Solomon Islands
Science
Year 7

Teacher's Guide

ALWAYS LEARNING

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Solomon Islands
Science
Year 7

Teacher's Guide

Solomon Islands Curriculum Development Division
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Contents

Introduction to this Teacher's Guide

This Teacher's Guide is designed to help you use the *Solomon Islands Science Year 7 Learner's Book*. The Teacher's Guide provides you with resources to help make your planning and teaching more effective.

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

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

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

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

The outcomes-based approach

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

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

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

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

One way to understand this approach is to think of the more traditional approach of our schools as banking education. In banking education, the teacher regards the learners as empty vessels to be filled with knowledge. The learners are tested by being asked to reproduce the knowledge that the teacher has given them. This method relies a lot on the learner listening to the

teacher, copying notes from the board, learning them and reproducing them later. This can be done successfully without the learner even understanding fully what they are writing and reading.

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

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

The approach of the Learner's Book

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

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

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

The Learner's Book and the syllabus

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

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

The Learner's Book is full of illustrations, photos, maps 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 7 Learner's Book.

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 7: Semester 1									
Weeks	**Week 1 (1 week)**	**Week 2–6 (5 weeks)**	**Week 7–8 (2 weeks)**	**Week 9–11 (3 weeks)**	**Week 12 (1 week)**	**Week 13–14 (2 weeks)**	**Week 15–18 (4 weeks)**	**Week 19 (1 week)**	**Week 20 (1 week)**
Periods (68)	n/a	20	8	12	4	8	16	n/a	n/a
Year 7	Extra-curricular program	Introduction to science and physical quantities	Life and living	Natural and processed materials	Energy and change	Earth and beyond	Natural and processed materials	Revision program	Examination program
		7.1 What is science? Doing science safely Being alive Observing Equipment Reporting Measurement Questions about science Working scientifically Science in Solomon Islands	*7.2 Classification of living things* From kingdom to species Animal classification Plants, fungi, monerans and protists	*7.3 Solids, liquids and gases* Solids, liquids and gases Change of states Physical and chemical change	*7.4 Energy forms* Energy forms	*7.5 Our planet Earth* Our Earth Rocks and minerals Types of rocks Weathering and erosion	*7.6 Solutions, solutes and solvents* Types of mixtures Separating insoluble substances Separating soluble substances Water supply and sewage		

Year 7: Semester 2									
Weeks	**Week 21 (1 week)**	**Week 22–24 (3 weeks)**	**Week 25–27 (3 weeks)**	**Week 28–30 (3 weeks)**	**Week 31–33 (3 weeks)**	**Week 34–36 (3 weeks)**	**Week 37–38 (2 weeks)**	**Week 39 (1 week)**	**Week 40 (1 week)**
Periods (68)	n/a	12	12	12	12	12	8	n/a	n/a
Year 7	Extra-curricular program	Life and living	Energy and change	Natural and processed materials	Life and living	Earth and beyond	Life and living	Revision program	Examination program
		7.7 Introduction to cells The microscope Plant and animal cells Specialised cells Groups of cells	*7.8 Light and colours* Light Bending light Lenses and curved mirrors Colour	*7.9 Elements, compounds and mixtures* Elements, compounds and mixtures	*7.10 Living structures and plant reproduction* Types of reproduction Plant reproduction Fruits and seeds Germination	*7.11 Earth and the solar system* The solar system The Sun Earth's movement in space The Moon	*7.12 Ecology* Ecosystems Physical attributes of an ecosystem Food chains and food webs		

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. In Year 7 you should not place too much emphasis on the formal writing of reports. It is usually enough for learners to answer a series of questions in a questionnaire.

Many of the units in the Year 7 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 girls being too shy to talk. All-girl groups may sometimes be better.
- **Organise the seating:** Good discussion will only take place if learners face each other in a circle. You cannot talk to someone else's back! If possible, classrooms may be arranged by grouping desks in circles facing each other so group work is easy and no movement is necessary. In crowded classrooms you may allow some groups to go outside and work.
- **Circulate and listen to progress:** It is best to do this only after giving time for discussion to start. Try to make sure all learners are being given a chance to speak. If you see certain people dominating groups, intervene and ask others their ideas. If groups are having difficulty, give guidance by explaining the topic, giving some extra questions or asking individuals their ideas. If groups are doing well on their own, do not interfere.
- **Decide on the language to be used:** In Year 7 most will want to use Pijin. It is best to let them do so or they may say nothing. There is nothing wrong with a local language if everyone in the group speaks it. But try to get each group to report back their ideas at the end in English, either verbally or in writing. If groups are confident to use English throughout, allow them to do so.
- **Reporting back:** It is often a good idea to appoint a chairperson, who will report back to the whole class at the end, but this is not always necessary. Each member may write their own ideas, or groups may just learn from the process of discussion.

Debate and discussions

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

Debates are good to encourage learners to form their own opinions about a topic. Even in Year 7 we should encourage this by using simple topics. An example is the extension question in Unit 12.2 about whether the environment should be kept free from human interference. 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 an area like the one being 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 text books 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 7 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	Assesssment 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 7 Science. The SLO is the curriculum benchmark. The statements in the table are assessment criteria for the SLO 7.1.11.1 (List the five senses that scientists use for observation). Each of the six levels describes the achievement of the learner.

Level	Assesssment criteria	Judgement criteria	Achievement award
L5	Five senses listed	Five senses listed in any order: sight, hearing, taste, touch and smell	Achieved (A) Full mastery of learning outcome
L4	Four senses listed	Four senses listed in any order	Partially Achieved (PA4) Substantial mastery of learning outcome
L3	Three senses listed	Three senses listed in any order	Partially Achieved (PA3) Moderate mastery of learning outcome
L2	Two senses listed	Two senses listed in any order	Partially Achieved (PA2) Minor mastery of learning outcome
L1	One sense listed	Any sense listed	Partially Achieved (PA1) Minimal mastery of learning outcome
L0	No senses listed	None of the senses given	Not Achieved (NA) No mastery of learning outcome

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 117). 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 118).

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 121).

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 124). However, detailed reports will be used for parent–teacher meetings at the school level (see Appendix 8, page 122). 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	E

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.

Translation of the National Achievement Standards within individual subjects

The National Achievement Standards can be translated and adapted within individual subjects and is determined by the knowledge content, processes and skills taught, learnt and assessed during an assessment period for each academic year. For example, specific Science knowledge content, processes and skills taught, learnt, assessed and achieved by each learner should be reported clearly with an appropriate achievement award, grade and percentage attained using the National Achievement Standards framework. The report should provide specific Science knowledge content,

processes and skills attained by each learner for a specific assessment period. Such attainments can be measured against the curriculum standards and benchmarks prescribed in the Science Year 7 – 9 Syllabus and the Science prescription handbook.

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.

Level and sub-strand	Year 7 Science sub-strands
Social Studies **Year 7** Weather tectonics, earthquakes, tsunamis volcanoes	Our planet Earth
Arts and Culture **Year 9** Traditional leadership	Ecology
Year 10 **Language** Living in harmony with others	Ecology
Maths **Year 9** Map work	Introduction to cells
Agriculture **Year 7** Shifting cultivation Plantation farming	Classification of living things
Year 9 Forestry farming	Ecology
Business Studies **Year 7** Resources and production	Energy
Home Economics **Year 8** Food and nutrition	**Year 7** Human body system 1
Technology **Year 7** Basic electricity	**Year 8** Energy

Chapter 1: What is science?

Strand: Introduction to science and physical quantities

Suggested class time: 20 periods

Sub-strand statement

Science is finding out about how things work and why things happen the way they do. To explain how things work, we observe and do experiments or investigations. Scientific experiments and investigations are done in a systematic way. We use our five senses to help us carry out experiments, observations and investigations. In carrying out scientific experiments and investigations, basic safety measures should be observed. Physical quantities are measured in standardised units. Appropriate instruments must be used to measure the different quantities.

General learning outcomes

Learners should:

7.1.1 Be able to work carefully and safely in the science laboratory.
7.1.2 Know the basic laboratory safety rules.
7.1.3 Know the meaning of living and non-living things.
7.1.4 Know the main branches of science.
7.1.5 Be able to show two types of observations.
7.1.6 Understand the terms *infer* and *predict*.
7.1.7 Know the basic science laboratory equipment.
7.1.8 Be able to write a scientific report.
7.1.9 Know how to measure accurately.
7.1.10 Be able to use balances.
7.1.11 Know the five senses.
7.1.12 Be able to plan scientific experiments.
7.1.13 Appreciate benefits provided by science.

Specific learning outcomes

Learners should be able to:

7.1.1.1 Apply safety procedures when doing science experiments in the science laboratory.
7.1.2.1 List basic laboratory safety rules.
7.1.3.1 Describe a living and a non-living thing.
7.1.4.1 Describe the four main branches of science.
7.1.5.1 Demonstrate the two types of observations: *qualitative* and *quantitative*.
7.1.6.1 Explain inferring and prediction.
7.1.7.1 List and draw basic science laboratory equipment.
7.1.8.1 Write a scientific report of a simple science experiment that has been carried out.
7.1.9.1 State the appropriate units used for these measurements: *length, height, distance, mass, time, speed, volume*, *temperature*.
7.1.10.1 Demonstrate the uses of balances: *beam balance, electronic balance*.
7.1.11.1 List the five senses that scientists use for observation.
7.1.12.1 Design a scientific experiment to solve a scientific problem.
7.1.13.1 Describe at least five benefits science has brought to our country.

Answers

Suggested assessment activity

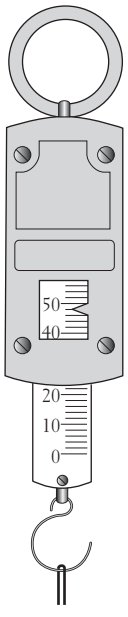
1 **a** Broken beakers must be reported to the teacher and must be carefully removed and thrown into the rubbish bin.

b If there is an acid spill, avoid having the acid make any contact with your body, especially your eyes. Notify the teacher immediately. Water must be poured on the spilt acid immediately to neutralise it before it can be removed. Soak up the spill with tissue paper and throw it into the rubbish bin.

2 The five characteristics of living things are: movement, respiration, excretion, growth and response to stimulus.

3 In this activity a Newton meter is used.

a



b Answers may vary, depending on the type of Newton meter. Learners should draw the table as shown below:

Mass (g)	Extension (cm)
50	
100	
150	
200	

c The pattern is that as the mass increases so does the length of the spring.

4 Answers will depend on where the school is.

Challenge questions

Learner's Book page 1

1 Science is the study of things around us, whether they are living or non-living, and what they are made of.

2 The dangers include spilling harmful chemicals on your body and smelling poisonous gases, which can cause serious illness or death. Broken glass and equipment can cut you or damage your eyes. It is important that learners be cautious and follow the science laboratory rules to avoid or minimise these dangers.

3 Science equipment includes: measuring cylinder, spatula, retort stand, test tube rack, test tube, beaker, watch-glass, conical flask, thermometer, safety glasses, tongs, clamp, boss head, clay triangle, funnel, Newton meter, beam balance, electronic balance.

4 A report about a science experiment should tell the reader the aim of the experiment, the hypothesis, the materials or equipment used, the method used to conduct the experiment, the results and observations of the experiment, discussion or analysis of the results and finally, the conclusion of the experiment.

5 Some of the metric units are: millimetre, centimetre, metre, kilometre, milligram, gram, kilogram, tonne, litre, degrees Celsius and kelvin.

