions

Learner's Book page 86

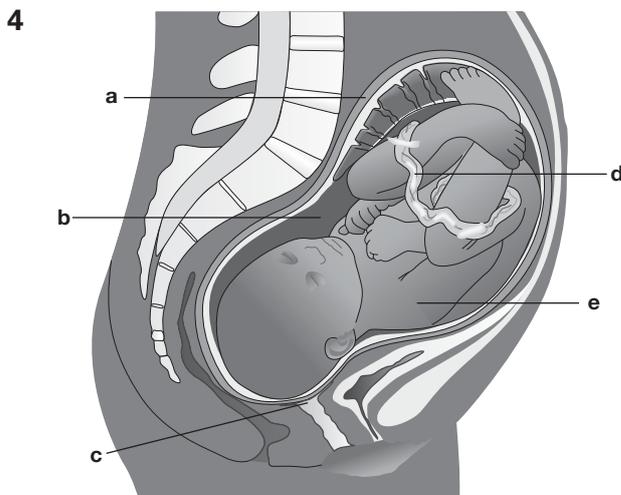
1–4 Learners' responses will vary.

Chapter review

Answers

Learner's Book pages 87–88

- 1
 - Beetle: exoskeleton
 - Dog: internal skeleton
 - Grasshopper: exoskeleton
 - Tapeworm: no skeleton
 - Prawn: exoskeleton
 - Bluebottle jellyfish: no skeleton
- 2
 - Triceps: voluntary
 - Heart muscle: involuntary
 - Jaw muscle: voluntary
 - Ciliary muscle: involuntary
 - Muscles that move food through your digestive system: involuntary
 - Hamstring: voluntary
- 3 Gametes, fertilisation, zygote, embryo, implantation, foetus



- 5 Gestation takes approximately 280 days (close to 9 months).
- 6 Fertilisation takes place in the fallopian tube, or oviduct.
- 7 A temperature of about 5°C below normal body temperature ensures maximum sperm production.
- 8 The internal environment of the mother's body offers greater protection for the baby.

9

Terms	Definitions
Ovum	Female sex cell
Ovaries	Female sex organs that produce ova
Ovulation	Process of releasing an ovum once a month
Oviduct	Tube that 'catches' the ovum
Uterus	Area where the embryo implants and grows
Cervix	Ring of muscle separating uterus and vagina
Vagina	Passageway for menstrual flow and birth of a baby. Sperm is also deposited here.
Sperm	Male sex cell
Testes	Male sex organs that make sperm cells
Scrotum	Pocket of skin that holds the testes
Epididymis	Area where sperm cells are stored
Seminal fluid	Nourishes and activates sperm cells
Semen	Consists of seminal fluid and sperm

- 10 a** A stimulus: something that brings about a change in the activity of an organism (eg heat, light)
b An effector: an organ, gland or muscle that carries out a response to a stimulus (eg heart, adrenal gland, bicep muscle)
c A receptor: part of the body that detects a stimulus (eg retina cells in eyes, cochlear cells in ears)
d A response: change in the activity of an organism as a result of a stimulus (eg pupils in the eye dilate as a response to bright light).
- 11 a** We respond to various stimuli, such as light, heat, sound and gravity.
b Retina cells in the eye, thermoreceptors in the skin, cochlear cells in the ears, semicircular canals in the ears
- 12** Refer to Figure 4.5.2 in the Learner's Book.

13

Part	Function
Cerebellum	Controls muscle movements while you are cycling
Medulla	Controls involuntary actions such as breathing
Meninges	Protect the brain from injury
Cerebrum	Centre for sight, hearing and speech

- 14 a** Synapses
b Chemicals called neurotransmitters carry the message.
- 15 a** A reflex action is performed without thinking.
b Examples are coughing, sneezing, blinking.
c They are fast because they involve very few neurons. They need to be fast because the organism's survival might depend on it getting away from danger as quickly as possible.
- 16 a** In human reproduction, metabolism and growth are controlled by hormones.
b In plants, flowering, seed germination and growth are controlled by hormones.
- 17** Testosterone causes males to grow taller, develop muscles and grow body hair, and their voices to deepen.
- 18** Learners' responses will vary. Sample answer:
 Condoms are rubber sheaths that fit over the penis to stop semen entering the vagina. There are no side-effects, although rare allergic reactions do occur. Condoms also can protect against many sexually transmitted diseases. They are very effective when used correctly.

- 19** Learners' responses will vary, and may include: drinking alcohol in pregnancy, smoking, poor nutrition.
- 20** To protect against herpes we should avoid contact with any open sore on another person.
- 21** Implant only one embryo at one time.
- 22** **a** Homeostasis
b Cells need a continuous supply of glucose for respiration.
c Endocrine
d Diabetes
- 23** **a** True; **b** False; **c** True; **d** False; **e** False

24

Hormones	Functions
Insulin	Blood glucose levels
Oestrogen	Female reproductive functions
Thyroxin	Rate of chemical reactions in cells
ADH	Water levels within the body
Adrenalin	Readiness of the body for action
Testosterone	Deepening of the male voice at puberty

25

Gland	Hormone
Adrenal	Adrenalin
Pancreas	Insulin
Pituitary	ADH
Thyroid	Thyroxin
Ovaries	Oestrogen
Testes	Testosterone

- 26** **a** Sensory neuron
b The axon carries messages to the cell from a receptor.
- 27** **a** A is the centre for decision making.
b C controls the heartbeat.
c D transmits messages from the PNS to the brain.
d A receives and interprets messages from the eyes and ears.
- 28** **i** = stimulus; **ii** = receptor; **iii** = sensory nerve; **iv** = motor nerve; **v** = effector; **vi** = response
- 29** **a** = pancreas; **b** = insulin; **c** = bloodstream; **d** = liver; **e** = response; **f** = feedback
- 30** **a** A tropism is a response where a plant grows towards or away from a stimulus.
b Examples: phototropism (response to light), geotropism (response to gravity)

Chapter 5: Human effects on ecosystems

Strand: Life and living

Suggested periods: 12

Sub-strand statement

This sub-strand deals with the effects of humans on ecosystems. Deforestation, development of towns, animal overgrazing, use of chemical mining and plantation practices are some activities that affect ecosystems. Introduction of non-local (invasive) species into local ecosystems puts pressure on indigenous species. We must act now to conserve our fragile ecosystems.

General learning outcomes

Learners should:

- 9.5.1** know that increasing human population and activities cause destruction to ecosystems
- 9.5.2** know that most human activities cause pollution in the environment
- 9.5.3** show that introduced species can be harmful to local or native species
- 9.5.4** know that an endangered species is a species whose population is declining
- 9.5.5** understand the purpose of conservation.

Specific learning outcomes

Learners should be able to:

- 9.5.1.1** identify human activities causing environmental problems in their community: deforestation, development of townships, animal overgrazing, use of chemicals, mining, plantation practices
- 9.5.2.1** identify types of pollution in their school or local community (eg water, air, soil and ocean)
- 9.5.3.1** conduct research to investigate introduced species such as toads, Indian (or common) mynas, tilapia and rain-tree in Solomon Islands, and describe their impacts on local species
- 9.5.4.1** name at least one local species that is in danger of extinction, such as the leatherback sea turtle
- 9.5.5.1** explain the purpose of conservation
- 9.5.5.2** identify methods or ways of conservation, both short-term and long-term.

Answers

Suggested assessment events

Solomon Islands Years 7–9 Science Syllabus

- 1** Ecosystems that are affected by human activities include logging, hotel development, mining, excavation and bush clearance for big plantations such as Guadalcanal Plains Plantation and Oil Limited (GPPOL). These activities affect ecosystems by destroying habitats.
- 2** Protection by law: Laws should be enacted to protect wildlife.
Establishment of protected areas: It is essential to establish wildlife sanctuaries, national parks and biosphere reserves. These places provide ideal conditions for wildlife.
Restoration of original habitat: Deforested areas need to be restored.
Provision of better living conditions: Animals need to be encouraged to live under the cover of thick grass or bushes and trees.
Education: People need to be educated about the importance of conservation and wildlife protection.
Training of wildlife management: Training of wildlife forest officers and wildlife ecologists is essential for conservation of wildlife.

Challenge questions

Learner's Book page 90

- 1 A system formed by the interaction of a community of organisms (plants and animals) with their physical environment
- 2 Ecosystems will include reef ecosystem, beach ecosystem, garden ecosystem, mangrove ecosystem, rainforest ecosystem, river ecosystem, etc.
- 3 Answers will vary according to the learners' locality. For example, those in rural areas will be likely to identify reef, forest and mangrove ecosystems.
- 4 Learners' responses will vary. However, here are three suggested solutions.
 - Control population growth. Reduce population growth to minimise human impact on the environment (more people need more resources to survive).
 - Establish control areas. Leave certain areas, eg reef or mangrove ecosystem, to restore their populations before harvesting them again for daily survival.
 - Limit the aspiration to have more than you actually need. For example, the desire to be rich can lead to destructive activities such as logging and mining operations.

Unit 5.1: Human effects on ecosystems

Activity 1: A climate in a beaker

Learner's Book pages 91–92

Processes and skills	Resources	Teacher's support notes	Answers to questions
To make a mini-climate in a beaker	<ul style="list-style-type: none"> • large glass bowl, jar or beaker • aluminium foil • ice cubes • paper tapers • matches 	<p>The term 'smog' is derived from the terms 'smoke' and 'fog', as it is a result of smoke and fog combining.</p> <p>The lighted paper creates the smoke, and the ice cubes and water provide the water vapour to make the fog.</p> <p>Be careful with learners using matches. Warn them not to inhale the smog and make sure that it is released outside.</p>	<ol style="list-style-type: none"> 1 Smog comes from a mixture of smoke and fog. Fog requires water vapour, so smog is more likely in a city that is located on a source of water, such as a river. 2 Learners may need to research this answer, as there is a complex set of relationships between the cold air, the hot air trapping more pollutants and the water vapour in the air. 3 The beaker was wet to simulate the situation. Water vapour is needed to create smog. 4 Learners' responses will vary.

Activity 2: Simulating global warming

Learner's Book page 94

Processes and skills	Resources	Teacher's support notes	Answers to questions
To observe the effect of an invisible 'blanket' on heat escape from a system	<ul style="list-style-type: none"> • small fruit juice cartons or box ('popper') • thermometer • scissors • microscope slides • sticky tape 	Use other transparent glass if you don't have microscope slides.	<p>1 The temperature inside the popper with the microscope slides covering the hole will increase at a faster rate than in the carton with the open hole.</p> <p>2 The temperature inside the popper covered with slides will increase much faster than the temperature in the popper with the open hole.</p> <p>3 Popper A illustrates the greenhouse effect. Heat energy from the Sun is trapped inside the Earth's atmosphere, providing the right conditions for living organisms to survive. However, if greenhouse gases increase, more heat energy will be trapped, which will result in global warming and eventually, climate change.</p> <p>In popper B, there is no greenhouse effect, and therefore, heat energy is not trapped. This causes the Earth's atmosphere to become too cold for organisms to survive.</p>

Answers

Unit questions

Learner's Book page 97

- 1** Pollution is the introduction of contaminants into an environment that causes harm to human health, other living organisms and the environment.
- 2** Three common air pollutants are sulfur dioxide, nitrogen dioxide and hydrogen sulfide.
- 3** Three products of air pollution and sunlight are ozone, nitric acid and formaldehyde.
- 4** The environmental threat caused by greenhouse gases is the enhanced greenhouse effect. The enhanced greenhouse effect leads to global warming.
- 5** Five sources of water pollution are sewage, agriculture run-off, sediment pollution, salinisation and inorganic chemicals.
- 6** The two main causes of soil degradation are overgrazing and deforestation.
- 7** In Solomon Islands, pigs are an introduced species. Pigs are well known for their destruction of the forest.