6 A variable is a factor that may affect the outcome of an experiment.

Unit 1.1: Doing science safely

Learner's Book page 3

Answers

Unit questions

1 The correct statements are:
- **a** It is *not* OK to pour all substances down the sink after an experiment.
- **b** Running and pushing people in the laboratory is never allowed.
- **c** It is *not* OK to eat and drink in the laboratory.
- **d** Spilt chemicals *must not* be left unattended.
- **e** The teacher must always be told if something goes wrong.
- **f** All solid objects should be put in the bin and not down the sink.
- **g** Safety glasses are *not* optional when we use chemicals in the laboratory.
- **h** Chemicals should never be tasted or smelled.
- **i** To investigate a reaction in a test tube, *never* look straight down the tube.
- **j** Always point test tubes away from yourself and others.
- **k** It is *not* good science to mix unknown chemicals together.

2 Four dangers are: smelling poison gases from laboratory chemicals can make you very ill; spilling concentrated acids can burn your skin; broken glass equipment can cut you or a piece could enter your eye and damage it; you could burn yourself when using a heating apparatus to heat substances in the laboratory.

3 Similar dangers in other subjects include:
- **a** Industrial Arts or Technology: smelling of harmful chemicals, cutting yourself on broken glass.
- **b** Home Economics: burning yourself from using a heating apparatus.
- **c** Agriculture: tasting and smelling harmful chemicals, e.g. fertilisers.

4 The rules in Science are different from the rules in other classes because of the types of equipment and substances that are used. Most of the equipment can break easily and many of the substances are harmful to the body.

5 Five injuries that can happen in a science laboratory are: burns from an acid spill; cuts from broken glass and equipment; eye injuries from fragments of broken glass; burns from hot metal and glass materials; burns from boiling or very hot water.

6 Follow the laboratory safety rules at all times when you are in the science laboratory.

7 Two ways in which eye injuries could occur are: looking directly and too closely into a container of chemicals; not wearing safety glasses when performing an experiment that involves dangerous chemicals or the heating of glass materials. To avoid eye injuries, ensure that you wear safety glasses at all times and never look directly into a container of chemicals.

8 The ten safety DOs:
- Do follow the safety rules when you are in the laboratory.
- Do be careful when handling glass.
- Do pay attention to your teacher's instructions.
- Do wear safety glasses when doing experiments that involve heating of glass.
- Do wash your hands before leaving the science laboratory.
- Do use the right equipment for the right purpose.
- Do read the instructions very carefully before performing any experiment.
- Do tie your long hair back neatly when using a Bunsen burner to heat a substance.
- Do pour water on any spilt acid or alkali and clean the spill with a rag or a mop.
- Do report any broken equipment to your teacher.

The ten safety DON'Ts:

- Don't run or play in the science laboratory.
- Don't drink water from the tap in the science laboratory.
- Don't taste any chemical in the science laboratory.
- Don't mix any unknown chemicals together in the science laboratory.
- Don't eat food in the science laboratory.
- Don't fall asleep when doing your experiment in the science laboratory.
- Don't place a test tube directly below your nose or smell any unknown chemicals.
- Don't tear the labels on the containers that store chemicals.
- Don't touch any spilt acid or alkali.
- Don't look straight into a test tube when observing a chemical reaction.

9 Learners' answers will vary. Sample answers:

a

b

c

d

e

10 Learners' answers will vary, but should illustrate the safety rules written by learners in answer to Question 1.

Extension questions

Learner's Book pages 3–4

1 Learners' answers will vary. They should be similar to:

a

b

c

2 Learners' answers will vary. Sample answers:

a A toxic substance is one that is poisonous.

b A caustic substance is able to eat away or destroy living cells or tissues by chemical action.

c A flammable substance is one that can catch fire easily.

d Spontaneous combustion is when a substance heats up quickly due to chemical reactions within the substance and catches fire.

3 Learners' answers will vary. Sample answers:

a

b

4 Learners' answers will vary. Sample answers:

a

b

5 **a** Hazardous chemicals; **b** Hard hats should be worn; **c** Toxic gas; **d** Radioactive material; **e** Do not light fires; **f** Do not drink the water

Unit 1.2: Being alive

Activity 1: Light and photosynthesis

Learner's Book pages 6–7

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate how the presence of light affects the amount of food (starch) that a plant makes during the process of photosynthesis	• 2 pot plants of the same species, with leaves • aluminium foil • ethanol • 2 beakers (1 large, 1 small) • iodine solution • heat mat • Bunsen burner • tripod • gauze • tweezers • watch-glass	This activity is in two parts. The first part is done by the teacher to prepare or select two pot plants of the same species. Make sure to label the pot plants: 'Sunlight' and 'Without sunlight'. Alternatively, use one plant but cover some of its leaves with aluminium foil. Place the pot plant/s in the appropriate places for three days before the activity. For the second part of the activity, learners should follow the steps in the Learner's Book. Learners should be aware that the presence of sunlight is very important for photosynthesis in plants. **Results:** The leaves that were kept in the dark show a very low starch content, while the leaves kept in the light show a high starch content. This shows that light is needed for the process of photosynthesis.	**1** The leaf that had the most photosynthesis occurring is the one placed in sunlight. **2** This experiment shows that light is needed for the process of photosynthesis.

Activity 2: The germinating seed

Learner's Book page 9

Processes and skills	Resources	Teacher's support notes	Answers to questions
To observe the changes that occur during the growth and development of a living thing, e.g. a seed	• 3 small glass or plastic containers • cotton wool • aluminium foil • sticky tape • 30 seeds (corn or bean seeds) • plastic wrap • pin	Note that some seeds need light for germination, while others do not. However, all seeds need water, oxygen and the right temperature for germination. Remember that the focus of this experiment is to observe the changes that occur during the growth and development of a living thing—in this case, a seed. **Results:** The seed grows into a plant with roots and leaves.	**1** Learners' sketches and results will vary. **2** This experiment has shown two things: **a** not all seeds need light for germination **b** changes occur during the growth and development of a living thing, e.g. from a seed into a fully grown plant with roots and leaves.

Answers

Unit questions

Learner's Book page 10

1 A characteristic is a typical quality of an organism.
2 Two characteristics of humans are that they use air and can move.
3 The seven characteristics of living things are: take in and use energy; take in and use gases from air or water; produce wastes; respond to stimuli; move; reproduce; grow.
4 Glucose + *oxygen* → carbon dioxide + *water* + *energy*
5 They can breathe through modified lungs or by using stomata.
6 Excretion
7 **a** Person running; **b** Chicken flying away
8 Endothermic animals: body temperature is constant; use energy from food to keep warm.
Ectothermic animals: body temperature changes; don't use energy from food to keep warm, so have to use the warmth from the Sun.
9 Sexual reproduction requires two parents. Asexual reproduction only needs one parent.
10 Cells are extremely small and cannot be seen without a microscope.
11 Plants moving towards light, e.g. a plant on a window sill moving towards the light or a sunflower following the movement of the Sun.
12 No, but they must be capable of them.
13 A river can move, but it is not a living thing.
14 Learners' answers will vary. Sample answers: living—student, plant; non-living—book, table.
15 They do things very slowly, e.g. grow and take in air.
16 **a** Rat: living—has all seven characteristics; **b** Pen: non-living; **c** Pineapple: living—has all seven characteristics; **d** Human: living—has all seven characteristics; **e** Car: non-living—can move and produce waste but cannot reproduce and grow; **f** Tree: living—has all seven characteristics; **g** Cow: living—has all seven characteristics; **h** Rubbish bin: non-living
17 **a** They respond to stimuli and can move but cannot take in air and use energy, produce waste, reproduce or grow.
b Not alive; only perform some functions of living things
18 **a** The carbon dioxide came from the astronauts' bodies—they breathed it out.
b On Earth, plants take in the carbon dioxide we breathe out and use it to make food.

19 Jack shows he is alive by: turning off the alarm clock, turning on the bedside lamp, blinking, walking to the bathroom, going to the toilet, taking a shower, walking down the stairs, breathing in deeply, eating breakfast, walking to the ferry, coughing.

Extension questions

Learner's Book page 10

The 'Investigate' activities in this section can be used as part of a whole-class or group discussion or a guided research question. The teacher should decide the best way to approach this section. The 'Create' activity provides additional questions for learners to complete in their own time. Give learners the opportunity to be creative. Assess their work as formative assessment.

Unit 1.3: Observing

Activity 3: The burning question!

Learner's Book page 11

Processes and skills	Resources	Teacher's support notes	Answers to questions
To observe a burning candle and investigate and understand which observations are qualitative and which are quantitative	• candle • gas jar or beaker • metal or plastic lid, or Petri dish • matches • electronic scales	**Qualitative observations** give a description of what is happening. **Quantitative observations** are based on measuring and determining the different things (factors) in the experiment. This experiment should enable learners to make both a qualitative and a quantitative observation. For example, the candle stops burning when covered with the beaker (qualitative observation) and the weight of the candle may be reduced after burning (quantitative observation). If electronic scales are not available, a simple spring balance can be designed (i.e. use strings to lift the lid with the candle) to measure the weight of the candle. You can use other examples that you think are relevant to illustrate this concept.	**1** Possible observations that can be made before and when the candle is lit: • Before it is lit, the mass of the candle + lid + dish in grams (quantitative). • The candle reduces in height and size (qualitative). • The candle flame is hot (qualitative). • The candle wax melts (qualitative). • The melted wax runs down the base of the candle onto the dish (qualitative). • The wax solidifies on the dish when it cools (qualitative). Possible observations when the candle is covered with the beaker or gas jar: • The flame reduces in brightness (qualitative). • The flame will eventually die (qualitative). • The mass of candle + lid + dish in grams (quantitative). **2** The mass of the candle + lid before the burning is greater than the mass of the candle + lid after burning. In the process of burning, mass is used up.

Answers

Unit questions

Learner's Book pages 12–13

1 The correct statements are:

a A *quantitative* observation is one where numbers are involved.

b If we use a thermometer, we are making *quantitative* observations.

c The colour of a leaf is an example of a *qualitative* measurement.
d An inference is a logical explanation about what happened in an experiment.
e A prediction is a logical guess about what might happen in the future.

2 **a** Sugar: solid, crystalline, white, easily crushed
b Water: liquid, clear, colourless (*not* white—a common Year 7 response), takes shape of container
c Talcum powder: solid, white/cream, fine, non-crystalline
d $1 coin: Learners' answers may vary, but could include: metal, shiny/dull (depending on age and condition of the coin), seven-sided, picture of Nguzu Nguzu on one side and the Queen on the other.
e Gas we breathe out: gas, clear, colourless, hot, moist (*not* CO_2—this is a prediction)

3 **a** The missing fish were eaten by the cat. (inference)
There will be no fish left in the pond after a while. (prediction)
The cat is on the edge of the fishpond. (observation)
b One Olympian is bigger than the other. (observation)
The bigger Olympian will win the event. (prediction)
One can lift a heavier weight than the other can. (inference)
c The fish will be a big one. (prediction)
I have caught a fish. (observation)
The line is stretched tightly and the fishing rod is bending. (observation)

4 Prediction

5 Jill would have seen the liquid changing colour, bubbles forming as gas was released and the temperature reading going up as heat energy was released into the environment. She would have heard the sound of the acid reacting with the metal and would have smelled the hydrogen gas. She would have noticed she felt dizzy.

6 **a** Inference; **b** Inference; **c** Inference; **d** Prediction; **e** Prediction; **f** Inference; **g** Prediction; **h** Prediction

7 **a–c** Learners' answers will vary.
d Learners' drawings should be similar to:

e One shark
f Learners' answers will vary.

8 **a** One footprint is bigger than the other footprint.
b The bigger footprints are close together, then further apart. The smaller footprints are far apart then move closer together.

9 **a** There are two creatures.
b After they met, they seemed to run from each other.

10 **a** Where the larger prints first appear at the left side of the diagram

b Where the smaller prints begin to get further apart (beginning to run)
c Where the larger prints meet up with the smaller ones
d Where the larger prints begin to get further apart
e Where the smaller prints begin to get further apart

11 The large dinosaur is carnivorous since it seems to have eaten the smaller one: there is no evidence of the smaller one after the larger one met up with it.
12 Large dinosaurs may have the largest feet. (inference)
13 It was probably eaten. (inference)
14 The dinosaur could have taken a large jump/hop out of the area or flown away.

Extension questions

Learner's Book page 13

Use these exercises to give learners opportunities to describe situations. These are open-ended questions that are designed to prompt good discussions.

Unit 1.4: Equipment

Activity 4: What is it?

Learner's Book page 15

Processes and skills	Resources	Teacher's support notes	Answers to questions
To correctly sketch, classify and name common scientific laboratory equipment	A range of scientific equipment such as: • beaker • test tube • conical flask • watch-glass • thermometer • measuring cylinder • spatula • tongs • retort stand • test tube rack (test tube holder)	In this activity, learners are introduced to scientific equipment. Encourage them to learn the names and draw sketches of the common scientific equipment. Warn learners to handle the equipment with care because glassware can easily break. **Note:** Encourage learners to name and draw other scientific equipment that is not listed here but is found in their school laboratory or science store room.	Measuring equipment: measuring cylinder, balance, beaker, volumetric flask Pouring equipment: beaker, measuring cylinder, conical flask Storage equipment: storage bottle, test tube, test tube rack Equipment to run chemical reactions in: conical flask, beaker, test tube, volumetric flask. Safety equipment: safety glasses, gloves, safety shoes Holding equipment: tongs, clamp, retort stand, boss head, clay triangle Cleaning equipment: brush, detergent, tissue paper Mixing equipment: volumetric flask, conical flask, beaker

Answers

Unit questions

Learner's Book pages 15–16

1 Pyrex
2 The correct statements are:
a A clay triangle is used to hold a *crucible* over a Bunsen burner.
b Beakers are used for *rough* measurement of liquid.

c Conical flasks are useful for chemical reactions.
d Test tubes are used for heating small amounts of liquids.
e Thermometers are *not* used to stir liquids.

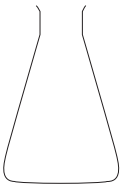
3 **a** Thermometer; **b** Measuring cylinder; **c** Retort stand, bosshead and clamp assembled together; **d** Spatula; **e** Funnel

4 **a** Magnifying glass; **b** Thermometer; **c** Microscope; **d** Telescope; **e** Stopwatch

5 **a** A beaker and a flask: glass (Pyrex), often have rough measurements on the side
b A beaker and a measuring cylinder: straight-sided, glass, measurements on side, pouring lip
c Tongs, a peg and a clamp: all can hold objects
d A clay triangle and a gauze mat: both used in heating and to support containers
e A test tube and an evaporating dish: both used over a Bunsen burner to heat liquids and solids to high temperatures

6 **a** Microscope with very high magnification; **b** Thermometer; **c** Stopwatch; **d** Metre ruler or tape measure; **e** Ammeter; **f** Telescope

7 Learners' answers will vary, depending on the layout of your school laboratory.

8 **a**  **b**  **c** 

9 Learners' answers will vary, depending on the layout of your school laboratory.

Extension questions

Learner's Book page 16

Select the equipment that you have available in your school. You can divide the equipment among the learners and ask them to complete the research as a group.

Unit 1.5: Reporting

Activity 5: Spreading puddles

Learner's Book page 18

Processes and skills	Resources	Teacher's support notes	Answers to questions
The ability to make a hypothesis (or the best possible guess) by measuring and estimating the area of water droplets	• glass microscope slide • eyedropper • graph paper	This experiment demonstrates how scientists make a hypothesis or the best possible guess given the information or data at hand. Learners should learn how to hypothesise or estimate by making the best possible guess based on the information that they have. In this experiment they should be able to estimate the area of a drop of water by counting the squares it covers on the graph paper. Encourage learners to estimate the end results based on the trend of their first results.	**1–4** Learners' answers will vary. **5** The number of drops should be directly proportional to the size of the area of the spread (the greater the number of drops, the greater the size of the area of the spread).

Answers

Unit questions

Learner's Book pages 18–19

1 The aim is what you want to find out in an experiment.

2 A hypothesis is an educated guess based on what a scientist thinks might happen, whereas an inference is a logical explanation about what happened and why it happened.

3 'Tabulated' means to organise and arrange your data or results in a table.

4 Headings and units in each column should always be included.

5 Graphs must have regularly spaced markings, labels and units of measurement.

6 Tony concluded that the group really enjoyed the experiment and learned lots about the strength and stretchiness of fishing lines.

7 The equipment section

8 It tells exactly what is expected.

9 Size of each weight that was added; how problems with the chipped ruler were minimised; how the knot was tied

10 Two things that Tony needs to add to his table of results are units in the heading and to be consistent with only one unit in his measurements.

11 Label, unit and title

12 The conclusion does not match the aim. The conclusion should answer the aim, including information about how much the fishing line actually stretched and the weight needed to break it. The conclusion should summarise the results.

13 Example: The fishing line was able to stretch a total of 3.3 cm before breaking and hold a mass of 200 g. A mass of 250 g caused the line to break.

14 **a** To find who stole the sausages

b Statement about who you think stole the sausages

c Lawn mown, 3.17 p.m., no sausages, wet floor, broken window, glass on floor, broken vase, curtains messed up, wet and muddy floor, blond hair on windowsill, stone on table, dog that is not hungry

d The dog stole the sausages.

Extension question

Learner's Book page 19

Learners can do this activity in groups and present their experiment design to the rest of the class.

Unit 1.6: Measurement

Activity 6: Taking measurements

Learner's Book page 22

Processes and skills	Resources	Teacher's support notes	Answers to questions
Improving learners' ability to measure various items with a range of measuring devices	A range of measuring instruments, such as: • ruler • beam balance • Newton meter or spring balance • measuring cylinder • measuring beaker	It is important to note that errors are often an unavoidable part of experiments, and small changes in measurements are also common even when you are being careful. Therefore, measurements taken by each group of learners might not be the same. There are two basic types of errors: • systematic errors are associated with the instrument (i.e. the ruler does not start at zero) • random errors are usually made by the learners themselves.	**1** Learners' answers will vary. **2** If the groups got all different measurements, then it does not mean that everyone is wrong. **3** Learners' answers will vary. **4** Errors can affect the results of the measurements. Therefore, each group's result may be different. **5** Scientists may not get the same results because of errors that may occur in the experiment in different conditions and situations.

Activity 7: How massive?

Learner's Book page 23

Processes and skills	Resources	Teacher's support notes	Answers to questions
Correct usage of scientific equipment, e.g. a beam balance, to measure the mass of various objects	• beam balances • objects to weigh • a 50 g mass	Teachers should only guide learners on how to use the beam balance. Learners should be given the opportunity to actually measure the mass of the objects themselves. Learners need to understand that experimental results do not have to be exact to the standard value because of the possibility of errors in the experiment.	**1** Zero **2** 50 g **3** Because of errors **4** Learners' answers will vary. Sample answers: • reading error: when we estimate a measurement because it falls in between actual markings • parallax error: not positioning your eye directly in line with the measurement • zero error: when a device reads some value even though nothing is being measured.

Activity 8: Observations and predictions

Learner's Book page 23

Processes and skills	Resources	Teacher's support notes	Answers to questions
To investigate and identify the relationship between mass and length of various ropes	• 10 different lengths of bush rope • beam balance or Newton meter • ruler	Mass is directly proportional to the length of the rope (as length increases, mass also increases). Therefore, longer ropes weigh more than shorter ones. Learners should be able to understand how to use the graph. If the length is known, then the mass can be predicted from the graph or vice versa. Use ropes of similar sizes. The factor that affects mass is the length of the rope, not the size.	**1** A line of best fit is the straight line that goes through all identified points of the *x* and *y* axes, starting from the origin. **2** Learners' answers will vary. **3** The mass of the rope is directly proportional to its length. Increasing the length of the rope is likely to increase the mass of the rope. Reducing the length is likely to decrease the mass of the rope.

Answers

Unit questions

Learner's Book page 24

1 The correct statements are:
- **a** Metric units are *always* used by scientists for measurements.
- **b** The kilometre is an example of *a metric* unit.
- **c** *Metres* could be used to measure the distance a sprinter runs.
- **d** There are *285* mL in a Szeba soft drink can.
- **e** Mistakes are *not* the same as errors.

2 The correct metric units for mass are milligram, gram, kilogram and tonne.

3 Two important types of errors are parallax errors and zero errors. A parallax error occurs when your eye is not directly in line with the measurement. A zero error is when the measuring device is not accurate, e.g. it reads some value even though nothing is being measured.

4 **a** Degrees Celsius, thermometer; **b** Metres and centimetres, a tape measure or metre ruler; **c** Centimetres, a centimetre ruler; **d** Grams, an electronic balance; **e** Millilitres, a measuring cylinder

5
- **a** Fraction should be a decimal (150.25 g)
- **b** No units given
- **c** Imperial units used instead of metric
- **d** Wrong unit, probably L
- **e** Wrong unit, probably 1.68 m or 168 cm

6

Time (sec)	Speed (mm/h)
0	0
5	20
10	30
15	50
20	60
25	80

7 **a** gram: g; **b** kilogram: kg; **c** millimetre: mm; **d** litre: L; **e** kilometres per hour: km/h; **f** minutes: min; **g** degrees Celsius: °C; **h** hour: h; **i** seconds: s

8 Weight

9 If too much sliding mass is added, the needle of a beam balance will drop below the line.

10 A mistake can be avoided with care. An error is unavoidable and beyond your control.

11

Time (min)	Temperature (°C)
0	15
1	18
2	21
3	35
Unknown	40
Unknown	51
Unknown	63
7	70
8	76
Unknown	100

12 **a** 41; **b** 4.4; **c** 220; **d** 14; **e** 27.2; **f** 199.7; **g** 50; **h** 150; **i** 17.4; **j** 48; **k** 110; **l** 42

Extension questions

Learner's Book page 25

1 Learners will only be able to do this investigation if you have the available resources. Note: NASA stands for the National Aeronautics and Space Administration, which is an agency of the United States Government that is responsible for the space program and for aeronautic and aerospace research.

2

Type of empty container	Mass of container	Type of substance that was added	Mass of container + substance	Mass of substance
Folded piece of paper	1.2 g	Salt	34.5 g	33.3 g
Watch-glass	13.7 g	Crystals	32.3 g	18.6 g
Beaker	79.9 g	Water	275.0 g	195.1 g

3 **a** Learners' answers will vary. Sample answer: Compare the packet of biscuits with an object with a known mass, for example a packet of rice, and estimate the difference in mass.

b Gather 10 or 20 pieces of paper, measure their width when held together, then calculate the width of a single piece.

c Hold your hand to your wrist or neck where you can feel your pulse and use a watch to count how many pulses you feel in a minute.

Unit 1.7: Questions about science

Activity 9: The mysterious case of the stolen sausages

Learner's Book page 27

Processes and skills	Resources	Teacher's support notes	Answers to questions
Using scientific skills and knowledge to investigate and solve a given problem, in this case, the theft of sausages	Read 'The mysterious case of the stolen sausages' and look at the clues in Figure 1.7.2 in the Learner's Book.	This activity helps learners to identify and explore many of the questions that scientists ask when trying to solve problems. Learners should be encouraged to draw possible conclusions based on the available evidence. The format of the scientific method of reporting will help learners to do this.	**1** To investigate (find out) who stole the sausages defrosting on the kitchen table. **2** Observations include: • The front window has been shattered. • Pieces of broken glass lie everywhere. • Mum's favourite vase is lying in pieces on the floor. • The curtains are all messed up. • The carpet is soaking wet and marked and smudged with mud. • Some strands of blond hair are stuck on the windowsill. • A small stone is on the coffee table. **3** The suspects are the neighbour and Fritz, the golden retriever. **4** Neighbour: the vase that they didn't like is broken. Fritz: he hadn't touched the food in his bowl. **5** In conclusion: Fritz the dog stole the sausages. The neighbour's lawn mower threw up a stone that broke the window. It happened in the morning while the weather was fine because the neighbour wouldn't have mowed the lawn when it was wet. Fritz may have broken the vase when he jumped through the window or the stone may have broken it. The order it all happened is: The stone from the mower broke the window (and may have broken the vase); Fritz jumped through the window (and may have broken the vase); Fritz stole the sausages.