- 8** The factors that put many species of Solomon Islands wildlife in danger of extinction are:
- predation by introduced species
 - competition with introduced species
 - destruction of habitat by humans.
- 9** Conservation involves helping all the plants and animals that live in a specific habitat to survive. This maintains biodiversity and conserves food webs so that all species in a community can survive. Every species in a community interacts in some way with all of the other species living there.
- 10** Humans need to conserve plants and animals. Humans rely on plants for food and oxygen. Plants also provide food for the animals we eat, and the materials we use to make our houses. Animals are used for a variety of things, including clothing (eg wool and leather) and food. Plants and fungi provide ingredients for many of the pharmaceutical drugs we use when we are ill.
- 11** The city is more polluted than the countryside or the wild. Pollution can affect the processes occurring in plants, and thus will affect their life span.
- 12** When the animals grazing in an area eat the plants completely away, the bare soil is left exposed to the erosive forces of wind and rain. This is also the case when trees are removed by deforestation. The root systems of plants hold the soil together and act as a protective agent against erosion.
- 13** A community is more resilient when it is diverse because there are many resources around to be used. For example, the more food sources available to each organism, the less stress they are placed under should one particular food item become scarce.
- 14** Learners' responses may vary. Sample answer:
The bulldozer is used to clear forest for roads. However, using this machine can affect the soil by:
- causing soil rutting, which leads to erosion and run-off pollution
 - destroying the topsoil
 - damaging the root systems of nearby trees.
- 15** Oil spills happen when oil tankers leak oil into the ocean. Short-term measures to stop the oil spreading include physically removing as much of the oil as possible from seashores and affected wildlife. Workers can use high- or low-pressure hoses to spray oil that is on the beaches. Vacuum trucks may be driven on the beaches to vacuum up the oil. They can also simply use shovels or road equipment to collect all the oil from the beaches.
Long-term measures to minimise the danger of oil spills include:
- reviewing the laws of how oil can be transported
 - reviewing oil tanker routes.
- 16** An endangered species is one that will be lost from the ecosystem if steps are not taken to stop those factors that are causing population numbers to fall. An extinct species is one that is no longer present in any ecosystem on the Earth.
- 17** For example, improved automobile mileage with a reduction in the amount of pollution in exhaust emissions; reforestation projects; greater use of solar and wind power; more energy-efficient homes; greater use of public transport.
- 18** Refer to Figure 5.1.5 in the Learner's Book for a diagram of the greenhouse effect.
- 19** There are many possibilities with such a large population, such as more deforestation, more pollution, global warming, less food, more extinction of species.

Extension questions

Learner's Book page 97

- 1** The Industrial Revolution is said to have begun in the middle of the eighteenth century in England with the mechanisation of textile production. It introduced many changes in agriculture, the method and system of the production of goods, transport, mining, and economic policies. All these areas were connected, and changes in one resulted in changes in another. Later, the revolution also spread to many other parts of Europe and Asia. The Industrial Revolution brought about much pollution in the environment.
- 2** Organise learners to work in groups and suggest plants or animals for each group to research.
- 3** Organise learners to work in groups and suggest habitats that learners can survey and work on.
- 4** Captive breeding is the process of breeding animals in human-controlled environments. Captive breeding programs facilitate biodiversity and may save species from extinction. However, they may also reduce genetic diversity and species fitness. Letters to the editor should contain concerns about captive breeding.
- 5** One of the introduced species that has proven to be the most damaging and the hardest to control in Solomon Islands is the giant African snail. This snail can lay millions of eggs in a short period of time and survive even in very harsh conditions. The snails grow quickly and consume any plants they come across. Their voracious feeding style and rapid reproduction rate have proven to be very damaging and hard to control in this country.

Class debate

Explain clearly the purpose of the debate. Set some guidelines to follow during the debate. After the debate, summarise the main ideas.

Creative writing

The purpose of creative writing is to express thoughts, feelings and emotions rather than to simply convey information.

Chapter 6: Environmental issues: Global and local

Strand: Earth and beyond

Suggested periods: 12

Sub-strand statement

This sub-strand deals with climate change and other environmental issues. Climate change is believed to be a result of increasing concentration of greenhouse gases in the atmosphere affecting global temperatures. The increase in global temperatures has resulted in changing weather patterns. This sub-strand also deals with the ozone layer, its role and threats to it, as well as nuclear radiation. Controlled nuclear radiation can be useful. However, it can also be extremely dangerous if it is not controlled.

General learning outcomes

Learners should:

- 9.6.1** know that the Earth's atmospheric temperature depends on greenhouse gases
- 9.6.2** understand the role of greenhouse gases
- 9.6.3** understand the cause and effect of increased concentration of greenhouse gases in the atmosphere
- 9.6.4** know that El Niño is causing weather extremes
- 9.6.5** know that the ozone layer protects life on Earth from the harmful rays of the Sun
- 9.6.6** understand that the ozone layer is being depleted
- 9.6.7** know that climate change is affecting many people
- 9.6.8** appreciate the importance of national and international forums on environmental degradation and climate change.

Specific learning outcomes

Learners should be able to:

- 9.6.1.1** name the greenhouse gases: water vapour, carbon dioxide, methane, nitrous oxide and ozone
- 9.6.2.1** explain the role of greenhouse gases in the atmosphere: water vapour, carbon dioxide, methane, nitrous oxide and ozone
- 9.6.3.1** explain the cause and effects of increased concentration of greenhouse gases in the atmosphere
- 9.6.3.2** explain ways in which we can help to reduce the greenhouse gas concentration
- 9.6.4.1** state the effects of El Niño in South America, Australia and the Pacific region
- 9.6.5.1** state that ozone is a gas that occurs naturally in the stratosphere
- 9.6.6.1** explain the cause of ozone layer depletion
- 9.6.6.2** explain the effect of ozone-layer depletion on living organisms
- 9.6.7.1** define the term 'climate change'
- 9.6.7.2** describe the term 'resilience'

- 9.6.7.3** suggest ways to adapt to the changing environment caused by climate change
- 9.6.7.4** identify specific means of climate change adaptation in Solomon Islands and other Pacific countries
- 9.6.8.1** identify one national or international forum on environmental degradation and climate change, and describe how the forum dealt with a specific environmental issue that is going to affect Solomon Islands and other Pacific countries.

Answers

Suggested assessment events

Solomon Islands Years 7–9 Science Syllabus

- The causes of sea-level rise in Solomon Islands are global warming and plate tectonic activity (causing islands to sink).
The effects of sea-level rise include destruction of plant, animal and human habitats in low-lying areas, eg increasing saltiness in water holes and unfavourable conditions for crop production.
The government needs to recognise this issue so that funding can be secured to relocate people in low-lying areas, such as the Sikaiana and Ontong Java atolls (Malaita outer Islands), to higher ground.
- An El Niño is part of a natural weather cycle that happens every 3–7 years. It occurs when temperatures in the Pacific Ocean increase, causing a shift in the prevailing trade winds and increased tropical rainfall.
- Answers could include melting of polar ice caps, rising sea levels, flooding of coasts, increases in temperature extremes and increases in the number and severity of storms, droughts, floods and hurricanes.
- Use a bucket or water jug that has a fill line or marks for the volume and fill the water in the bucket to an exact volume. Add a large amount of ice to the bucket. Record the change in the volume. Then let the ice melt and note the change in volume again.
Learners should observe that when the ice is added to the bucket, the water level rises quite a lot, due to the large quantity of ice. They should also observe that there is not much change in volume when the ice melts. Prompt learners with leading questions to help them understand what the ice melting did to the overall volume of water.

Challenge questions

Learner's Book page 98

- Global warming is causing significant and harmful damage to our communities, health and climate.
- El Niño is a change in weather patterns.
- Everything we encounter in our everyday lives contains some radioactive material—either naturally occurring or human made. Bananas are radioactive because they absorb the radioactive potassium in the soil.
- Radioisotopes can cause cancers but are also used in nuclear medicine to diagnose and treat them. Radiotherapy involves directing high, localised doses of radiation to cancer sites.
- Energy fuelled in a way that does not use up the Earth's natural resources or otherwise harm the environment
- Learners' responses will vary but could include moving further inland because of coastal erosion and sea-level rise; growing food above ground to avoid salt-water intrusion.

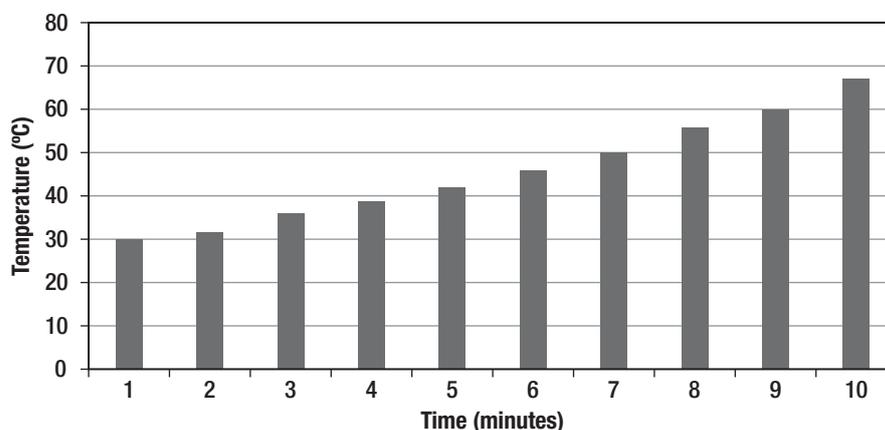
Unit 6.1: Global warming

Activity 1: The greenhouse effect

Learner's Book page 99

Processes and skills	Resources	Teacher's support notes	Answers to questions
To simulate the conditions required for the greenhouse effect	<ul style="list-style-type: none"> • small cardboard box (eg a shoebox) • 2 thermometers or temperature probes and datalogging equipment • sheet of glass or polythene plastic • lamp <p>You can also improvise if some of the equipment is not available. The important thing is to have an enclosed set-up where you can have a light bulb (those used for torches are okay) and sets of batteries so that heat is contained and not allowed to escape.</p>	<p>Heat generated is kept in the box. As the heat builds up, the temperature will rise. This resembles our atmosphere as the greenhouse gases block the Sun's heat from escaping.</p> <p>Learners should notice that the temperature inside the box increases as long as the lamp is on. If they turn the globe off, they should expect the temperature to remain high for a while. This is because heat continues to remain inside the box as it cannot escape.</p>	<ol style="list-style-type: none"> 1 Learners' graphs should show temperature on the vertical axis and time (in minutes) on the horizontal axis. A sample graph is given below. This graph assumes that temperature rises every minute. 2 Learners' descriptions will depend on their results, shown in their graphs; for example, what happens between the first minute and the tenth minute. 3 The glass or plastic represents the greenhouse gases that prevent the Sun's heat from escaping. 4 Adding another layer of glass or plastic represents the build-up of more greenhouse gases such as carbon dioxide in our atmosphere.

Sample graph for Activity 1, question 1



Activity 2: Icebergs

Learner's Book page 102

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the effect of melting ice on water levels	<ul style="list-style-type: none"> • 4–6 ice cubes • cold water • beaker <p>The challenge for teachers, particularly those in rural areas, is to obtain ice cubes. If you have clinics or some shops that have refrigerators, you could ask them to provide you with some.</p>	<p>The melting of ice floating in the sea does not raise sea levels. Such floating ice displaces an amount of water equal to its own weight. Thus the water from the melting ice fits into the space occupied by the ice under the water level. In the experiment, the learners will observe a very slight increase in the level of the water after the ice cubes melt, equivalent to the volume of ice cubes originally above the level of the water.</p> <p>However, if land ice melts and runs into a sea or lake, we expect to see levels rise. For example, the melting of the polar caps of Antarctica would contribute to sea-level rise.</p>	<ol style="list-style-type: none"> 1 The melting of floating icebergs does not contribute to a rise in sea levels. 2 The melting of land ice does contribute to a rise in sea levels.