Answers

Unit questions

Learner's Book page 28

1 The five senses are sight, hearing, smell, taste and touch.

2 Four of the main branches of science can be chosen from: Physics, chemistry, biology, geology, astronomy, ecology.

3 The table can be completed as follows:

Experiment	Senses that you would use	Sense that would give the most information	Senses that you would NOT use
Testing the ability of strong acids to clean a sheet of metal	Sight, hearing	Sight	Taste, touch, smell
Testing how long milk takes to go off	Sight, smell	Smell	Taste, hearing, touch
Testing how long it takes for six tomatoes to ripen	Sight, smell, taste, touch	Sight, smell, taste	Hearing
Studying lava flowing from a volcano	Sight, smell, hearing	Sight	Touch, taste
Testing a new pesticide	Sight, hearing	Sight	Smell, taste, touch

4 **a** Biology; **b** Chemistry; **c** Biology; **d** Astronomy; **e** Geology

5 **a** Knowledge about what non-living materials are made up of, e.g. atoms, elements, molecules and compounds
b Knowledge about what living things are made up of and how they function
c Knowledge about space, e.g. the Sun, Moon, planets and galaxies
d Knowledge about the Earth and what it is made up of, e.g. rocks, soils and minerals

Extension questions

Learner's Book page 28

1 **a** Botany is the study of plants.
b Microbiology is the study of very small organisms such as germs.
c Palaeontology is the study of prehistoric life.
d Acoustics is the study of sound.
e Seismology is the study of earthquakes.

2 **a** Physics; **b** Biology; **c** Geology; **d** Biology

3 **a** Millilitre; **b** Commonwealth Scientific and Industrial Research Organisation; **c** Hazardous Chemicals; **d** Kilogram; **e** Micro; **f** Human Immunodeficiency Virus positive; **g** Millimetre; **h** National Aeronautics and Space Administration; **i** United Nations Educational, Scientific and Cultural Organization; **j** pi

Unit 1.8: Working scientifically

Activity 10: Froth production

Learner's Book page 30

Processes and skills	Resources	Teacher's support notes	Answers to questions
To design an experiment to scientifically investigate and solve an identified problem	• dishwashing liquid • dropper • ruler • large beaker or bucket or ice-cream container • thermometer • tap with running water	This activity helps learners to design experiments to solve an identified problem scientifically—in this instance, the production of froth. The production of froth during washing can be different each time. To understand exactly what causes it, learners should be able to identify variables (possible factors) before making educated guesses (hypothesis). The hypothesis will then be tested to find the answer. **Note**: Care should be taken to avoid unnecessary damage to books and notepads from the water and froth.	**1** The variables that Joe tested were: • the amount of detergent used • the amount of water in the sink • the speed of water coming from the tap • the temperature of the water. **2** Joe only changed one factor at a time and kept the other variables the same so that he could find which factor had the greatest effect. **3** Three other variables that could be tested are: time; type of detergent; type of water (e.g. rain water or river water). **4** The variable that is likely to have had the most effect is the amount of detergent.

Activity 11: Answering a question with an experiment

Learner's Book page 30

Processes and skills	Resources	Teacher's support notes	Answers to questions
To identify possible variables that cause an outcome and to design a simple experiment	• tennis ball • metre ruler	This activity helps learners to identify variables that cause a certain outcome. The variables that can affect the bouncing of the ball are: • the material that the ball bounces on (sand or concrete) • the force that Rose applies to the ball (strong or small push) • the elasticity of the ball or the material that the ball is made of.	**1 a** Size of the ball; surface the ball is bounced on; whether the ball is inflated; pressure applied to the ball **b** Time of the day; temperature of the ball **2 a** High bounce: a soft ball and a hard surface **b** Low bounce: a harder ball, such as a golf ball, and a soft surface

Answers

Unit questions

Learner's Book page 31

1 (Refer to Joe's experiment for examples but learners may suggest their own.)
- The problem you are trying to solve, e.g. what determines the amount of froth production
- Exactly what you are going to measure, e.g. factors that affect froth production
- What you are going to change (the variables), e.g. the speed or temperature of the running water
- What you are going to keep the same (the control factor), e.g. the type of detergent or water
- Anything else that might affect the experiment but you cannot control, e.g. air pressure (very unlikely to control it even though it might affect the experiment to some extent)

2 Variables are factors that may affect the results of an experiment.

3 Only one variable should be changed at a time so that you can find which factor has the greatest effect. This is to ensure that that the test is fair.

4 a Weather, e.g. high humidity, sunny day; day of the week, e.g. weekend, holiday

b Position of the plant (light or dark place); amount of water in the soil; status of the soil (fertile or not); type of plant; soil pH (acidic or alkaline); amount of air in the soil

c Type of the potato; size of the potato; type of pot used to cook the potato; amount of water used to boil the potato; type of fuel used to boil the water, e.g. firewood or gas stove

d Amount of water you drink; weather (hot or cold day); if female, whether you are pregnant

e Organisation of the program; number of learners who are graduating; number of speeches and how long each speech lasts

f Learner's interest in the topic; teacher's presentation of lesson; how well the learner absorbs information during the class and from the textbook; how much preparation the learner has done for the test

5 The four variables are: the amount of detergent; the amount of water in the sink; the speed of the water coming from the tap; the temperature of water.

6 Temperature of water

7 Amount of grease on dishes, number of dishes, depth of water

8 All would affect the froth production.

9 A ruler from the top of the water to the top of the froth

10 a Experiment 1: To see if the speed of water affects the amount of froth produced;
Experiment 2: To see if the amount of detergent affects the amount of froth produced.

b Experiment 1:
1. Put 3 drops of detergent into the sink.
2. Run hot water very slowly and fill the sink halfway.
3. Repeat the above two steps with fast running hot water and then again with very fast running hot water.

Experiment 2:
1. Put 1 drop of detergent in the sink and turn the tap on high until the sink is half full.
2. Repeat step 1 with 2 drops of detergent, then with 3 drops, then 4.

c Experiment 1:

Water speed	Very slow	Fast	Very fast
Water depth	Half full	Half full	Half full
Water temperature	Hot	Hot	Hot
Amount of detergent	3 drops	3 drops	3 drops
Froth height (cm)			

Experiment 2:

Amount of detergent	1 drop	2 drops	3 drops	4 drops
Water depth	Half full	Half full	Half full	Half full
Water temperature	Hot	Hot	Hot	Hot
Water speed	High	High	High	High
Froth height (cm)				

11 a To see if water temperature had any affect on the amount of froth production

b dishwashing detergent, dropper, large beaker/bucket or ice-cream container, tap with running water, ruler, thermometer

c 1. Place 3 drops of detergent in the container.
2. Fill container to halfway with cold water at high speed.
3. Measure the temperature of the water.
4. Measure the amount of froth produced.
5. Repeat with warm, then hot water.

d

Water temperature (°C)	Cold (temperature)	Warm (temperature)	Hot (temperature)
Water depth	Half full	Half full	Half full
Speed	High	High	High
Amount of detergent	3 drops	3 drops	3 drops
Froth height (cm)			

Extension questions

Learner's Book page 31

1 a Answers could include: the amount of sugar added (solute); the amount of hot water added (solvent); the volume of water used; how well the coffee was stirred.

b amount of sugar (solute); volume of water (solvent); temperature of water; how well the coffee was stirred

c Learners' answers will vary, but make sure they choose a related variable and a hypothesis and consider the five factors in designing an effective experiment as noted on page 30 of the Learner's Book. The variable may be the amount of sugar. This means that the other variables are kept constant and only the amount of sugar is changed. For example:
Beaker 1: 1 g sugar, 100 mL water (room temperature), 1 tablespoon coffee
Beaker 2: 10 g sugar, 100 mL water (room temperature), 1 tablespoon of coffee
Beaker 3: 100 g sugar, 100 mL water (room temperature), 1 tablespoon of coffee

2 Learners' answers will vary. Guide learners in identifying variables, creating a hypothesis and including the five factors in designing an appropriate experiment as noted on page 30 of the Learner's Book.

Unit 1.9: Science in Solomon Islands

Answers

Unit questions

Learner's Book page 35

1 Learners' answers will vary. Sample answers: medications that can prevent or cure diseases such as malaria and tuberculosis; telecommunications such as mobile phones and the internet have made communicating with people in other provinces or countries much easier; fertilisers are added to soil to increase food production; canoes with motors have made travel between islands much quicker.

2 Technology is the method of applying science to solve practical problems.

3 Learners' answers will vary.

4 Satellites are used to track cyclones.

5 GPS technology is used to track earthquakes.

6 Science and technology are not the same thing. Science is a way of understanding the things around us. Technology is the use of science to solve practical problems.

7 If an earthquake or landslide occurs on or under the sea floor, it displaces the water above it, which can cause large, fast-moving sea waves that become a tsunami. When a coast line experiences a tsunami it may have been caused by an earthquake near the coast or much further away. The earthquake may cause little damage, but the resulting tsunami can be devastating.

8 Science is limited because we do not yet have the answers to all of our questions. Learners' examples of these limits will vary, but might include finding a cure for HIV/AIDS and cancer, and stopping a tsunami.

9 Learners' answers will vary.

10 **a** Improvement in health services and living standards, e.g. more readily available medications and cleaner drinking water

b Malaria, tuberculosis, pneumonia, smallpox

Chapter review

Answers

Learner's Book pages 36–37

1 The correct statements are:

a Spatulas are used for *scooping fine powdered substances*.

b Goggles *must* be worn when using chemicals.

c Measuring cylinders are used to *accurately measure water* OR *Beakers* are used to heat water in.

d A gram is a unit used in the measurement of mass.

e The air hole should always be shut when lighting a Bunsen burner.

f The gas should always be turned on *after* the match is lit.

g The air hole must be closed to produce the yellow flame.

h Burning paper *cannot* be used to safely light a Bunsen burner.

2 **a** Physics; **b** Biology; **c** Biology; **d** Chemistry

3 Other sources include science journals and books written by other scientists, browsing on the internet, seminar presentations by other scientists and experiments performed by other scientists.

4 Learners' answers will vary, but should include:
- **a** Liquid, orange-coloured, tastes sweet, does not rot
- **b** Solid crystal, cold, transparent, melts slowly
- **c** Solid, white-coloured, retains ink marks, easily torn
- **d** Solid, powdery, brownish black

5 **a** Measuring cylinder; **b** Test tube; **c** Crucible; **d** Electronic balance; **e** Beaker

6 A good experimental report should include: aim; hypothesis (optional); equipment or materials; method; results and observations; discussion or analysis; conclusion.

7 **a** Milligram, gram, kilogram, tonne; **b** Second, minute, hour; **c** Millimetre, centimetre, metre, kilometre; **d** Degrees Celsius, kelvin; **e** Kilometres per hour, metres per second; **f** Millilitres, litres, megalitres

8 **a** Megalitre; **b** Tonne; **c** Centimetre; **d** Kilogram; **e** Litre

9 Learners' answers will vary.

10 **a** Stop: octagonal; Give way: triangular; **b** and **c** Learners' answers will vary; **d** 244 pages (or 248 if the introductory pages are counted)

11 **a** I've eaten something that was off. (inference)
My stomach is not feeling well. (observation)
I'll vomit soon. (prediction)

b The plant required sun and water to grow. (inference)
The plant will grow and fruit. (prediction)
The seed has a small leaf shoot breaking it in two. (observation)

12 Advantages: fast, comfortable, carry a lot of passengers; Disadvantages: expensive to operate, cause pollution to the environment, cause noise pollution

13 **a** Drawings should show: beaker, Bunsen burner

b Drawings should show: test tube, Bunsen burner, test tube holder

c Drawing should show: evaporating dish

14 Make sure learners clearly state their aim in this experiment before they start designing it. The aim should be to find whether the number of heartbeats increases when you exercise and what it does if exercise stops. Ensure the experiment design also has a hypothesis, a list of equipment or materials to be used, a method, results and observations, discussion or analysis and a conclusion (see Unit 1.5 'Reporting' for more detail).