Answers

Unit questions

Learner's Book pages 104–105

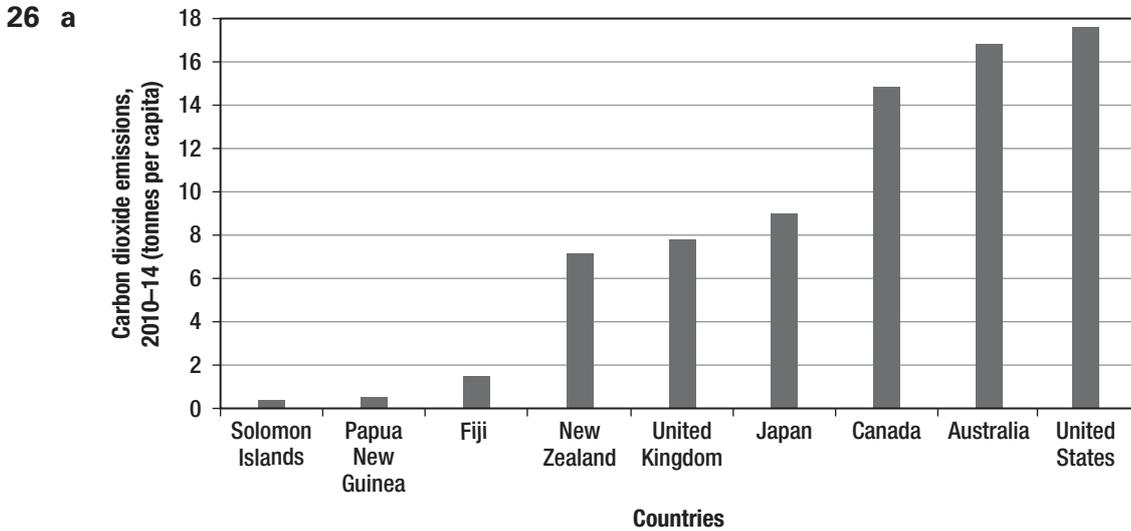
- 1 Carbon dioxide
- 2 They keep the Earth warm. Carbon dioxide is useful in plants in the process of photosynthesis.
- 3 The greenhouse gases act as a blanket. Heat from the Sun when it reaches the Earth is reflected back to space. The greenhouse gases trap the reflected heat and keep it in our atmosphere. In this way, the greenhouse gases keep the Earth warm. They act as a blanket.
- 4 Without the greenhouse gases, heat from the Sun would escape from our atmosphere, which would result in the Earth's temperature dropping too low to sustain life.
- 5 The blanket of greenhouse gases in the Earth's atmosphere has become thicker. This results in the enhanced greenhouse effect, where the same amount of heat energy is coming in from the Sun, but less is escaping back into space. The enhanced greenhouse effect is leading to global warming, increasing the average temperature of Earth.
- 6 Clearing land by means of cutting and clearing forests can increase the greenhouse effect. This is because trees absorb carbon dioxide in the atmosphere to make food through the process of photosynthesis. By absorbing carbon dioxide, the level of carbon dioxide in the atmosphere is reduced. Therefore, clearing land by cutting trees means less absorption of carbon dioxide.
- 7 The amount of carbon dioxide being released has increased significantly, due to the increase in the number of factories, vehicles and ships in which fossil fuels are burnt. It is estimated that, globally, 27 billion tonnes of carbon dioxide are produced annually.
- 8 Carbon dioxide, methane, nitrous oxide, chlorofluorocarbons
- 9 Carbon dioxide persists in the atmosphere for 100 years while methane persists for 11 years.

- 10** As snow falls, air bubbles are trapped in the ice. So the older the ice, the older the air that is trapped inside the ice. As scientists drill into the ice, they gather information about carbon dioxide present in the atmosphere in the past.
- 11** Over the last 420 000 years the level of carbon dioxide has fluctuated (moved up and down), averaging 250 ppm. However, at the present time, the level of carbon dioxide has risen significantly, to over 350 ppm. It is predicted to reach almost 650 ppm by the year 2100.
- 12** The graph in Figure 6.1.8 in the Learner's Book shows carbon dioxide levels in the Earth's atmosphere for the last 420 000 years. It is normal for the level of carbon dioxide to go up and down, but the amount of carbon dioxide in the atmosphere is now at the highest level ever. Notice that the Earth's temperature changes in line with changes in the amount of carbon dioxide in the air. On the temperature line, the troughs represent the ice ages, when the average temperature was up to six degrees lower than today. The peaks indicate when warmer periods occurred on Earth.
- 13** In the last 100 years the average temperature rise is about 0.5°C.
- 14** Three possible effects of global warming are sea level rise, temperature extremes, severe droughts.
- 15** The Pacific Ocean contains warmer water than other oceans. In a normal year, trade winds push this warmer water west towards the east coast of Australia, where high levels of evaporation cause normal amounts of rainfall. Every few years when trade winds weaken, the warm, moist air does not reach the coast and drought occurs.
- 16** Two effects of El Niño in Solomon Islands are increased temperatures and increased frequency of cyclones.
- 17** The production of methane gas is small compared to carbon dioxide and so the level of carbon dioxide in the atmosphere is very high compared to methane. Also, methane persists for only 11 years compared to carbon dioxide, which persists for 100 years.
- 18** Because greenhouse gases remain in the atmosphere for many years, greenhouse gas concentrations would not fall quickly.
- 19** As temperature increases, evaporation will also increase. Therefore, our atmosphere will be saturated with water vapour. This will then result in increased rainfall.
- 20** Learners' responses will vary but may include more profits for companies using existing fuel and car design.
- 21** Kumara production is expected to increase. Major requirements for the production of kumara or any other root crops are water (rainfall), right temperature and carbon dioxide. Where these three ingredients are present we expect that production of food to increase.
- 22** Population increase contributes to global warming. For example, clearing of land for housing or farming increases significantly with population increase. Cutting of trees is one contributing factor to global warming. Also, more people require more jobs, use more energy and so forth. Thus, a reduction of population will help in reducing global warming.

23

Greenhouse gas	Chemical formula	Sources
Carbon dioxide	CO ₂	Factories, steamships and locomotives, coal, fossil fuels
Methane	CH ₄	Rice paddies and rubbish tips, breakdown of vegetation
Nitrous oxide	N ₂ O	Car exhausts, forest burning
Chlorofluorocarbons (CFCs)		Aerosol sprays, refrigerators and air conditions

- 24 a** CO₂: between 280 and 285 ppm; CH₄: steady at a little over 600 ppm
b Around 1800 because of the Industrial Revolution
c CO₂ concentrations increased from 295 ppm to over 340 ppm
d CO₂: 15% increase, CH₄: 127% increase
- 25 a** Per day: 280 litres of methane × 3000 cattle = 840 000 litres of methane.
b Per year: 840 000 litres × 365 days = 306 600 000 litres



- b** The United States produced the most carbon dioxide per person, while Solomon Islands produced the least.
- 27 a** Factors: emission uncertainty and climate response uncertainty
b Average temperature rise (compared to 1990) in 2040 = 1.5°C, in 2080 = 4°C

Extension questions

Learner's Book page 105

- 1** All low-lying island states (Solomon Islands, Kiribati, Tuvalu, Fiji, Torres Strait Islands, the Maldives, the Seychelles), and countries such as Vietnam, Egypt, Tunisia, Indonesia, Mauritania, China, Mexico, Myanmar, Bangladesh, Senegal, Libya
- 2 a** Learners may like to create a KWL chart (what they know, what they want to know and then what they learn after doing their research) about each of these factors. Learners could use information from the Learner's Book about El Niño and La Niña as their starting point.
b El Niño, La Niña and the Southern Oscillation are thought to have increased in frequency because of global warming.

Unit 6.2: The ozone layer

Answers

Unit questions

Learner's Book pages 108–109

- 1** The ozone layer is found in the lower portion of the stratosphere from approximately 20 to 30 kilometres above the Earth.
2 Refer to Figure 6.2.1 in the Learner's Book.
3 Physical properties of ozone: colourless gas, has pungent smell
4 Harmful effects of ozone: can cause asthma; eye, nose, throat irritation; and lung damage.
5 Refer to Figure 6.2.2 in the Learner's Book.

- 6 Ozone is an isotope of oxygen molecule. The ozone layer is a deep layer in the stratosphere, encircling the Earth, which has large amounts of ozone in it. The layer shields the entire Earth from much of the harmful ultraviolet radiation that comes from the Sun.
- 7 Three properties of CFCs: non-poisonous, odourless and stable.
- 8 Refer to Figure 6.2.3 in the Learner's Book.
- 9 CFCs have been used as aerosol spray can propellants; in refrigerators and air-conditioners; to produce bubbles within polystyrene; and in electronic components
- 10 The element in CFCs that destroys the ozone layer is chlorine.
- 11 Ozone can also be destroyed through lightning and volcanic activities.
- 12 Ozone is measured in Dobson Units (DU).
- 13 Five hundred DU is equivalent to 5 mm of ozone. Therefore 100 DU is equivalent to 1 mm.
- 14 A value of less than 220 DU is considered to be an ozone hole.
- 15 Although the Antarctic ozone hole varies throughout the year, it is thinnest at the end of winter in August, and peaks by the end of October.
- 16 The harmful effects of UV radiation include sunburn, tanning, premature ageing of the skin, suppression of the immune system, eye damage and skin cancer. Beneficial effects include stimulating the production of vitamin D in the body, which is important for increasing calcium and phosphorus absorption from food and plays a crucial role in skeletal development; immune function; and blood cell formation. UV radiation has been used successfully to treat a number of diseases, including rickets, psoriasis, eczema and jaundice. UV radiation therefore has a therapeutic use.
- 17 Food supplies can also be affected by a thinner ozone layer. As the ozone layer gets thinner, it will increase the entry of UV radiation into our atmosphere. Photosynthesis and plant metabolism can be impaired by the increased UV radiation. Food crops may be less productive and forest ecosystems may be less healthy. Plants will try to minimise their exposure to UV radiation, thereby reducing their exposure to sunlight and CO₂, which will lead to a reduction in food production.
- 18 A hole in the ozone layer is actually the area where the ozone is thinnest and is seen to be less than 220 DU. It is considered to be a hole because it will allow UV radiation to penetrate.
- 19 Although the ozone hole is not directly above us, everyone on Earth will be affected in one way or another. It is directly above the Southern Ocean, which is considered one of the world's most productive marine ecosystems, home to huge numbers of penguins, seals and plants, and a major supplier of nutrients carried to other parts of the world by undersea currents. Thus UV radiation will spread to affect our marine stock, including tuna.
- 20 If UV radiation affects the population of phytoplankton in the marine ecosystem, many phytoplankton-eating animals will be affected. Phytoplanktons are at the bottom of the ocean food chain. Without them, ocean animals would have little food, and there would be fewer fish and other animals for us to eat. As part of the process of photosynthesis, phytoplanktons add oxygen to ocean water. A lot of this oxygen leaks from the ocean into the atmosphere. At least half of the oxygen that we breathe is produced by phytoplanktons. In addition, phytoplanktons remove carbon dioxide from ocean water to carry out photosynthesis and make their shells.
- 21 They should have the 'Ozone Friendly' sign on the can.
- 22 a 30 000 000 square km
b September 2000
- 23 These are 'error bars', representing uncertainty in measurements.

Extension questions

Learner's Book page 109

- 1 Assist learners to produce a brochure or a pamphlet that raises public awareness of the problem of UV radiation to the human eye. If you do not have a computer, you can use A4-size paper folded into three parts to produce a brochure.
- 2 Assist learners to identify a number of types of spray cans (eg perfumes, insect repellent, etc) and check if the cans are labelled 'ozone friendly'. Learners should also search the internet to determine which chemicals are used in place of CFCs. The chemical should include HFCs (hydrofluorocarbons).

Unit 6.3: Nuclear radiation

Answers

Unit questions

Learner's Book pages 115–116

- 1 Radiation can be fast-moving *particles* or electromagnetic *waves*.
- 2 Nuclear force
- 3 A radioisotope is an unstable isotope of an atom with a short enough half-life to cause measurable amounts of radioactive particles to be emitted.
- 4 Four radioactive elements: lithium, uranium, hydrogen, radium
- 5 Types of radiation: alpha radiation, beta radiation, gamma radiation
- 6
 - a Alpha radiation
 - b Beta radiation
 - c Gamma radiation
 - d Beta radiation
 - e Alpha radiation

	Alpha particles	Beta particles	Gamma rays
Speed	One-tenth the speed of light	Nine-tenths the speed of light	Speed of light
Penetration ability	Low: stopped by sheet of paper	Medium: stopped by a few millimetres of aluminium	High: largely absorbed by lead or concrete but never totally absorbed

- 8 Half-life is time required for half of the atoms in a radioactive isotope to decay. It is the half-life of the particular isotope. For example, if atom X has a half-life of 50 years, then it will take 50 years for the atom X to decay or lose its strength.
- 9 What is left from a 2 kg sample of iodine after:
 - a 8 days = 1 kg
 - b 16 days = 500 g
 - c 24 days = 250 g
- 10 The Earth is continually being struck by solar radiation and cosmic radiation produced by, for example, collapsing stars. Terrestrial radiation originates from substances in the Earth's crust— an example is the decay of uranium in rocks in the Earth's crust.
- 11 Radon gas is present in our atmosphere and is produced by the decay of natural underground uranium.
- 12 Ions produced by radiation are more likely to affect our cells than atoms because ions can attract other atoms and molecules, and therefore involve a chemical reaction. So, if the ions (radiation or ionising radiation) get to the body or hit any parts of the body, they will cause chemical reactions that can destroy cells or cause abnormal growth of cells.

- 13** Nuclear radiation may be detected through the use of a Geiger counter or a dosimeter.
- 14** Radiotherapy, where focused beams of high-energy radiation are used treat cancer; radioactive tracers, which are used to trace conditions in the body.
- 15** Advantage: Food lasts longer due to bacteria and fungi being killed. Disadvantage: Possible creation of other unwanted chemicals within the food.
- 16** A dirty bomb is any bomb that contains radioactive materials, such as nuclear wastes. These radioactive materials spread in the air and the water, and get into food once the bomb explodes.
- 17** Cells such as cancer cells that divide rapidly are more sensitive to radiation damage.
- 18** Bones can be X-rayed, but internal organs do not show up well in X-rays. Radioactive tracers are more suitable for internal organs as they can travel to particular sites, where they may be detected using a gamma-ray camera, which produces an image of the site.
- 19** No, it is not possible to measure the thickness of cardboard with alpha particles. This is because alpha particles cannot pass through even a single sheet of paper.
- 20** They do not penetrate out of the body and are therefore not able to be detected and used for imaging purposes. They have a high ionising ability and so are dangerous to cells, causing damage and mutations.
- 21** Cells that grow rapidly are affected most by radiation. Hair cells are rapidly growing cells, and so they are damaged by radiation.
- 22** Soldiers and other personnel who were in the region may have inhaled radioactive substances. Once inside the body, radioisotopes are much closer to body cells and may cause a great deal more damage to living tissue. The effects may take years to become obvious. There may also still be radioactive substances in the area where the ammunition was used, which could affect local people, plants and animals.
- 23** Their cells are still growing and dividing quickly, and growing cells are more susceptible to radiation damage.
- 24 a** ${}_{84}^{218}\text{Po} \rightarrow {}_{82}^{218}\text{Pb} + {}_2^4\alpha$
- b** ${}_{11}^{24}\text{Na} \rightarrow {}_{12}^{24}\text{Mg} + {}_{-1}^0\beta$
- c** ${}_{54}^{133}\text{Xe} \rightarrow {}_{54}^{133}\text{Xe} + \gamma$
- d** ${}_{26}^{59}\text{Fe} \rightarrow {}_{27}^{59}\text{Co} + {}_{-1}^0\beta + \gamma$
- 25** Pure radon-222 that will remain after 12 days.
Half-life of radon is four days.
If we begin with 10 micrograms of radon:

Days	Mass of radon-222
0	10 micrograms
4	5 micrograms
8	2.5 micrograms
12	1.25 micrograms

In other words, the mass of radon-222 after 12 days will be one-eighth of the original mass.

- 26** Carbon-14 has a half-life of 5730 years.

Years	Amount of C-14
0	Total amount
5730	1/2
11 460	1/4
17 190	1/8
22 920	1/16

Therefore, the age of the fossil found to contain 1/16 of the amount of carbon-14 is 22 920 years.

Extension questions

Learner's Book page 116

- 1 Units for measuring nuclear radiation:
 - gray (Gy): unit of absorbed dose of energy usually associated with ionising radiation such as X-rays or gamma particles
 - rem (rem), unit of radiation dosage (such as from X-rays) applied to humans
 - rad (rad): unit of absorbed radiation dose, defined as $1 \text{ rad} = 0.01 \text{ Gy} = 0.01 \text{ J/kg}$.
 - curie (Ci): unit of radioactivity. One curie was originally defined as the radioactivity on one gram of pure radium.
 - becquerel (Bq): unit of radioactivity caused when one atom disintegrates, releasing energy. One Bq is the radiation caused by one disintegration per second.
 - roentgen (R): non-metric unit used to measure the ionising ability of radiation.
- 2 a Carbon dating is used to determine the age of biological materials up to 50 000 years old. This technique is widely used on recent materials, but will not work on older fossils (like those of the dinosaurs, which are over 65 million years old). Carbon-14 dating has been used successfully on the Dead Sea Scrolls, Minoan ruins and tombs of the pharaohs. It has also been used on the Shroud of Turin (burial cloth of Jesus Christ). Carbon-14 (isotope of carbon-12) has a half-life of 5730 years and decays at a constant rate. Carbon-dating shows that the amount of carbon-14 in the Shroud of Turin decreases at a predictable rate.
 - b The technique is considered reliable, but there have been a number of criticisms of the procedures used in the testing of the shroud. More testing is needed.
- 3 a A dirty bomb is a weapon that combines radioactive material with conventional explosives. The purpose of the weapon is to contaminate the area around the explosion with radioactive material. Dirty bombs do not cause major destruction like conventional bombs. This is because the radioactive materials they contain may need the aid of, say, wind to disperse them.
 - b As a dirty bomb is unlikely to cause many deaths, many people do not consider this to be a weapon of mass destruction. Its purpose would presumably be to create psychological, not physical, harm through ignorance, mass panic and terror. Based on this, terrorists are unlikely to use these kinds of bombs. They would prefer a bomb that causes mass destruction in a short time.

Unit 6.4: Climate change and Solomon Islands

Answers

Unit questions

Learner's Book page 120

- 1 Climate change is the change in regional and global climate patterns as a consequence of increased levels of carbon dioxide in the atmosphere from the burning of fossil fuels.
- 2 Extreme high tide, salt-water intrusion and coastal erosion
- 3 Adaptation to climate change is about finding ways for people to adjust to the environmental changes that are happening around them. The Solomon Islands Government has set out areas for climate change adaptation. Communities can also develop their own local adaptation plans, such as growing food above ground to avoid saltwater intrusion. Learners' local examples will vary.
- 4 a Growing food above ground to avoid contamination by salt water
 - b Using rainwater tanks to collect fresh water
- 5 Dealing with the causes of climate change by reducing the greenhouse gases in the atmosphere

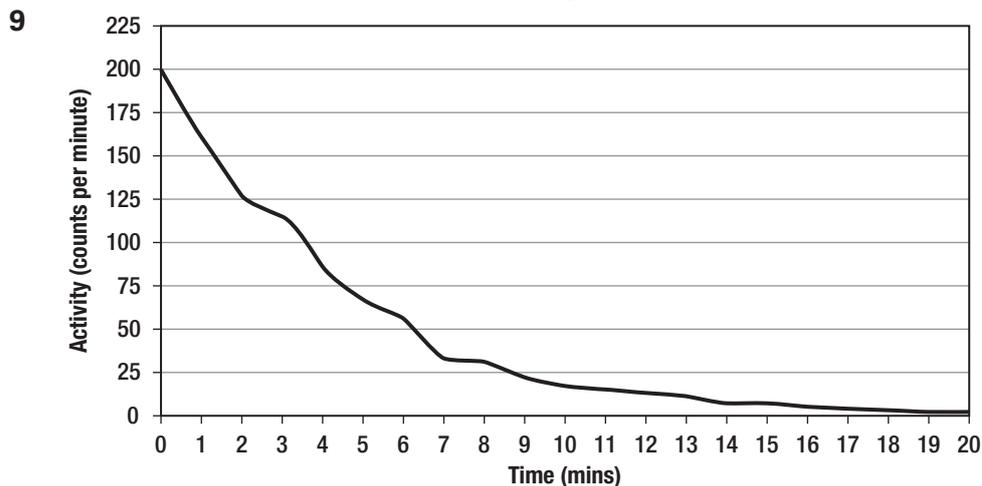
- 6 Greenhouse gases are produced by the burning of fossil fuels such as petrol, diesel, kerosene and oil. In Solomon Islands, the number of machines that use these fossil fuels is on the rise. Therefore, it is true to say that we produce greenhouse gases. However, the amount of greenhouse gases produced in Solomon Islands is very small when compared with industrialised countries such as China, India and the USA.
- 7 Learners' responses will vary. Floods often occur from natural changes to climate rather than human-induced climate change. Learners may present arguments about the cause and how it relates to the climate at the time.
- 8 Learners' responses will vary.
- 9 Trees absorb carbon dioxide, convert it into clean water and oxygen and release it back into the atmosphere. Just as the respiratory action of the lungs is of fundamental importance to human life and health, so is the function of trees fundamental to the life and health of our planet.

Chapter review

Answers

Learner's Book page 121

- 1 Carbon dioxide, methane, nitrous oxide
- 2 Greenhouse gases could be decreased by reducing energy use, using solar energy and reducing global travel.
- 3 Rising sea levels, more extreme weather
- 4 In the stratosphere, about 20 to 30 km above the surface of the Earth
- 5 Chlorine (or bromine)
- 6 Refrigerators manufactured using CFCs are still in use today, and are still being dumped, causing the release of CFCs into the atmosphere. Poorer countries may be using older air-conditioning equipment.
- 7 They do not have the funds or technology to manufacture or use CFC alternatives.
- 8 Answers could include solar or wind energy.



- a It halved in about 3.5 minutes initially.
 - b It halved again in a further 3 minutes.
 - c It halved again in a further 3 minutes.
 - d Answer is about 3 minutes 6 seconds.
 - e It will still be between 1 and 2.
- 10 a 33
 - b 35
 - 11 Alpha
 - 12 ${}_{226}^{Ra} \rightarrow {}_{222}^{Rn} + {}_4^{\alpha}$
 - 13 About 1 gram

Chapter 7: More chemical reactions

Strand: Natural and processed materials

Suggested periods: 12

Sub-strand statement

Chemical reactions occur around us every day. We observe colour change or heat release during a chemical reaction. Chemical equations are a scientific way of representing a reaction. They show the reactants and products of a chemical reaction. Chemical equations are balanced to show equal numbers of each type of atom on both sides of the equation.

General learning outcomes

Learners should:

- 9.7.1 know that chemical reactions occur every day around us, in our bodies, and in plants and animals
- 9.7.2 be able to show simple chemical reactions using common everyday materials
- 9.7.3 know how to balance simple chemical equations
- 9.7.4 appreciate that chemical reactions are important in our lives.

Specific learning outcomes

Learners should be able to:

- 9.7.1.1 describe four common chemical reactions that occur around us: cell respiration, photosynthesis, rusting of iron, burning of carbon
- 9.7.2.1 perform the following chemical reactions and write word equations for each reaction performed: burning of wood, burning of paper, and reacting of metals with oxygen, acids with bases, and acids with carbonates
- 9.7.3.2 write balanced chemical equations for simple chemical reactions
- 9.7.4.1 recognise that our lives depend on chemical reactions such as cellular respiration and photosynthesis.

Answers

Suggested assessment events

Solomon Islands Years 7–9 Science Syllabus

- 1 $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
- 2 **a** $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
b Iron + water + oxygen \rightarrow rust
 $4\text{Fe}_{(s)} + 6\text{H}_2\text{O}_{(l)} + 3\text{O}_{2(g)} \rightarrow 4\text{Fe}(\text{OH})_{3(s)}$
c $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
- 3 There are a lot of soap recipes on the internet. Most use baking soda, not baking powder. Most recipes are a mix of olive and or coconut oil, fragrance (either in an oil or in dried herbs such as lavender) and baking soda or baking powder.

Challenge questions

Learner's Book page 122

- 1 Water— H_2O ; carbon dioxide— CO_2 ; hydrochloric acid— HCl
- 2 Matter cannot be created or destroyed. It can only change from one form to another.

- 3 Learners' responses could include any two of the three possible flames on a Bunsen burner:
- Safety flame: hole closed; orange flame; not too hot
 - Blue flame: half open; almost invisible; hot; used for heating liquids
 - Roaring blue flame: hole open; very hot blue part inside lighter coloured part; used for heating solids
- 4 Ethanol can be a dangerous chemical to work with. The risks are higher with higher concentrations of ethanol (it is common to work with 50%, 70% and 90% ethanol). Skin contact can cause irritation or dehydration, and eye contact can be damaging (instantly wash out eyes). It can be intoxicating if ingested and medical attention may be required. Continued inhalation can cause illness. Higher concentrations of ethanol are flammable.