15

Observation	Inference
a Vase was broken	The thief might have broken the window and climbed through
b Carpet is soaking wet	Window had been broken for a while
c Blond hair on windowsill	Someone with blond hair might have climbed through the window and stolen the sausages
d The sausages that you left defrosting on the kitchen table are gone	Thief is hungry
e Stone on the table	The thief used the stone to break the window
f Next door's lawn was mowed	It's very likely that the stone was thrown up by the lawn mower and broke the window
g Fritz was not hungry	Fritz might have stolen and eaten the sausages
h The soaking wet carpet is marked and smudged with mud	Someone entered via the window
i Curtains were all messed up	The wind has been blowing directly at the curtains for a while because of the broken window

16 They are all qualitative observations.

Chapter 2: Classification of living things

Strand: Life and living

Suggested class time: 8 periods

Sub-strand statement

This sub-strand deals with characteristics of living things. Plants and animals can be grouped or classified into different groups according to their characteristics. Scientists normally use keys to identify particular organisms. The main groups of living things are: animals, plants, fungi, protists and monera.

General learning outcomes

Learners should:

7.2.1 Know the characteristics of living things.
7.2.2 Know that living things are grouped (classified) according to their body features.
7.2.3 Be able to use the binomial nomenclature system of classification.
7.2.4 Understand the classification of vertebrates and invertebrates.
7.2.5 Know flowering and non-flowering plants.
7.2.6 Know fungi, monera and protists.

Specific learning outcomes

Learners should be able to:

7.2.1.1 Describe the main characteristics of living things: use energy, use air, produce waste, respond to stimuli, growth.
7.2.2.1 Identify the five main groups of living things as: animals, plants, fungi, protists, monerans.
7.2.2.2 State levels of classification: kingdom, phylum, order, family, genus, species.
7.2.2.3 Name a domestic animal using the binomial nomenclature: genus and species.
7.2.3.1 Use a two-choice key to classify domestic animals and plants.
7.2.4.1 Explain what vertebrates are.
7.2.4.2 Identify and give examples of vertebrates (mammals, amphibians, reptiles and fish).
7.2.4.3 Identify and give examples of different invertebrates.
7.2.5.1 Identify and name a flowering and non-flowering plant.
7.2.5.2 Draw the parts of a flower (differentiate male and female parts of flower).
7.2.6.1 Identify and give an example of fungi, monera and protists.

Answers

Suggested assessment activity

1 Kingdom, phylum, class, order, family, genus, species

2 **a** Rat: vertebrate; **b** Starfish: invertebrate; **c** Snail: invertebrate; **d** Frog: vertebrate; **e** Human: vertebrate; **f** Shark: vertebrate; **g** Rhinoceros beetle: invertebrate; **h** Possum: vertebrate; **i** Earthworm: invertebrate

3 Flowering plants are plants that bear flowers, e.g. mango, pawpaw and coconut. The flowers provide the structure for sexual reproduction. Non-flowering plants are plants that do not have flowers, e.g. ferns. These plants reproduce by means of spores.

Challenge questions

Learner's Book page 38

1 You would look for a tin of food in the food section, and for washing powder in the soaps and detergents section.
2 A snake warms its body by exposing it to sunlight.
3 Protists, fungi, monera
4 Frogs or grasshoppers
5 A scientist
6 No

Unit 2.1: From kingdom to species

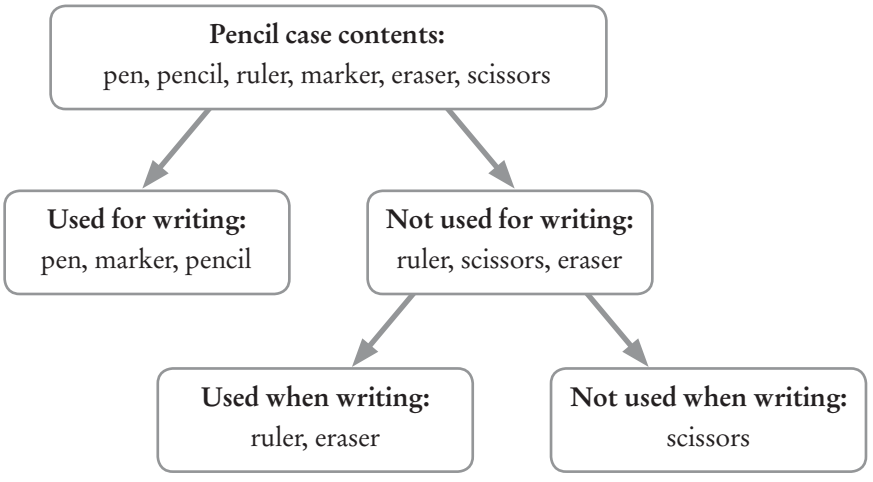
Answers

Unit questions

Learner's Book pages 42–43

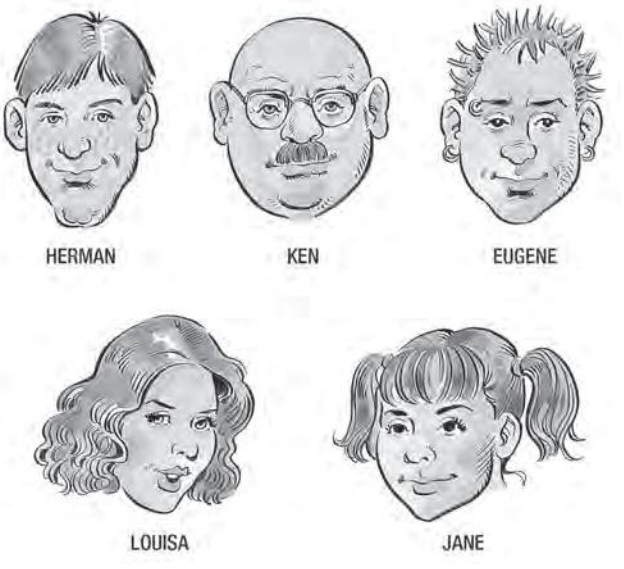
1 Classification is the practice of putting things into groups of related types.
2 Learners' answers will vary. Sample answers: sweet or bitter, soft or hard, colour, shape, weight
3 Learners' answers will vary. Sample answers: a hospital, a farm, a school
4 Classification systems help us to identify the many living things surrounding us and enable us to understand them in a more organised way.
5 Taxonomy is the process of sorting living things into groups.
6 Kingdom, phylum, class, order, family, genus, species
7 A species is a group of similar organisms that can interbreed and produce fertile young.
8 A horse and a donkey are different species because though they can interbreed, the offspring that is produced (a mule) is sterile and therefore cannot reproduce.
9 The scientific name for a living thing has two parts: the genus name followed by the species name.
10 A key is a set of instructions or criteria that is followed to place an organism in a particular group.
11 It means that the key has two choices at each point in deciding where to place an organism.
12 Mammals
13 The system would be based on what the tools are used for. Basing the system on what they are made of would mean limiting the groups to only two or three (metal, wood and plastic). Basing the classification on the use of the tools would be more meaningful and useful.
14 Learners' answers will vary. Sample answers: the type of engine, the weight of the car, the colour, the number of doors, the type of fuel used, the rate of fuel consumption, the brand of car.
15 A subclass is a group smaller than a class but bigger than an order.
16 **a** The invention of the microscope meant that new organisms were discovered that did not fit into the existing kingdoms.
b More organisms may be discovered that do not fit into the descriptions of the current kingdoms. More information about existing organisms may be discovered due to more detailed tests and examinations.
c It shows that scientific knowledge is always changing as we discover new facts and develop new ideas about ourselves and our world.

17 Learners' answers will vary. Sample answers: pen, pencil, ruler, marker, eraser, scissors.
A possible key might be:



18 **a** Learners' answers will vary.
b Learners' answers will vary. Sample answer: The key is easier to understand, because the information can be found quickly and easily.

19



Unit 2.2: Animal classification

Answers

Unit questions

Learner's Book page 52

1 Biologists have used the body structures of animals as the basis for classifying them.
2 A vertebrate is an animal that has a backbone.
3 Vertebrates belong to the phylum Chordata.
4 **a** Chordata; **b** Mammals, fish
5 A vertebrate has a backbone; an invertebrate does not have a backbone.
6 Arthropoda (arthropods), Annelida (worms), Cnidarians, Porifera (sponges), Molluscs, Echinodermata (echinoderms)
7 Learners' answers will vary, but should include the following:
a Amphibians: thin skin; adults breathe with lungs; lay eggs; two-stage life cycle; get heat from surroundings ('cold-blooded')

b Reptiles: dry scales; breathe with lungs; lay eggs; eggs are waterproof; get heat from surroundings ('cold-blooded')
c Birds: feathers; breathe with lungs; lay eggs; make their own heat ('warm-blooded')
d Fish: scales; breathe with gills; lay eggs; live in water
e Mammals: hair or fur; young born alive; female mammals produce milk to feed their young; make their own heat ('warm-blooded')

8 Monotreme

9 **a** Hamster: vertebrate; **b** Starfish: invertebrate; **c** Snail: invertebrate; **d** Mouse: vertebrate; **e** Human: vertebrate; **f** Dung beetle: invertebrate; **g** Shark: vertebrate; **h** Rabbit: vertebrate; **i** Earthworm: invertebrate

10 Polyps, medusas

11 Arthropods

12 **a** About one million
b Learners' answers will vary, but are likely to state that there are a lot more species to discover.
c Learners' answers will vary. Sample answers: It is likely that there are still more insect species to find because insects are found in every kind of habitat including the soil, the air, the water, on land and inside other animals. They also come in various sizes from microscopic to quite large ones.

13 Centipedes: one long pair of antennae; one pair of legs on each segment; flat body. Millipedes: one short pair of antennae; two pairs of legs on each segment; rounded body.

14 Learners' answers will vary. Sample answers: snail, octopus, slug, squid, clam.

15 A parasitic organism is one that lives on and feeds off another living thing.

16 Learners' answers will vary. Sample answers: earthworm, leech, hookworm, tapeworm.

17 Learners' answers will vary. Sample answers: Land invertebrates—grasshopper, centipede; marine invertebrates—sponge, starfish.

18 The other features would be: three body sections (head, thorax, abdomen); one pair of antennae; an exoskeleton; a segmented body; paired jointed legs. The species is an insect, because it has six legs.

19 Dry scales; lungs to breathe; lay soft, waterproof eggs; get heat from surroundings ('cold-blooded')

20 **a** Bird, fish, monotreme, amphibian or reptile
b Observe its body covering (scales, feather, hair/fur, smooth); whether it can make its own heat ('warm-blooded' or 'cold-blooded'); whether it has a pouch

Extension questions

Learner's Book page 52

1 The Dewey decimal system is used to classify books in the library. The code number for this book would be 507 (Science Education).

2 Animals are classified into groups according to their physical features. Animals with similar body structures are placed in one group.

Unit 2.3: Plants, fungi, monerans and protists

Activity 1: Two-choice key for organisms that are not animals

Learner's Book page 53

Processes and skills	Resources	Teacher's support notes	Answers to questions
Construct a two-choice key for organisms that are not animals	• various plant samples, e.g. grasses, flowering plants, ferns, mosses, liverworts • an example of a two-choice key	Before you ask learners to carry out this activity, it is recommended that you design your own two-choice key for the plants to see if it works. Ask the learners to collect the plants, but you should make the final selection of the samples for consideration. This is to ensure that a logical two-choice key is constructed. Look for similarities and differences in the plants and guide the learners to construct their own two-choice key.	**1** The key is a good one if another learner can use it to identify all the plant samples collected. **2** If some of the plants cannot be placed into any of the groups, then the key needs to be improved. The key can be improved by creating a few more descriptions that describe all of the plant samples.