Unit 7.1: Writing chemical equations

Activity 1: Studying a reaction

Learner's Book page 123

Processes and skills	Resources	Teacher's support notes	Answers to questions
To make quantitative observations of the reaction of magnesium metal and an acid	<ul style="list-style-type: none"> • magnesium strips • 1 M sulfuric acid • large beaker • small filter funnel • 100 mL measuring cylinder • cling wrap • gloves • lab coat • safety glasses 	<p>Treat all chemicals as dangerous. Use dilute acid only.</p> <p>Do not use concentrated hydrochloric acid.</p> <p>Concentrated hydrochloric acid has the potential to damage respiratory organs, eyes, skin and intestines. Upon mixing hydrochloric acid with common oxidising chemicals such as sodium hypochlorite (bleach, NaClO) or potassium permanganate (KMnO₄), the toxic gas chlorine is produced.</p>	<p>1 Hydrochloric acid + magnesium → magnesium chloride + hydrogen gas; $Mg + 2HCl \rightarrow MgCl_2 + H_2$</p> <p>2 The amount of hydrogen produced will be proportional to the amount of magnesium used. The amount produced with twice as much magnesium will be twice as much as shown in the experiment, and a quarter as much with a 1 cm strip than a 4 cm strip, assuming all other factors are the same.</p>

Activity 2: Conservation of mass*Learner's Book pages 125–126*

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate conservation of mass in a chemical reaction	<ul style="list-style-type: none"> solid calcium carbonate 0.5 M hydrochloric acid 200 mL conical flask balloon spatula 100 mL measuring cylinder lab coat safety glasses access to an electronic balance 	<p>Treat all chemicals as dangerous. Use dilute acid only.</p> <p>Do not use concentrated hydrochloric acid. Concentrated hydrochloric acid has the potential to damage respiratory organs, eyes, skin and intestines.</p>	<p>1 Calcium carbonate + hydrochloric acid \rightarrow calcium chloride + water + carbon dioxide $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$</p> <p>2 Learners will see the results of the conservation of mass, which should agree with the law. Learners' responses should reflect the experiment.</p> <p>3 If learners' findings suggest that the law is not correct, their findings would be inaccurate. Assist them to see where they have gone wrong.</p>

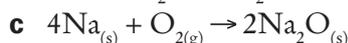
Answers**Unit questions***Learner's Book pages 128–129*

- The three main parts of a chemical equation are: reactants, product and the state of the reactants.
- The '+' means 'combined or reacted with one another' and the ' \rightarrow ' means 'forming a product'.
- The three main types of chemical bonds are ionic, simple covalent and large covalent.
- The Law of Conservation of Matter is that matter can neither be created nor destroyed, but can be changed in form.
- The Law of Conservation of Mass is that mass is neither created nor destroyed in any ordinary chemical reaction. Or, more simply, the mass of substances produced (products) by a chemical reaction is always equal to the mass of the reacting substances (reactants) (eg 1 g carbon + 5.34 g sulfur \rightarrow 6.34 g carbon disulfide; 2 g carbon + 10.68 g sulfur \rightarrow 12.68 g carbon disulfide)
- (s) for solid; (g) for gas; (l) for liquid; (aq) for substance dissolved in water
- 25°C; 1 atmosphere
- The small numbers represent the number of the preceding atom or ion. The large numbers are used in front of formulas to balance equations.
- $\text{NaCl}_{(s)}$ is sodium chloride in crystalline form; $\text{NaCl}_{(aq)}$ is sodium chloride dissolved in water.
- The molecules are: **a** (CO_2), **b** (H_2O), **e** (N_2), **g** (Ar). The rest (NaCl , Li_2CO_3 and CaO) are ionic lattices.
- C (Calcium chloride is CaCl_2)
- H_2O is a molecular formula because there are two hydrogen atoms and one oxygen atom in a water molecule. Na_2SO_4 is an ionic compound, not a molecular formula, because it represents the ratio of sodium to sulfate ions in a lattice of sodium sulfate, not the actual number of atoms that can exist as a discrete unit.
- Equation B is balanced ($2\text{HNO}_3 + \text{MgO} \rightarrow \text{Mg}(\text{NO}_3)_2 + \text{H}_2\text{O}$).
- Equation A is not balanced ($\text{C}_5\text{H}_{12} + 8\text{O}_2 \rightarrow \text{CO}_2 + 6\text{H}_2\text{O}$; should be 5CO_2).

- 15**
- a $\text{H}_2\text{O}_{(l)}$
 - b $\text{CO}_{2(g)}$
 - c $\text{H}_2\text{SO}_{4(aq)}$
 - d $\text{CaCl}_{2(s)}$
 - e $\text{Ne}_{(g)}$
 - f $\text{H}_{2(g)}$
 - g $\text{MgCO}_{3(s)}$
 - h $\text{HNO}_{3(aq)}$
- 16**
- a Mg—metallic
 - b SrSO_4 —ionic (between ions Sr^{2+} and SO_4^{2-} , but covalent within the sulfate ion, SO_4^{2-})
 - c O_2 —covalent
 - d CO—covalent
 - e CaC_2 —ionic
 - f S_2 —covalent
 - g Na—metallic
 - h Ar—no bonding. The element consists of individual atoms.
- 17**
- a $\text{P}_{4(s)} + 5\text{O}_{2(g)} \rightarrow 2\text{P}_2\text{O}_{5(s)}$
 - b $2\text{KClO}_{3(s)} \rightarrow 2\text{KCl}_{(s)} + 3\text{O}_{2(g)}$
 - c $\text{BaO}_{(s)} + 2\text{HNO}_{3(aq)} \rightarrow \text{Ba}(\text{NO}_3)_{2(aq)} + \text{H}_2\text{O}_{(l)}$
 - d $2\text{Pb}_3\text{O}_{4(s)} \rightarrow 6\text{PbO}_{(s)} + \text{O}_{2(g)}$
 - e $2\text{Pb}(\text{NO}_3)_{2(s)} \rightarrow 2\text{PbO}_{(s)} + 4\text{NO}_{2(g)} + \text{O}_{2(g)}$
- 18**
- a $2\text{H}_{2(g)} + \text{O}_{2(g)} \rightarrow 2\text{H}_2\text{O}_{(l)}$
 - b $2\text{Na}_{(s)} + \text{Cl}_{2(g)} \rightarrow 2\text{NaCl}_{(s)}$
 - c $\text{CaCO}_{3(s)} \rightarrow \text{CaO}_{(s)} + \text{CO}_{2(g)}$
 - d $\text{CH}_4(g) + 2\text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + 2\text{H}_2\text{O}_{(l)}$
 - e $2\text{HNO}_{3(aq)} + 2\text{Ca}_{(s)} \rightarrow \text{Ca}(\text{NO}_3)_{2(aq)} + \text{H}_2(g)$
- OR
- $$10\text{HNO}_{3(aq)} + 4\text{Ca}_{(s)} \rightarrow 4\text{Ca}(\text{NO}_3)_{2(aq)} + \text{NH}_4\text{NO}_{3(aq)} + 3\text{H}_2\text{O}_{(l)}$$
- 19**
- a Reactants: copper(II) nitrate. Products: copper(II) oxide, nitrogen dioxide, oxygen
 - b Copper(II) nitrate \rightarrow copper(II) oxide + nitrogen dioxide + oxygen
 - c $2\text{Cu}(\text{NO}_3)_{2(s)} \rightarrow 2\text{CuO}_{(s)} + 4\text{NO}_{2(g)} + \text{O}_{2(g)}$
- 20**
- a
 - i Sodium hydroxide + hydrochloric acid \rightarrow sodium chloride + water
 - ii $\text{NaOH}_{(s)} + \text{HCl}_{(aq)} \rightarrow \text{NaCl}_{(aq)} + \text{H}_2\text{O}_{(l)}$
 - b
 - i Nitrogen + hydrogen \rightarrow ammonia
 - ii $\text{N}_{2(g)} + 3\text{H}_{2(g)} \rightarrow 2\text{NH}_{3(g)}$
 - c
 - i Carbon monoxide + oxygen \rightarrow carbon dioxide
 - ii $2\text{CO}_{(g)} + \text{O}_{2(g)} \rightarrow 2\text{CO}_{2(g)}$
 - d
 - i Iron + chlorine \rightarrow iron(III) chloride
 - ii $2\text{Fe}_{(s)} + 3\text{Cl}_{2(g)} \rightarrow 2\text{FeCl}_{3(s)}$
 - e
 - i Sodium hydroxide + sulfuric acid \rightarrow sodium sulfate + water
 - ii $2\text{NaOH}_{(aq)} + \text{H}_2\text{SO}_{4(aq)} \rightarrow \text{Na}_2\text{SO}_{4(aq)} + 2\text{H}_2\text{O}_{(l)}$
 - f
 - i Ammonium nitrate \rightarrow ammonium ions + nitrate ions
 - ii $\text{NH}_4\text{NO}_{3(s)} \rightarrow \text{NH}_4^+_{(aq)} + \text{NO}_3^-_{(aq)}$
 - g
 - i Hydrochloric acid + calcium metal \rightarrow calcium chloride + hydrogen gas
 - ii $2\text{HCl}_{(aq)} + \text{Ca}_{(s)} \rightarrow \text{CaCl}_{2(aq)} + \text{H}_{2(g)}$

21 The CO₂ gas has escaped to the atmosphere.

22 a Sodium_(s) + oxygen_(g) → sodium oxide_(s)



d Mass of reactants = mass of products

Extension questions

Learner's Book page 129

- a** Green chemistry or sustainable chemistry describes chemical research and engineering that is environmentally friendly because it lowers the use and generation of hazardous substances.
- b** Learners' responses will vary but could include: the pharmaceutical industry producing medicine with less harmful side-effects and less toxic waste; the production of biodegradable plastics (plastics that are renewable and don't harm the environment).
- c** Learners' responses will vary.

Unit 7.2: Naming compounds

Activity 3: Action of heat on ionic and covalent compounds

Learner's Book pages 130–131

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the effect of heat on various compounds	<ul style="list-style-type: none"> solid samples of various ionic and covalent compounds that do not produce toxic fumes on heating (eg wax—candle or paraffin) graphite sodium chloride potassium nitrate Bunsen burner heat mat metal spatulas wooden pegs safety glasses lab coat 	<p>Treat all chemicals as dangerous.</p> <p>Use dilute acid only.</p> <p>Do not use concentrated hydrochloric acid.</p>	<p>1 Learners' responses should include whether the bond was ionic or covalent, and how that affected whether or not the compound melted and when or how easily it melted. They could list compounds in order of how easily they heated.</p> <p>2 Learners should observe that an ionic bond is a strong bond, and a covalent bond is a weak bond.</p> <p>3 Based on bonding type, ionic substances have high melting points and covalent substances have low melting points. a Low; b High; c Low; d High</p>

Answers

Unit questions

Learner's Book page 134

- 1 A negative ion is formed when an atom gains electrons and a positive ion is formed when an atom loses electrons.
- 2 Electrostatic attraction between the ions holds the atoms together in an ionic compound.
- 3 **a** A polyatomic ion is an ion with more than one charge.
b A magnesium ion, Mg^{2+}
- 4 **a** Carbon dioxide
b Dinitrogen pentoxide
c Water
- 5 Ionic bonding involves the complete transfer of electrons. Covalent bonding is the sharing of electrons.
- 6 **a** NaBr
b MgS
c CaF_2
d Li_3N
- 7 **a** $\text{Na}_2(\text{SO})_4$
b $\text{Mg}(\text{OH})_2$
c SrCO_3
d LiNO_3
e $(\text{NH}_4)_2\text{O}$
- 8 **a** FeCl_3 ionic
b FeCl_2 ionic
c CuNO_3 ionic
d OCl_2 covalent
e $\text{Cu}(\text{NO}_3)_2$ ionic
- 9 **a** +4
b +32
c -9
- 10 Learners' responses will vary. Sample response: It would be difficult to write and interpret formulas and would create confusion.

Extension questions

Learner's Book page 134

- a** Paper is mostly wood, and therefore base would be from carbon.
- b** CaCO_3
- c** $\text{C}_{12}\text{H}_{22}\text{O}_{11}$

Chapter review

Answers

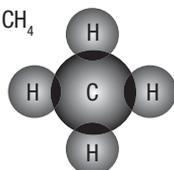
Learner's Book page 135

- 1 In chemical reactions, the mass of reactants always equals the mass of products.
- 2 A chemical equation is a shorthand way of representing a chemical reaction.
- 3 Learners can provide any equation they have learnt. They should identify the reactants and products, and explain how they wrote the formulas and balanced the equation.
- 4 SLC means standard laboratory conditions of one atmosphere pressure and the current room temperature.
- 5 Learners' responses will vary, and may include the following: remove products as they are formed, add reactants as they are used up, increase the temperature.
- 6 Ionic and covalent
- 7 Antoine Lavoisier

Substance	Ionic or covalent	Melts on heating?
Sodium chloride	Ionic	Not until very high melting points
Wax	Covalent	Yes

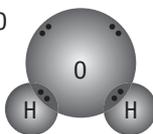
- 9 SO_2 is a molecular formula. Na_2SO_4 is an ionic compound and forms a lattice, not discrete molecules.
- 10 a $\text{Al}(\text{OH})_3 + 3\text{HNO}_3 \rightarrow 3\text{H}_2\text{O} + \text{Al}(\text{NO}_3)_3$
b $2\text{H}_2\text{O} + 2\text{K} \rightarrow \text{H}_2 + 2\text{KOH}$
- 11 An ion is formed when an atom gains or loses outer-shell electrons.
- 12 Because there will be more electrons (negative charge) than protons (positive charge).
- 13 Ionic compounds form when positive and negative ions attract each other and are joined together by electrostatic attraction (the attraction between opposite charges).
- 14 Covalent compounds form when atoms bond by sharing outer-shell electrons.