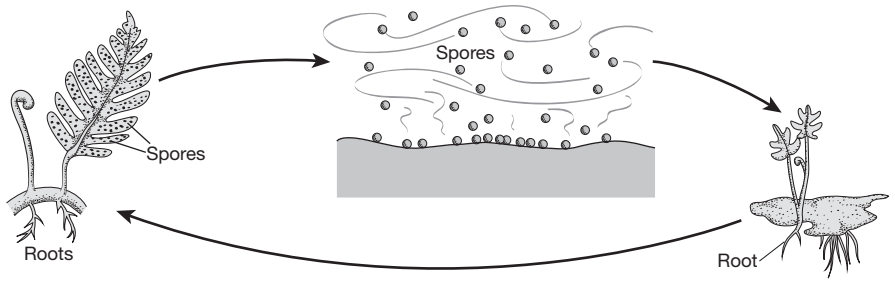
Answers

Unit questions

Learner's Book pages 56–57

1 Botany
2 Phylum (vascular plants are a phylum)
3 Angiosperms are the group of plants that produce flowers.
4 Ovary
5 Conifers produce seeds that are found on the scales of a cone.
6 Fungi are like animals in that they do not produce their own food. They feed on other plants and animals to survive.
7 Parasitic fungi live on and feed off other organisms.
8 Helpful bacteria in your intestines help to digest your food. Some kinds of bacteria can cause serious illnesses.
9 Protists include organisms that don't fit into other kingdoms. Some are plant-like and others are animal-like.
10 The correct statements are:
- **a** A vascular bundle *can transport liquids and other nutrients*.
- **b** Conifers thrive in *cool* climates.
- **c** Fungi reproduce *with spores*.

11 Ferns reproduce with spores. The spores grow on the underside of the leaves. The wind blows the spores away and when they land in a suitable place they germinate and grow into a new fern plant.



12 Learners' answers will vary. Sample answers: in the soil, on skin, in the intestines, in the water.

Extension question

Learner's Book page 57

Learners use the library or biology textbooks to find information on tinea and ringworm. Their research should include how these infections are caused, how they are spread and how they can be treated.

Chapter review

Answers

Learner's Book page 57

1 **a** Rat: mammal; **b** Parrot: bird; **c** Bonito: fish; **d** Tadpole: amphibian; **e** Gecko: reptile

2 Learners' answers will vary. Sample answers:
   - **a** Common features: jointed legs; exoskeleton; segmented bodies
   - **b** Different features: insects have six legs, wings, antennae; arachnids have eight legs, no wings, no antennae

3 **a** Angiosperms: flowers; **b** Ferns: spores; **c** Fungi: spores

4 Cats and dogs are classified as mammals but are different species because they cannot mate with each other and produce fertile offspring.

5 The two stages in the life of amphibians are life under water and life above water.

6 Placental mammals give birth to well-developed babies. Marsupials give birth to tiny babies that continue to develop in a pouch (a pocket of skin on the mother's body). Both types of animals feed their young on milk, have fur and can make their own heat ('warm-blooded').

7 Unlike plants, fungi do not make their own food (chlorophyll) and need to feed on plants and animals.

8 The creation of the separate kingdom called protists was necessary because there are organisms that do not fit into the other kingdoms.

Chapter 3: Solids, liquids and gases

Strand: Natural and processed materials

Suggested class time: 12 periods

Sub-strand statement

This sub-strands deals with solids, liquids and gases. These are different forms of substances (matter). These forms of matter can be changed under given conditions. Physical change makes the substance look very different but it is the same thing. Another type of change is called chemical change. In chemical change, the substance is changed into a totally new substance.

General learning outcomes

Learners should:

7.3.1 Know that everything surrounding us is made up of matter.
7.3.2 Understand the different states of matter.
7.3.3 Be able to investigate physical changes.
7.3.4 Be able to show that in a physical change the mass of the substance remains the same, only the particles are rearranged.
7.3.5 Be able to demonstrate the difference between a physical change and chemical change.
7.3.6 Appreciate the significance of solids, liquids and gases in everyday life.

Specific learning outcomes

Learners should be able to:

7.3.1.1 State that matter is substance that has mass and occupies space.
7.3.1.2 Use the idea of particle movement to explain the difference between the three states of matter: solids, liquids and gases.
7.3.3.1 Investigate the changes caused by heating and cooling of solids, liquids and gases.
7.3.3.2 Draw a simple particle diagram to show the change of state from one form to another.
7.3.3.3 Use a thermometer to measure the temperature of rain water and boiling water.
7.3.4.1 Conduct an experiment to observe that in a physical change the properties of the materials change, but the mass remains unchanged: melting ice cubes, and water boiling and evaporating.
7.3.5.1 Perform the following to show a chemical change as differentiated from a physical change: boil an egg, burn wood to charcoal, keep an unripe tomato to ripen, etc.
7.3.6.1 Express in their own words the process that helps to dry wet clothes hanging on the line.

Answers

Suggested assessment activity

1 Examples of solids are: stone, wood, glass, ice, sugar, salt and plastic.
Examples of liquids are: water, cup of tea, Milo or coffee, fruit juice and soft drinks, such as Fanta or Coca-Cola.
Examples of gases are: water gas (steam), carbon dioxide, oxygen, hydrogen, methane and helium.

2 In a liquid such as water, the particles are close to each other. When the liquid boils, the particles are further apart. Boiling is process of changing state (phase) from liquid to gas. The particles in the gas state are further apart than in the liquid. The particles are closest in the solid state.

3 In a candle burning activity, the changes observed can be classified as physical or chemical changes.
Physical changes are: Candle is burning, the flame is yellow at the tip and blue at the base. Solid wax changes to liquid wax. Liquid wax runs down to the base, wax solidifies at the base. Candle gets shorter after some time, smoke is given off.
Chemical changes are: Reaction of wax, carbon compound (alkane) and oxygen (oxidation). The product is carbon dioxide and water.

4 It is more accurate to use the thermometer to measure the temperature of any hot objects than feeling with your hands because touch cannot give the accurate temperature; it can only give an estimation. A thermometer measures the temperature in degrees Celsius.

Challenge questions

Learner's Book page 58

1 The best way to get out of quicksand is to wiggle the legs, i.e. to move the legs from side to side in small quick movements.
2 The 'fog' on stage and in movies is caused by sublimation of dry ice (solid carbon dioxide).
3 A steel ship floats because less pressure is exerted over a big volume on the surface of the water. The ship's density is small compared to the density of the water. A steel bolt has greater density than the water so it sinks.
4 Gas is used in shock absorbers because gas can be compressed more than liquid.
5 When you breathe out, your breath contains water vapour. On a cold day, the vapour condenses into tiny droplets of water, forming a cloud.
6 A model is used to explain certain behaviour and can help us understand and predict what will happen in other situations.
7 A scientific model does not always stay the same because further experiments and findings can modify it.

Unit 3.1: Solids, liquids and gases

Activity 1: States of matter

Learner's Book page 59

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate when water changes its state from liquid to gas through the process of evaporation	• kettle • flame (stove, local kitchen) • water OR • beaker • Bunsen burner • tripod stand • gauze mat • water	Explain to learners that matter (anything that takes up space and has mass) exists in three different states: solid, liquid and gas. Learners should understand the different particle arrangement of the three states of matter so that they can understand the physical changes that occur between the states. Boiling water is a good way to show how matter changes from one state to another. It demonstrates a change from liquid to gas during the process of evaporation.	The boiling water produces bubbles of steam (water vapour) that escape from the kettle. Bubbles are evidence of boiling, and indicate the change of state from liquid to gas.

Activity 2: Solids and liquids

Learner's Book page 60

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate the properties of solids and liquids	• bottles • solid materials such as wood or stones • water	Demonstrate to learners that solid materials are strongly packed and compressed. It is important to relate the physical state of a solid to its particle arrangement. This will reinforce the concept of incompressibility: since particles are already compacted in solid materials, they cannot be further compressed (using force to move the particles even closer together).	Solids do not take the shape of the container. Liquids flow and take the shape of the container.

Activity 3: Observing gas particles

Learner's Book page 61

Processes and skills	Resources	Teacher's support notes	Answers to questions
Observe and investigate the behaviour of gases	• smoke from a fire • 2 transparent empty jam jars or drinking glasses • piece of plastic	Explain to learners that particles in gases are not bonded to each other and have much more energy than those in a solid or liquid. Therefore, they fly around and bounce off each other and will spread to completely fill a container. They have no fixed shape. On the board, draw a diagram showing the particle arrangement of a gas (see Learner's Book, page 60, Fig. 3.1.2). This will help learners to see how gas particles move around. Ensure that learners light fires at the right place to collect the smoke particles. They must not play around with the matches or light fire from waste papers in the classroom.	**1** When the piece of plastic is removed, the collected smoke (gas) escapes from the bottom glass into the top one. **2** Refer to learners' observations and responses.

Activity 4: Compressibility

Learner's Book page 61

Processes and skills	Resources	Teacher's support notes	Answers to questions
Observe and compare the compressibility of different states of matter (liquid and gas) in relation to the difference in their particle arrangement	• plastic syringe (no needle attached) • water • rubber stopper	Emphasise to learners that the particles in a gas have no fixed bonds, so the gas can therefore be easily compressed compared to a liquid. Compare the diagrams of particle arrangements on page 60 of the Learner's Book (Fig. 3.1.2). It important that this practical is done outside the classroom to avoid water spillage in the room. If possible, allow each learner to do the activity so they can feel the differences in the compressibility of the gas and the liquid. Plastic syringes and rubber stoppers can be easily obtained from a nearby clinic or hospital. Be sure to explain why you need them.	**1** The gas was able to be compressed. **2** Learners should refer to the diagrams on page 60 of the Learner's Book (Fig. 3.1.2).

Activity 5: Diffusion of food dye

Learner's Book page 61

Processes and skills	Resources	Teacher's support notes	Answers to questions
Observe and investigate diffusion in liquids	• food dye • eye dropper • test tube or beaker • cold and hot water	Explain diffusion in relation to the arrangement of liquid particles. It is important to note that water (like all liquids) has spaces between the particles that allow the flow of the food dye particles, which results in the diffusion. Heating the water moves the particles further apart and is likely to increase the rate of diffusion. Teachers should prepare beakers or test tubes of cold water and hot water to test the rate of diffusion in these two different situations. Food dyes are likely to be obtained from the Bulk Shop in Honiara or the other provincial capitals. If a food dye cannot be obtained, products such as pop drink may be readily available in the local shops. Teachers are asked to be innovative in such circumstances in order to obtain the best possible results.	**1** Gravity only acts downwards, and the colours also move horizontally. **2** Increasing the temperature can speed up the diffusion process—the colour can spread at a faster rate. **3** The water particles have spaces between them that allow the food dye particles to fit between them. This is diffusion.

Activity 6: Evidence of moving particles

Learner's Book page 62

Processes and skills	Resources	Teacher's support notes	Answers to questions
Show the movement of particles	• pollen grains • beaker or jar • water	Explain to learners that the movement of the pollen grains is the evidence that water particles move around.	**1** The pollen grains move around in the water. **2** The water particles bumped against the pollen grains. This clearly shows the particle model of matter (Brownian motion), which helps to explain why particles diffuse, dissolve and stain each other.

Activity 7: Plasticine particle models

Learner's Book page 63

Processes and skills	Resources	Teacher's support notes	Answers to questions
Build a model showing the arrangement of particles in various solids	• Plasticine	This activity provides an opportunity to explore modelling of particle configurations in solids.	**1** Learners' answers will vary. **2** Solids

Answers

Unit questions

Learner's Book pages 63–64

1 A model is an idea that we use to explain and understand certain behaviour.

2 Learners' answers will vary. Sample answers: Matter is what everything in the universe is made of. Matter has mass and takes up space.

3 The term 'phase of matter' refers to a type of matter, i.e. solid, liquid or gas. Another term for this is 'state of matter'.

4 Learners' answers will vary. Sample answers: Solids: stone, wood, paper, ruler, cup; Liquids: water, kerosene, glue, petrol, honey; Gases: oxygen, carbon dioxide, nitrogen, water vapour, hydrogen.

5 Diagrammatic answer required. Learners' diagrams should be similar to Fig. 3.1.2 on page 60 of the Learner's Book.

6 Robert Brown was observing pollen grains suspended in water through a microscope and saw the pollen grains were constantly moving. He concluded that this motion must be due to the water molecules bumping against the pollen grains.

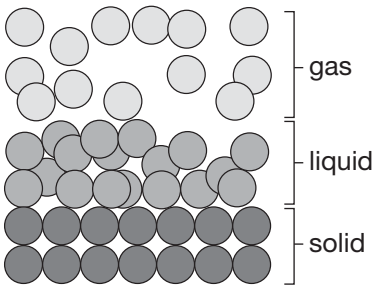
7 The particles of the solid that is dissolving fit between the particles of the liquid into which it is dissolving.

8 Small particles spread by diffusion through solids, liquids and gases, e.g. smells or stains on clothes.

9 Scientists repeat experiments to see if the first ones were correct. They gather more facts and figures to prove their new model.

10 **a** Soup of yam and coconut milk; **b** Beer; **c** Rice; **d** Coconut water

11 Learners' diagrams should show the particles in a similar arrangement to the following:



12 The particles in a gas have no bonds, so there is space between them. The particles can be pushed together. Particles of solids and liquids are already touching each other and so cannot be compressed any further.

13 When heat is applied to a solid, the bonds between particles get weaker and start to change position as the solid changes to a liquid. As more heat is applied, the particles move further apart and the bonds between the particles continue to weaken and finally break as the liquid becomes a gas.

14 Solids have definite shapes. They do not flow. They cannot take the shape of a container unless they are shaken or moulded into it.

15 By diffusion—the particles constantly move, bump into each other and spread across the room

16 Random motion caused by vibration of particles in a liquid or gas

17

Property	Solid	Liquid	Gas
Shape	definite	*takes shape of bottom of container*	*takes shape of entire container*
Ease of compression	very low	*low*	*high*
Bonds between particles	*strong*	weak	*none*
Movement of particles	*slow*	medium	*fast*

18 The particles in a liquid are weakly attracted to each other. They can change position in the liquid; this is why liquid flows but particles cannot exit separately.
19 Foam rubber is made with some space in the structure. It can be compressed as particles take up these empty spaces under pressure.
20 **b** and **c** are objective

Extension questions

Learner's Book page 64

1 A fluid is any substance whose particles can change position. This includes all gases and liquids. Liquids are those substances whose particles can change position but are still touching each other.
2 Learners' answers will vary. Sample answer: Viscosity describes how easily or quickly a liquid flows. The more easily a liquid flows, the less viscous it is. Honey has a high viscosity. Heating honey would decrease its viscosity, making it flow more quickly and easily like water.
3 The surface of some liquids acts like a tightly stretched skin. This is caused by the attraction of the particles in the liquid. In most of the liquid, the particles are pulled equally in all directions by other particles. At the surface of the liquid, the particles are pulled inwards by other particles below, but there are no particles above the surface to balance these forces. This causes the surface layer to act like an elastic sheet and enables, for example, insects to walk on the surface of water.

Unit 3.2: Changes of state

Activity 8: Ice to water to steam temperature graph

Learner's Book page 67

Processes and skills	Resources	Teacher's support notes	Answers to questions
Observe and investigate the relationship between the state of matter and temperature	• ice cubes • heat-proof mat • water • gauze mat • beaker (250 mL) • measuring cylinder (100 mL) • thermometer (0°C to 110°C) • Bunsen burner • tripod	It is important to note the relationship between the temperature and the state of matter, i.e. solid (ice cubes), liquid (water), gas (water vapour or steam). Make sure that all science laboratory rules are followed at all times to avoid unnecessary accidents. If you cannot obtain an ice cube, start recording the temperature from the liquid state, progressing to the gas state (when the water is boiling).	**1** Refer to learners' results. **2** To allow enough air for combustion, which provides a stronger heat (blue flame) **3** Because the initial reading did not start at 0°C. The equilibrium temperature will be higher than the temperature of ice (0°C). **4** The will be two level sections: when the solid becomes liquid and when the liquid becomes gas. **5** The graph would gradually increase.

Answers

Unit questions

Learner's Book page 69

1 From solid to liquid
2 The temperature at which melting begins, i.e. when a solid changes to a liquid
3 Ice melts at 0°C.
4 Solidification or freezing

5 About 60°C

6 Evaporation is when particles escape as gas from the surface of a liquid. Boiling is when bubbles form within a liquid being heated and rise to the surface. Evaporation may occur without boiling.

7 When water boils, the particles move very fast and the bonds between particles are broken. Small bubbles of gas form within the liquid. The bubbles of gas escape from the liquid.

8 The water vapour in the child's breath changes state from gas to liquid on hitting the glass.

9 Sublimation is when a solid absorbs heat energy and changes directly to a gas without melting and going through the liquid phase. This is unusual because the particles in most substances attract each other strongly enough to form a liquid.

10 Dry ice (frozen carbon dioxide) and iodine

11 **a** Evaporation; **b** Condensation; **c** Sublimation

12 1500°C (**d**)

13 0°C (**b**)

14 Nothing, because the melting point of wax is 60°C

15 Vaporisation

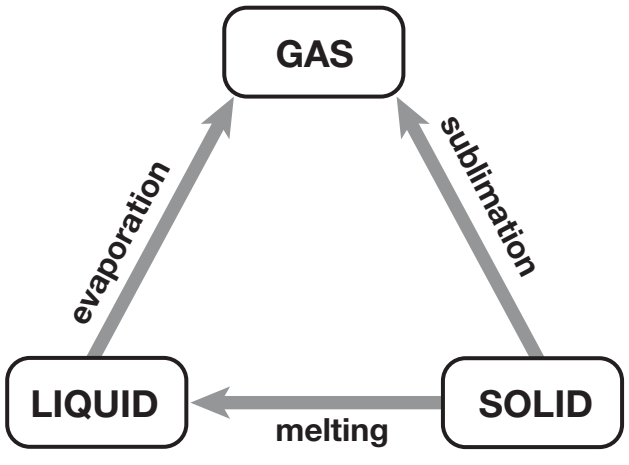
16 **a** Solidifying; **b** Evaporation

17 Liquid to gas: boiling water; solid to liquid: melting of ice; liquid to solid: freezing of ice

18 The heat energy absorbed by a solid during sublimation increases the potential energy of particles, breaking the bonds and causing the particles to move further apart as the solid changes to gas.

19 Dry ice is frozen carbon dioxide; when it breaks down, it turns into gas, which produces foggy effects. When ice (frozen water) breaks down, it melts and becomes liquid.

20



21 **a** Water does not have to boil to evaporate. As water is heated, the water particles at the surface absorb enough energy from the air to escape the liquid.

b **i** The water level would drop by a very small amount or not at all depending on other factors such as humidity and wind, which would accelerate evaporation.

ii The water level would drop by a greater amount as more and more particles gain enough energy to escape the surface of the water.

Extension questions

Learner's Book page 69

1 Learners' answers will vary. Sample answers:

Substance	Melting point	Boiling point
water	0°C	100°C
oxygen	–218°C	–246°C
carbon dioxide	–55.6°C	–78.5°C
iron	1540°C	2890°C
aluminium	660°C	2450°C
copper	1085°C	2580°C

2 Learners' answers will vary.

3 Snap freezing is reducing the temperature of a substance below the freezing point of water as quickly as possible. This is done so the water in the substance does not have time to form large ice crystals, which can destroy the substance. Food manufacturers use snap-freezing so the texture of frozen food is not destroyed.
Freeze-drying is a dehydration process. It works by freezing the substance and then reducing the surrounding pressure to allow the frozen water in the substance to sublimate directly from the solid phase to the gas phase. It is often used to preserve a perishable food, such as apples.

Student activities

Learner's Book page 69

1 **a** A model is an idea that we use to explain and understand certain behaviours.

b When a solid is heated, it melts and becomes a liquid. If heating continues, the liquid then boils. In a solid, the particles are strongly held together. Heating causes bonds between the particles to weaken, allowing the particles to move around as the substance changes to liquid. Further heating finally breaks all the bonds, causing the particles to separate and move fast as the liquid changes to gaseous state.

c Inference: a logical explanation about what happened in an experiment
Hypothesis: an 'educated guess' made by scientists about what they think might happen or what they might find out in an experiment
Prediction: a logical guess about what might happen in the future, based on what has been inferred from observations
Theory: a summary of a hypothesis that has been supported with repeated testing
Law: the rules describing how something occurs, based on observation
Observation: what a scientist sees happening, e.g. in an experiment

2 Refer to the definition of a scientific model on page 59 of the Learner's Book. Allow learners to discuss and share their ideas.

Unit 3.3: Physical and chemical change

Activity 9: Observing changes

Learner's Book page 70

Processes and skills	Resources	Teacher's support notes
Observe changes that occur during burning	• candle • matches • paper	Make sure that science laboratory rules are followed at all times. Ensure that learners understand the difference between a physical change and a chemical change as explained in the Learner's Book on pages 71 and 72. This activity will reinforce that understanding.

Answers

Unit questions

Learner's Book page 72

1 A physical change occurs when a substance is changed, but no new substance is formed.
2 Learners' answers will vary. Sample answers: evaporation of water and dissolving sugar in water.
3 A chemical change occurs when a new substance is formed.
4 Features include: a change in colour; the production of heat or light; a drop in temperature of the substance.
5 Learners' answers will vary. Sample answers: metal rusting; a ripening pawpaw.
6 Learners' answers will vary. Sample answers: rocks being broken up; a puddle of water evaporating; juice being squeezed from a lemon; rain turning the surface of a sports ground to mud; sawdust being produced when a circular saw cuts timber; margarine melting in a hot fry pan; water freezing to make ice cubes.
7 Physical: wax melts; chemical: smoke (gas) and carbon produced

Chapter review

Answers

Learner's Book page 73

1 Solid, liquid, gas
2 Learners' answers will vary. Sample answers: cup (solid), kerosene (liquid), cooking gas (gas).
3 Matter is something that takes up *space* and has *mass*.
4

To / From	Solid	Liquid	Gas
Solid		melting	*sublimation*
Liquid	*freezing*		*evaporation*
Gas	*sublimation*	*condensation*	

5 Frozen soup (solid) thawing—melting (liquid), soup boiled—some evaporation (gas)
6 Learners' answers will vary. Sample answers: iodine, dry ice (frozen carbon dioxide).
7 A model in science is an idea that explains certain observed behaviour. Models are used to help us understand something better.
8 Evaporation and diffusion
9 Learners' answers will vary. Sample answers: the model of the atom; the model of the interior of the Earth; the model of the human skeleton; the double-helix model of DNA.

10 Bonds in a solid are stronger than bonds in a liquid.

11 Gas

12 Brownian motion as observed by pollen grains suspended in water is supporting evidence for the particle model.

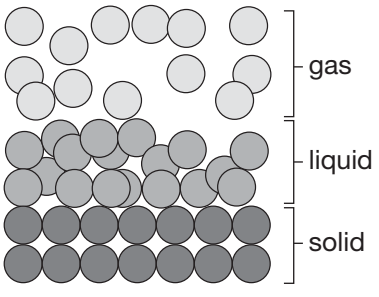
13 Liquid (or gas if its boiling point is less than room temperature)

14 Note: The Learner's Book question should give the following options: (**a**) 0°C; (**b**) 2°C; (**c**) 4°C; (**d**) 6°C. The correct answer is (**c**) 4°C. Liquid water is denser than ice. As water gets near to freezing point (0°C), its particles form a crystal structure, with space between the particles, which reduces its density. Water is at its most dense at 3.98°C, so the answer to this question is 4°C.