- 15 methane, CH_4



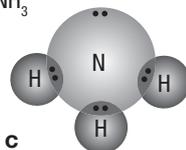
a

- water, H_2O



b

- ammonia, NH_3



c

Chapter 8: Mining and energy sources in Solomon Islands

Strand: Earth and beyond

Suggested periods: 8

Sub-strand statement

This sub-strand deals with mineral and energy sources in Solomon Islands. Gold is one of the many minerals that are found in our islands. Currently some companies are undertaking mineral prospecting. Minerals are a very important resource, but care must be taken when we extract them. Energy is important for Solomon Islands. The current main source of energy is fossil fuels. Scientists predict that fossil fuels will eventually run out. It is therefore important that alternative sources of energy (such as solar, coconut oil, wind, etc.) are identified.

General learning outcomes

Learners should:

- 9.8.1** know that minerals form naturally in the Earth
- 9.8.2** know that there are different types of ores or mineral deposits in Solomon Islands
- 9.8.3** understand methods of mineral mining
- 9.8.4** be able to explain the process of mineral extraction
- 9.8.5** appreciate that minerals bring economic benefit for our country
- 9.8.6** understand that mining activities can cause destruction to the natural environment
- 9.8.7** know that mineral resources are non-renewable resources
- 9.8.8** know the world's main producers of fossil fuels
- 9.8.9** know that there are alternative sources of energy to solve the 'energy crisis'
- 9.8.10** know that nuclear energy is an alternative source of energy generated from nuclear radiation.

Specific learning outcomes

Learners should be able to:

- 9.8.1.1** explain how material in the Earth's crust under very high temperature and pressure produces minerals
- 9.8.2.1** name the ores and minerals found in Solomon Islands
- 9.8.3.1** describe two types of gold mining methods in Solomon Islands: open mining (mining industry) and punning (villagers)
- 9.8.3.2** state the advantages and disadvantages of closed mining, open mining and punning
- 9.8.4.1** describe and demonstrate the important steps in the process of gold, aluminium, iron or nickel extraction
- 9.8.5.1** state the value of gold exported from Solomon Islands in the years 1998 to 2012
- 9.8.5.2** state how much government and land owners received from the export of gold from 1998 to 2012
- 9.8.6.1** discuss the negative and positive impacts of mining in Solomon Islands
- 9.8.7.1** understand that gold and other minerals found in Solomon Islands are non-renewable resources
- 9.8.8.1** list the main fossil fuel producer countries in the world: Saudi Arabia, Iraq, Iran, USA and Kuwait

- 9.8.8.2** state that the Earth's 'energy crisis' is the situation in which the world's fossil fuel deposits are running out
- 9.8.9.1** describe alternative sources of energy, such as solar, wind, wave, hydro, geothermal, tidal and biofuel
- 9.8.10.1** describe the sources of nuclear energy
- 9.8.10.2** describe the positive and the negative effects of nuclear radiation.

Answers

Suggested assessment events

Solomon Islands Years 7–9 Science Syllabus

- 1** Gold is extracted from the ore in the following steps:
- The conglomerate rock is crushed into small particles.
 - The crushed rock is placed in a dilute cyanide solution, which dissolves the gold pyrite.
 - The cyanide solution is passed through activated carbon particles and the carbon picks up all the metals. The metals (including gold, silver and some copper) adhere to the carbon pellets.
 - The carbon with the attached metal is removed and chemically dried to separate the metals from the carbon to obtain a very concentrated metal solution.
 - The gold and silver are then extracted from the solution by electrolysis and a metal alloy, which is 70/30 gold/silver, is obtained.
 - This alloy is then sent to Australia, where it is refined to separate the gold from the silver to produce gold that is more than 99 per cent pure.
- 2 a** Economic effects of mining: landowners receive royalties, government receives revenue, people get jobs and so have money to spend and therefore boost the economy.
- b** The social effects of mining may be both advantageous and disadvantageous.
- Advantages include:
- There may be an increased awareness of the land owners' genealogy.
 - Relocation of land owners from mining sites means building of new permanent houses, clinics, schools and playing fields where the new community can interact through games and live peacefully together.
- Disadvantages include:
- There may be disputes over land issues.
 - There may be drinking and social disorder due to the availability of liquor and even disputes with the operating company.

Challenge questions

Learner's Book page 136

- Minerals possess a definite chemical structure, occur naturally, are inorganic, and are solid at natural temperature.
- Renewable resources are resources that can be renewed and will be available for future generations; non-renewable resources are resources that will run out.
- Gold is stable and unreactive, whereas sodium is most reactive.
- The 'energy crisis' is the situation in which the world's fossil fuel deposits are running out.
- Fossil fuels are fuels such as petrol, diesel and oil, formed from dead trees or animal remains.
- Alternative energy is energy that is not produced from fossil fuel, such as solar, hydro, geothermal, etc.

Unit 8.1: Minerals and mining

Activity 1: Electrolysis of copper

Learner's Book page 140

Processes and skills	Resources	Teacher's support notes	Answers to questions
To extract solid copper from a solution	<ul style="list-style-type: none"> • 1 M sulfuric acid • black copper oxide • spatula • 50 mL beaker • glass stirring rod • Bunsen burner • tripod • gauze mat • bench mat and matches • 12 V power pack • globe • electrodes and connecting leads • filter paper/ paper towel 	<p>Learners will be using chemicals and expensive electronic equipment and instruments. Remind them to use these responsibly and safely.</p> <p>Demonstrate this activity before allowing the learners to work on their own.</p>	<ol style="list-style-type: none"> 1 Copper is formed at the negative electrode. The positive ions are attracted to the negative electrode. 2 The intensity of the blue dropped slowly. 3 The negative electrode is negative because electrons are arriving there. These electrons are taken by the copper ions, forming copper metal. 4 $\text{Cu}^{2+}_{(\text{aq})} + 2\text{e}^{-} \rightarrow \text{Cu}_{(\text{s})}$ 5 The cost of the electricity is very high. Electrolysis is actually used as a final stage of purifying the copper. 6 Aluminium is far more reactive than copper and much more difficult to extract in this way. The water breaks down instead of the aluminium reacting.

Activity 2: Chocolate-chip mining

Learner's Book pages 141–142

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the process of mineral extraction	<ul style="list-style-type: none"> • chocolate-chip biscuits • electronic scales • sieves • beakers • measuring cylinders 	<p>Learners will formulate their own hypotheses and plan, and then conduct the investigation to support or refute them.</p> <p>Learners must present their results using appropriate data formats.</p> <p>Make sure learners do not eat the chocolate chips while they are in the science lab and using science equipment.</p>	<ol style="list-style-type: none"> 1 This answer will vary between groups and between biscuits. 2 The composition of each biscuit would almost certainly be different—the ability of the manufacturer to disperse the chips completely evenly is unlikely. The chips probably float or sink in the dough mixture also. 3 The volume of the waste will be less than at the start, as the chocolate has been removed. 4 The waste will not usually fill the hole left by the biscuit. 5 The original biscuit is the ore. The chocolate is the mineral and the biscuit crumbs are the gangue.

Answers

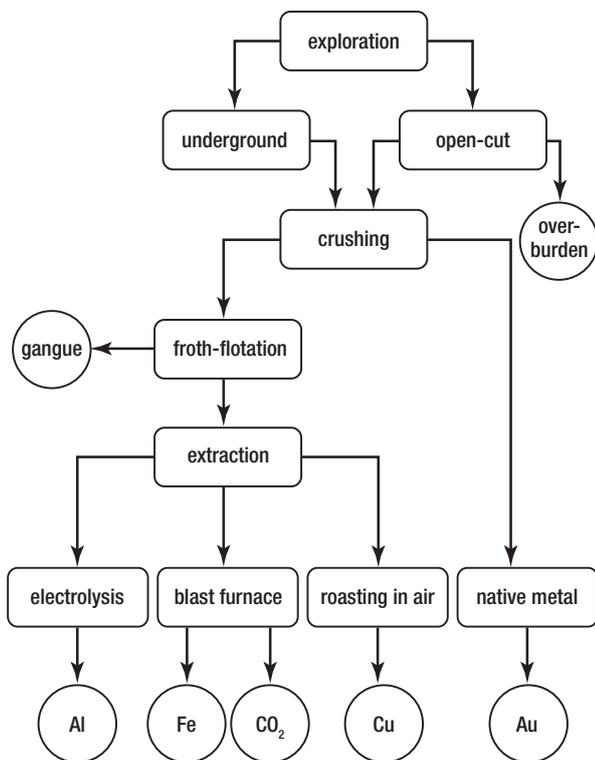
Unit questions

Learner's Book pages 144–145

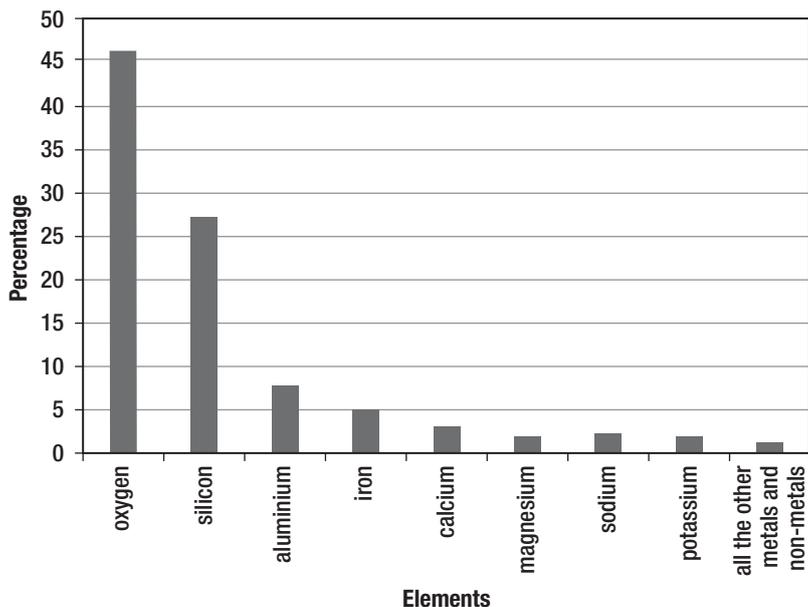
- 1 Oxygen
- 2 27.8%
- 3 Native elements are elements that exist in nature as pure elements.
- 4 Silver, platinum, copper, gold
- 5 Nuggets, veins
- 6 **a** Metals that are not native elements are found as compounds.
b Rocks containing large amounts of metals are known as minerals.
c An ore contains sufficient metal to mine.
- 7 Choose any three from the table.
- 8 Three possible answers are: not sufficient metal in the ore; damage to the environment; lack of transport from the mine site.
- 9 Problems are: water penetration and related pumping, threat of collapse and need for reinforcement, venting of poisonous and explosive gases, provision of fresh air.
- 10 Refer to Figure 8.1.3 in the Learner's Book.
- 11 Mined mineral is *crushed* by rollers or steel balls within a *ball mill*. Impurities known as *gangue* are separated by *gravity*, *froth flotation* or *sieves*. The remaining ore is then ready for *extraction*.
- 12 The activity series lists metals in the order of their ability to react chemically.
- 13 More reactive metals lose their outer-shell electrons faster than less reactive metals.
- 14 Potassium, sodium, calcium
- 15 Refer to Figure 8.1.6 in the Learner's Book.
- 16 Electrolysis requires electricity, which is expensive.
- 17 Lead, iron, zinc
- 18 Slag is CaSiO_3 .
- 19 Gold Ridge, Guadalcanal
- 20 Isabel
- 21 23.6%
- 22 Learners' answers will vary but may include impact on environment, impact on work (increased employment for a limited time or extra visitors for work purposes, non-nationals working in the islands), impact on ecosystems, impact on housing, value of properties in certain areas may change, economy growth, financial impacts (potentially positive or negative) and so on. Many factors may be both advantageous and disadvantageous for the society.
- 23 **a** False; **b** True; **c** True
- 24 Advantage—the production cost of new aluminium is twenty times more than the cost of recycling it.
Disadvantage—recycling of other metals is often too expensive. The difficulty of separating the iron from tin in food cans makes it far too expensive to recycle cans.
- 25 Sodium atoms (Na) are very reactive and will react with nearly anything that they come in contact with. If the ion that forms, Na^+ , were reactive then it would react to re-form the sodium atom, which would then react again to form the Na^+ ion. Neither would exist for long.
- 26 **a** Al, Mg, Ca, Na, K (All metals can be listed.)
b Pb, Fe, Zn
c Cu
d Au, Ag (Pt and Cu can be included.)

- 27 a** Slag (CaSiO_3) is the waste from the chemical reactions used to extract iron in a blast furnace. Gangue is all the impurities that are mixed with the ore. The gangue is removed even before the blast furnace stage.
- b** A mineral contains large amounts of a metal. An ore contains enough of the metal in the mineral to make extraction worthwhile.
- c** Electrolysis is using electricity to extract any metal from its ore. Smelting is heating to extract the pure metal.
- d** Stable means that the chemical is unlikely to react. Reactive is the opposite to stable.
- 28** Because they are reactive and are harder to extract from the ore.

29



30



31 a Learners' timelines might include the basic information but could be extended to include other events, such as when the metals were first discovered (as that was always before they were successfully extracted) and any important people involved. Learners may also find other points in history to include in their timeline.

1890 AD Aluminium was first discovered in 1825 and was successfully extracted and value increased dramatically between 1888 and 1890.

1500 AD Zinc was first used as early as 10th century BC. Extraction of zinc in Asia is thought to have begun around 14th century AD but in the west closer to 1668.

1400 BC Early iron extraction methods were used for tools and extraction methods have refined over the years. The process of creating steel was developed in the 18th century.

2000 BC Lead was used as early as 2000 BC, in money.

8000 BC Copper was one of the earliest used metals. Early potters were able to extract copper in hot furnaces. As copper resources depleted, copper extraction techniques became more advanced, including the use of electrolysis.

b The native metals are found naturally, are easy to find and hence were found first. Metals such as iron and magnesium had to be extracted by heat, which probably first happened around campfires. Metals such as aluminium need electrolysis and their discovery had to wait until the invention and widespread use of electricity.

Extension questions

Learner's Book page 145

- 1 Learners' responses will vary. Sample answer: Once car parts are removed, the body of the car is crushed for recycling. Recycling the steel of a car body saves energy and natural resources.
- 2 You usually pan for gold in a river, using a container (pan). Because gold is heavier than the sand, when you swirl the river sand around in the pan, the gold falls to the bottom. Learners' instruction sheets should include the following key points:
 - submerge the pan
 - remove large rocks and clay first
 - move the pan from left to right to cause the gold to fall to the bottom of the soil and sand.

Unit 8.2: Energy sources: Fossil fuels

Answers

Unit questions

Learner's Book page 148

- 1 Coal is a rock found mainly in underground seams and used as fuel.
- 2 Peat must be physically and chemically changed to form coal. Peat can include a large range of different decaying materials and organisms. Coal is formed from peat over time, with heat and pressure.
- 3 Coal is used to generate electricity and to produce gas and oil.
- 4 Oil is used as a fuel for transport and industry, to generate electricity and gas, and a small amount is used for cooking.
- 5 Any two of: Pressure, heat and time
- 6 Crude oil is the unrefined oil that comes out of the ground.
- 7 Natural gas is used in many ways including to generate electricity, heat buildings, fuel vehicles, heat water and bake foods.
- 8 Diesel
- 9 Diesel, kerosene

- 10 In ancient forests, which were warm and humid, layers of dead trees and other plants built up on the forest floor before they could rot. As the land sank, these layers of vegetation were covered with water, which deposited sediments of gravel, sand, mud and silt. Over millions of years the weight of the sediments and high temperatures removed much of the water from the plant remains. These plant remains are known as peat. As the peat was compressed and became warmer, moisture was driven out and it became brown coal or lignite. In some places, more layers of sediment built up on top of the brown coal. This caused more and more moisture to be driven out, and black coal or anthracite, was formed.
- 11 Oil and natural gas are believed to have formed from the remains of tiny plants and animals that lived in the sea. The bodies of these organisms were trapped in sediments on the sea beds. As their remains broke down, chemical changes took place. These changes, along with great pressure and high temperatures, produced oil and gas. The oil and gas were trapped between grains of sediment. The grains were compressed further so the oil and gas were forced upwards or sideways.
- 12 They are formed from the remains of tiny plants and animals stored in the Earth.
- 13 Solomon Islands Electricity Authority (SIEA), which is the main source of energy production for industries, offices and homes, uses diesel fuel to run its generators. Furthermore, heavy plant machinery and most of the transportation system in Solomon Islands (ships and vehicles) also use diesel. Therefore, the amount of diesel used is likely to be higher than the other fuel imports.

14

Imported fuel	Percentage (%)	Uses
Diesel	65	SIEA power stations, heavy machinery, ships and vehicles
Petrol	23	Vehicles, generators and outboard motors
Kerosene	4	Cooking
Aviation gas	3	Planes and helicopters
Jet fuel	2	Planes
Oil	2	All heavy and light machinery (generators, ships, vehicles etc.)
Renewable	1	Solar lighting, hydropower and wind energy

Extension questions

Learner's Book page 148

- 1 Learners must describe the different stages in the formation of coal.
- 2 Oil refining from crude oil involves distillation as different oils have different boiling points. The oil is heated and then vaporised to separate the oils that boil off at different temperatures.

Unit 8.3: Nuclear and other energy sources

Answers

Unit questions

Learner's Book page 153

- 1 Refer to Figure 8.3.1 in the Learner's Book.
- 2 When the neutrons released during a fission reaction cause other atoms to split and the process keeps repeating itself, huge quantities of energy are released in a fraction of a second.
- 3 Refer to Figure 8.3.3 in the Learner's Book.
- 4 There is no nuclear waste.
- 5 Temperatures of hundreds of millions of degrees are needed for fusion.

- 6 Solar, wind, hydro, wave, tidal, fuel cells and others
- 7 Solar energy and biomass energy
- 8 The sea-wave energy potential of Solomon Islands has not yet been assessed.
- 9
 - a Uranium provides much more energy per kilogram than coal.
 - b Unstable atoms emit radiation.
 - c Natural uranium contains 0.7 per cent uranium-235.
 - d A critical mass of uranium-235 will start a chain reaction.
 - e Fission is the splitting of an atom.
- 10
 - a Heat energy that comes from deep within the Earth where the temperature is so high that rocks are molten
 - b Geothermal power stations use steam from under the ground to drive turbines to produce electricity.
- 11 Uranium is used in nuclear power plants to create energy by splitting its atoms.
- 12 Solar energy is energy generated from the heat of the Sun. Geothermal energy is energy that comes from deep within the Earth where the temperature is high.
- 13 Learners' responses will vary. Reasons should be given.

Extension questions

Learner's Book page 153

- 1 Learners' responses will vary based on alternative energy source selected.
- 2 The affirmative team could consider the advantages of an alternative form of energy, such as more energy available for less usage of the resource and less damage to the environment. The negative team could consider the risks of damage to the environment and radioactivity.
- 3 A significant accident that occurs will bring up sensitive issues. Learners should cover what happened, why it happened, when it happened, any lasting effects, approximately how many people were affected and what can be done to prevent a similar occurrence in the future.

Chapter review

Answers

Learner's Book page 154

- 1 Minerals can be extracted from ore through electrolysis and smelting.
- 2 Coal was formed from the remains of plants buried by sediments. Oil and natural gas are believed to have formed from the remains of tiny plants and animals that lived in the sea.
- 3 Fossil fuel is fuel made from oils and coal found beneath the Earth's surface.
- 4 China, US, Russia and Saudi Arabia
- 5 Bauxite
- 6 Diesel and petrol
- 7 Coal, oil and natural gas
- 8 There are many coal deposits still available and coal is one of the easiest non-renewable sources to use. It is used to source almost half of the world's electricity so is required for extensive everyday uses.
- 9 Fission is the splitting of atoms with the release of energy; fusion is the combination of atoms with the release of energy.
- 10 Metal extraction by electrolysis involves applying a voltage to extract the metal. Electrolysis is a very powerful method but uses a huge amount of electricity in mining situations and so is used only when there is no cheaper method available. Both heat and electrolysis seek to extract the metal from their compounds by separating the compounds they are naturally found in. Less reactive metals can be extracted using heat, as they are not as strong in their bonds.

- 11** The growth of mining in Solomon Islands brings a range of issues, for example:
- In Solomon Islands, land is customarily owned. This means that every land owner has the same power and equal rights to the benefits of the development. Because of this equal rights system, leadership difficulties can occur, which often results in disputes over land. This type of dispute is one of the major hindrances to any development in this country.
 - Mining operations use a very poisonous chemical substance called cyanide. The disposal of even small amounts of cyanide can have disastrous effects on the environment. A classic example is the dewatering process of mining waste water at the Gold Ridge mine site that was abandoned by the St Barbara mining company in 2014.
- Other issues are inefficient infrastructure, power supply, government policies towards company operating in this country and social issues affecting land owners (such as dependence on royalty money, or heavy drinking, which can lead to violent behaviour and long-term illness).
- 12** Uranium must be enriched before it goes through the process. It is enriched while in its gas form.
- 13** Energy comes from the combustion of the fossil fuels, which generates heat energy.
- 14** Electrolysis is a process of splitting reactive metals from their ores after they are taken from the ground. It is required in the process of metal extraction to separate the metals from the compounds they are naturally found in.
- 15** Non-renewable resources are expected to eventually run out when sources can no longer be found. They cannot be remade as they come from natural sources that take a much longer time to produce than renewable resources.

Chapter 9: Communication technology

Strand: Energy and change

Suggested periods: 8

Sub-strand statement

This sub-strand deals with electromagnetic spectrum, which consists of a variety of electromagnetic waves. Light is one of the electromagnetic waves. Visible light enables us to see things with our eyes. The rest of the waves are invisible. X-rays, radio waves and ultraviolet rays are some examples of invisible waves. Invisible rays can only be detected by machines such as mobile phones, radios, fax machines and other types of equipment. Today's technology uses electromagnetic waves, making communication possible.

General learning outcomes

Learners should:

- 9.9.1** know the types of waves
- 9.9.2** understand that waves have different properties
- 9.9.3** know that the electromagnetic spectrum contains a variety of waves with different wavelengths and frequencies
- 9.9.4** be able to describe the use of electromagnetic waves in things we use in our daily lives
- 9.9.5** appreciate today's communication efficiency.

Specific learning outcomes

Learners should be able to:

- 9.9.1.1** describe the two types of waves: transverse and longitudinal
- 9.9.2.1** explain the properties of waves with the aid of a diagram: frequency, wavelength and amplitude
- 9.9.3.1** identify the different wavelengths and frequencies from the electromagnetic spectrum (ie from smallest to largest wavelength): gamma ray, X-ray, ultraviolet ray, visible light, infrared, microwave and radio wave
- 9.9.4.1** identify the electronic equipment that uses the following waves: gamma ray, X-ray, ultraviolet ray, visible light, infrared, microwave and radio wave
- 9.9.5.1** explain analogue and digital signals and their uses.

Answers

Suggested assessment events

Solomon Islands Years 7–9 Science Syllabus

- 1** Learners may wish to revise content in Chapter 1 of this book to explore various uses of electromagnets and how they work. The use of electromagnets makes many objects work. In the case of a generator, electromagnetic induction uses the fact that a moving electrical current creates a magnetic field and then the field creates an electric current.
- 2** A telegram works using a tapped-out message via Morse code. The code was transmitted along a telegraph wire or when more advance through wireless telegraph methods. A telephone allows conversations over the phone, as it transports the full signal through telephone wires or wirelessly. Mobile phones use microwaves to transmit the digital signals. This activity could be done after learners complete Unit 9.2.

Challenge questions

Learner's Book page 155

- 1 AM and FM are radio signals. AM stands for amplitude modulation and FM stands for frequency modulation.
- 2 Frequency is the rate of the wave, and wavelength is the length of the period or the distance between the compression.
- 3 Mobile phones use microwaves to transmit signals and find each other.
- 4 Learners' responses will vary and can include any that have been mentioned throughout the Learner's Book, or others: doorbell, phone, microphone, speaker.
- 5 Alexander Graham Bell
- 6 A digital message is made up of code in electrical signals.

Unit 9.1: Waves in communication

Activity 1: Waves in a slinky

Learner's Book page 156

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the movement of waves in a slinky	<ul style="list-style-type: none"> • slinky • masking tape • stopwatch • floor or corridor space in which to generate waves between points 5 to 10 metres apart 	<p>Be careful not to overstretch the slinky.</p> <p>Explain to learners about the direction of the wave before starting so that the direction makes sense.</p>	<ol style="list-style-type: none"> 1 Perpendicular 2 a-b The frequency of the wave affects its speed. The size (amplitude) of the wave does not affect its speed. The wavelength and frequency are relative to the speed. 3 a When two waves meet on the same side of the slinky they multiply and therefore increase the amplitude. b When they meet on the opposite side of the slinky they cancel each other and therefore decrease the amplitude. 4 When learners bunch up and release the coil it creates a longitudinal wave. It will pulse back and forth, and the masking tape will travel in the direction of the wave.

Activity 2: Polarised

Learner's Book page 157

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate the interaction of two polarising filters	<ul style="list-style-type: none"> • 2 polarising filters • window or other light source 	<p>Take care when using the filters. Make sure they are not damaged.</p> <p>Learners may research further information about polarising filters if time permits. Polarising filters are used in photography.</p>	<p>1 A second filter will double the effect. Learners' responses will vary, depending on the quality and type of the filters and the position of the light.</p> <p>2 Learners should explain what they saw and why.</p>

Answers

Unit questions

Learner's Book page 162

- 1 Transverse and longitudinal waves
- 2 In a transverse wave the particles vibrate up and down, while in longitudinal wave the particles vibrate back and forth.
- 3 Frequency is the rate of the wave, amplitude is the height of the wave crest and wavelength is the length of the period or the distance between the compressions or rarefactions.
- 4 The unit 'hertz' (Hz) is used to describe anything that has regular repetitive behaviour, and can be taken to mean 'per second'.
- 5 A light wave is made up of changing *magnetic* and *electric* fields that are *next* to each other, and moves at 300 000 kilometres per second.
- 6 **a** True; **b** True; **c** False
- 7 Similarity: the waves travel at the same speed. Difference: they travel at different wavelengths and frequency.
- 9 Main type of waves in the electromagnetic spectrum in order from shortest to longest wavelength: gamma rays, X-rays, ultraviolet rays, visible light, infrared rays, microwaves, radio waves
- 10 AM—amplitude modulation; FM—frequency modulation
- 11 Amplitude modulation waves can be received from radios in remote places. Frequency modulation waves are less affected by interference.
- 12 It does not make sense to talk about wavelength or white light because white light is made up of different colours with various wavelengths.
- 13 **a** The colour with the greatest wavelength is red.
b The colour with the highest frequency is violet.
- 14 The colours that human beings are most sensitive to are blue, green and yellow.
- 15 Microwaves can penetrate the Earth's atmosphere.
- 16 The harmful rays that are released in a nuclear explosion are gamma rays.
- 17 A small amount of UV helps produce vitamin D. Too much can cause damage to the skin, including skin cancers.
- 18 The frequency of the wave = $20/10 = 2$ wave per second or 2 hertz.
- 19 **a** The time between each wave is $1/2$ second.
b If the wave frequency increases, the period will decrease.
- 20 **a** Learners should draw a wave in which the distance from crest to crest is 3 cm and the height of the two waves from the centre to the top of the wave or crest is 2 cm.
b Learners should draw a wave in which the distance between the two crests is 10 cm and the height of the two waves from the centre to the top of the wave or crest is 1 cm.

Extension questions

Learner's Book page 162

- a** James Clerk Maxwell: demonstrated that electric and magnetic fields travel through space in form of waves and at the constant speed of light. His work in producing a unified model of electromagnetism is one of the great achievements of physics.
- b** Edwin Howard Armstrong: invented modern frequency modulation radio transmission.
- c** Guglielmo Marconi: known as the father of long-distance radio transmission and for his development of Marconi's law and a radio telegraph system.
- d** John Logie Baird: invented the world's first practical, publicly demonstrated television system, and also the world's first fully electronic colour television tube.

Unit 9.2: The communications network

Answers

Unit questions

Learner's Book pages 167–168

- 1** Some old forms of communication: drums, smoke, mirrors and flags
- 2** The distance over which the first telephone call was made was 3.2 kilometres.
- 3** Digital signals are transmitted by optical fibres.
- 4** Most coaxial cables contain several tubes, each consisting of an inner copper core and an outer cylindrical copper mesh layer separated by an insulating material. The inner core carries analogue or digital signals, while the outer copper layer protects the signal from interference between tubes in the same cable or from outside sources.
- 5** An optical fibre is a hair-thin tube or strand of glass surrounded by a protective cladding that traps and conducts light.
- 6** Microwave links transmit digital signals through the air from repeater station to repeater station.
- 7** Mobile phones use microwaves to transmit digital signals. When we turn on a mobile phone, it sends a signal to the network, which registers our location. As we move from place to place, base stations within the network detect signals from the mobile phone, and the base station receiving the strongest signal sends it to the exchange. When a call is made to our mobile phone, the exchange detects where we are and sends the call to the base stations in the cell we are in.
- 8** The network predicted for the future is B-ISDN (Broadband Integrated Services Digital Network).
- 9** Communication services/devices that are currently available in Solomon Islands are:
 - mobile phones (texts messages, phone and video calls)
 - telephones
 - fax machines
 - internet services such as email, Skype, Facebook and Twitter.
- 10** With a digital signal, several messages can be sent using the one data stream and there is less chance of signal corruption.
- 11** Mobile phones are sometimes called cell phones because of the shape of the regions in which the mobile phone network is divided. The regions are arranged like biological cells.
- 12** The world is sometimes referred to as global village because of the efficient telecommunications that we have today. People can talk to each other in remote and isolated places.
- 13** With a video-phone we can see the person we are talking to, and we would be more likely to use gestures and facial expressions to communicate—as we would if we were standing next to them.

14 The towers are arranged to avoid direct interference between adjacent towers.

15 The message is: I AM HAVING FUN.

Extension question

Learner's Book page 168

This type of investigation can be difficult for learners if they do not have access to the internet. Give the question only to those who are in urban centres. Do not use this assignment for summative purposes.

Chapter review

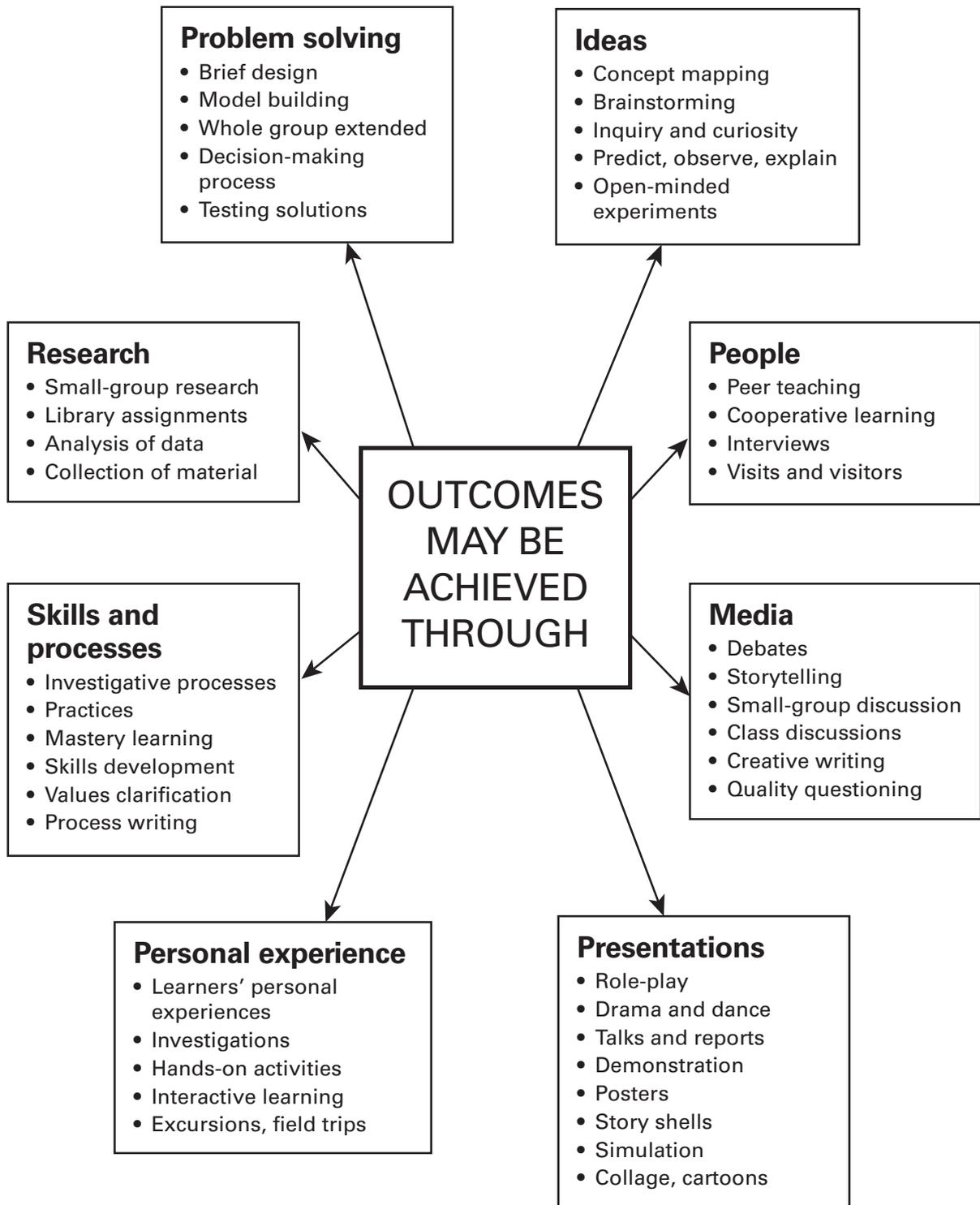
Answers

Learner's Book page 168

- 1** The two types of waves that are possible in a slinky are transverse and longitudinal waves.
- 2** Examples of electronic devices: mobile phone, calculator, digital watch, computer, camera
- 3** These could include any of the following (a suggested use for each is in brackets): gamma rays (produce scans of the skeleton), X-rays (photograph in the body), ultraviolet rays (kill bacteria), visible light (everyday life), infrared waves (technology to connect remote devices), microwaves (microwave) and radio waves (transporting messages in communication).
- 4**
 - a** Samuel Morse invented Morse code.
 - b** Alexander Bell invented the telephone.
 - c** Almon Strowger invented the automatic telephone exchange.
 - d** William Shockley headed the team that invented the transistor.
- 5** The visible spectrum is a small part of the electromagnetic spectrum. We see it as light, containing the colours of the rainbow.
- 6** As frequency increases, the wavelength decreases.
- 7** Waves of laser light are all of the same wavelength and colour and are in step (coherent).
- 8** Messages are sent by coaxial cable (advantage: uses existing cabling), optical fibre (advantages: high capacity, cheap, suited to transfer of digital information) and microwave (advantages: requires no cabling as it uses electromagnetic waves, useful for long distances, satellite communications).
- 9** If the same frequency was used, several conversations could be heard by unrelated callers (crossed lines, lack of privacy).
- 10** Radios used valves (which were much larger and heavier than transistors) to amplify radio signals for conversion into sound waves.
- 11** Learners use a ruler to measure the wavelength of the diagram.
 - a** Frequency: 0.5 Hz
 - b** Wavelength: 15 mm
 - c** Amplitude: 10 mm.
- 12** Each letter could be given a code made up of zeros and ones (in a similar way to how each letter is made up of dots and dashes in Morse code).

Appendix 1: Suggested teaching methods

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



Appendix 2: Lesson plan format

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

Appendix 6: Sample learner's remedial work form

Learner's name:		Class:		Term/Semester:	Year:
Strand:		Sub-strand:			
Assessment event	Specific Learning Outcomes and benchmarks (use appropriate code)				
	Code	Description of outcomes assessed	A	PA	NA
		5	4, 3, 2, 1	0	Remedial work required
					Results after remedial work
Class teacher:					Signature:
					Date:

Appendix 8: Sample learner's classroom report form

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

Appendix 9: Sample learner's school report form

TAKWA COMMUNITY HIGH SCHOOL

Name: _____ Year level: _____

Reporting period: _____

Subjects	Score (100%)	Overall achievement level, award and certification	Grade	Comments
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

Class teacher comments on learner's attitude, behaviour and character:

Head teacher/Principal comments:

Key

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 9

Teacher's Guide

The Solomon Islands Science Year 9 Teacher's Guide provides support material to the *Solomon Islands Science Year 9 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.