15 A thermometer is made of a glass tube with a thin tube inside, connected to a bulb containing either mercury or coloured alcohol. When in use, the heat absorbed by the bulb causes the mercury or alcohol to expand and rise up the inside tube. The height of the mercury or alcohol is a measure of the temperature.

16 Gas pressure inside a closed container is caused by the bombardment of the container walls by the particles of the gas as they bounce around.

17



Chapter 4: Energy forms

Strand: Energy and change

Suggested class time: 4 periods

Sub-strand statement

This sub-strand deals with energy. Energy is the ability to do work. There are different forms of energy, including gravitational, elastic, electrical, heat and sound. Energy can neither be created nor destroyed, but can be changed from one form to another. The source of all energy is the Sun. Renewable energy sources are sources that are continually replenished or restocked. This includes energy from the Sun, water, wind, geothermal and biomass sources from crops. Non-renewable energy sources cannot be replenished—once they are used up, another source has to be found. This includes oil, coal and natural gas.

General learning outcomes

Learners should:

7.4.1 Be able to show that energy is the ability to do work.
7.4.2 Know that there are different forms of energy.
7.4.3 Be able to show that energy can be changed from one form to another.
7.4.4 Know that the total amount of energy remains the same during energy transformations.
7.4.5 Appreciate the use of forms of energy in our daily lives.
7.4.6 Know that energy sources can be renewable or non-renewable.

Specific learning outcomes

Learners should be able to:

7.4.1.1 Demonstrate that energy is used when work is done by: boiling an egg, lifting a book, digging a hole, etc.
7.4.2.1 Identify and describe different forms of energy: heat, sound, elastic, electrical, etc.
7.4.3.1 Demonstrate energy transformation in the following situations: falling coconut, moving car/canoe, kicking a soccer ball, writing in a book, brushing your hair, etc.
7.4.4.1 State the law of conservation of energy: Energy cannot be created nor destroyed, but can be changed from one form to another.
7.4.5.1 Identify the form of energy in: music coming from the radio, stretching a rubber band, boiling water using firewood, heating water using an electric jug.
7.4.6.1 Identify and describe renewable and non-renewable energy sources.

Answers

Suggested assessment activity

1 Learners' responses will vary.
2 When firewood burns, chemical energy is converted to heat energy and light energy.
3 Listening to music: sound energy; pulling a rubber band: elastic energy; boiling of cassava: heat energy
4 Learners' responses will vary.

Challenge questions

Learner's Book page 74

1 Learners' answers will vary. Sample answers: sound, heat, electrical, light, elastic, chemical, nuclear, gravitational.
2 Water draws the heat from your body much faster than air, so you feel colder.
3 The walls of the thermos are made of two thin layers of glass with a vacuum between to prevent heat loss due to conduction and convection. The glass walls have a silvered coating to reduce emitted radiation.
4 Learners' answers will vary. Sample answers: speaker, iron, heater, car.
5 Note: the question in the Learner's Book does not belong in this chapter.
6 When it is so loud that it can damage your hearing

Unit 4.1: Energy forms

Activity 1: Energy in food

Learner's Book page 76

Processes and skills	Resources	Teacher's support notes	Answers to questions
Measure and identify the energy stored in some foods	• test tube • retort stand • boss head and clamp • tripod and gauze mat • Bunsen burner • balance • measuring cylinder (50 mL) • aluminium tray • thermometer (–10°C to 110°C) • small amounts (1 g) of three different food types, e.g. peanuts, bread, chips, breakfast cereal, meat, cheese	The temperature rise of a certain food should indicate how much energy content is in the food. A higher temperature rise means more energy content.	1 Refer to learners' responses. 2 The highest temperature tells us that food has the highest energy content.

Activity 2: Popcorn

Learner's Book page 78

Processes and skills	Resources	Teacher's support notes	Answers to questions
Use heat energy to change the stored energy in corn into sound and motion	• popping corn • small saucepan with lid • Bunsen burner • cooking oil	Energy stored in food can be converted into other forms, e.g. sound, heat, light, motion.	1 Chemical, heat, sound, kinetic, potential 2 Popped corn: grains are quite weak so when there is higher pressure inside, the seed eventually breaks. Unpopped corn: Grains are probably strong enough to withstand the pressure, and so the seed does not break.

Activity 3: Chemical energy

Learner's Book page 78

Processes and skills	Resources	Teacher's support notes	Answers to questions
Perform an energy transformation	• test tubes • test tube rack • 100 mL measuring cylinder • sodium hydrogen carbonate (bicarbonate soda) • hydrochloric acid (2 M) • acetic acid (vinegar) (2 M)	Energy can be released or gained in a chemical reaction. A neutralisation reaction between an acid and a base involves a release of energy in the form of heat and bubbles, which indicates that gases are given off.	**1** Chemical → heat and light **2** The hydrochloric acid will produce more bubbles than the acetic acid. **3** Hydrochloric acid, because it releases bubbles faster than the acetic acid **4** Hydrochloric acid releases more heat energy, producing more bubbles. **5** Hydrochloric acid

Answers

Unit questions

Learner's Book pages 82–83

1 Energy is the ability to do work.

2 Potential and kinetic

3 Potential energy is stored energy. The energy in food, a stretched rubber band, petrol or a battery is all stored inside the material.
Kinetic energy is energy of motion. All moving things have kinetic energy. We use energy when we play soccer, train for netball or athletics or even just sit around talking.

4 Electrical, gravitational, elastic, nuclear, light, heat, chemical, sound, kinetic

5 Learners' answers will vary. Sample answers:
Electrical: light bulb; gravitational: stone falling off a table; elastic: stretched rubber band; nuclear: atomic bomb; light: the Sun; heat: burning wood; chemical: kerosene; sound: dog barking; kinetic: flying aeroplane

6 When one form of energy is changed into another form

7 Chemical → kinetic → heat and sound → light and heat

8 The Sun

9 Learners' answers will vary. Sample answers: producing fire using convex lens, drying clothes.

10 Learners' answers will vary. Sample answer: A cow gets its energy from the plants it eats. Plants make food using the Sun's energy.

11 Learners' answers will vary. Sample answers: A crocodile gets its energy from eating other animals, including herbivorous animals that eat only plants. Plants make food using the Sun's energy.

12 Energy cannot be created or destroyed but can be changed from one form to another.

13 When energy is 'lost', it has 'gone' into other forms, e.g. sound, heat or light.

14 Sound and heat

15 Chemical energy → heat, sound, light → kinetic

16 **a** electrical → heat, light → chemical, kinetic; **b** electrical → light, heat; **c** electrical → kinetic → light (laser), sound; **d** chemical → kinetic → heat, sound; **e** potential → kinetic; **f** potential → kinetic → elastic → kinetic; **g** chemical → kinetic → heat

17 Solar panels and plants both collect light from the Sun and use it to produce energy.

18

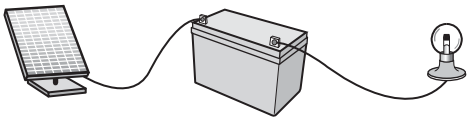
Energy transformation	Situation
a Chemical potential → heat and light	Burning wood in a fire
b Light → heat	Light bulb
c Chemical potential → electrical → light and heat	Turning on a torch
d Chemical potential → kinetic and heat	Dragging a box of books on the ground
e Gravitational potential → kinetic → sound (and heat)	Mango falling and landing on a roof
f Chemical potential → kinetic → gravitational potential	Crane lifting an old car
g Chemical potential → kinetic, sound and heat	Running car
h Kinetic → heat and sound	Swinging object

19 **a** Water heats up the pipes (a little) because of friction; friction in turning the turbine blades and heat as the blades rotate on their bearings

b 'Converted' or 'transformed'

c Electrical → light, sound, heat

20 Learners' answers will vary but may be similar to:



Extension questions

Learner's Book page 83

1 Chemical energy → mechanical energy → electrical energy → light energy / heat energy

2 Learners' answers will vary. Sample answers: radio: electrical → sound; electric oven: electrical → heat; electric jug: electrical → heat and sound; television: electric → sound and light; candle: chemical → light and heat.

3 Learners' answers will vary. Sample answers:

a

Renewable	Non-renewable
Advantages	*Advantages*
Readily available in rural villages in Solomon Islands Low running costs Cause little environmental pollution Efficient heating	Many uses Some countries still have reserves Easily mined Easily transported
Disadvantages	*Disadvantages*
Depend on natural conditions, e.g. weather Large collectors needed Site of energy source not able to be used for other purposes Risk to lives in the community, e.g if a dam breaks	Responsible for causing environmental pollution Most countries have limited supplies Problems with disposal of radioactive waste produced by nuclear energy

b Renewable energy sources: suitable to use in the future because they are unlimited and will never run out.

Non-renewable energy sources: not suitable to use in the future because there are limited supplies and they will eventually run out.

Chapter review

Answers

Learner's Book page 83

1. Potential and kinetic
2. Solar, wind and hydro
3. Fossil fuels (kerosene, petrol and diesel)
4. Mechanical energy to sound and heat energy
5. Reduce, reuse, recycle
6. (Note: the question should read: Explain briefly how a solar-powered electrical system works.) Learners' answers will vary. Sample answers: Solar panels, or solar modules as they are sometimes called, are usually installed on the roof. These solar panels are made up of photovoltaic (PV) cells, which convert sunlight into direct current (DC) power. The DC power from the solar panels is sent to an inverter, where it is converted into alternating current (AC) power, or standard electrical current used in your home.
7. Learners' answers will vary. Sample answer: The Sun is a huge source of energy. Its energy is available in the form of light and heat. These forms of energy can be utilised or transformed into other forms for use.
8. Learners' answers will vary. Sample answer: Work is the amount of energy transferred into or out of a system. For example, the amount of energy in food that is eaten (indicated in kJ—kilojoules) is transferred to your body for use in other forms. So the work done by the food is the amount of energy it transferred to your body.

Chapter 5: Our planet Earth

Strand: Earth and beyond

Suggested class time: 8 periods

Sub-strand statement

This sub-strand deals with our planet Earth. The Earth is made of different layers of materials, from its centre to its surface. The surface of the Earth consists of solid masses of rock called plates. These plates can move horizontally (sideways) and vertically (upwards). The plates change in size as materials may be added to their edge when they come together or push back. The Earth consists of many types of rocks and minerals. The three main types of rocks are igneous, sedimentary and metamorphic. Each rock type is formed in a different way.

General learning outcomes

Learners should:

7.5.1 Know that the Earth has a series of layers from the centre to its surface.
7.5.2 Know that the Earth's layers are made up of different materials.
7.5.3 Be able to show the various layers of the Earth.
7.5.4 Know that the crust of the Earth forming the 'plates' that float on the liquid layer (mantle) can move.
7.5.5 Appreciate that earthquakes, volcanoes and tsunamis are natural processes occurring in the Earth's layers.
7.5.6 Know that a mineral is a natural substance in which the particles are arranged in patterns.
7.5.7 Know that an ore is a rock or mineral.
7.5.8 Be able to show that minerals can be identified using their properties.
7.5.9 Appreciate the use of valuable minerals in our society.
7.5.10 Know that there is a continuous process of change between rock types.
7.5.11 Understand that weathering and erosion are natural process that change the face of the Earth.
7.5.12 Know that human activities cause weathering and erosion processes.

Specific learning outcomes

Learners should be able to:

7.5.1.1 Draw the layers of the Earth in the correct order: crust, mantle, outer and inner core.
7.5.2.1 Describe the various layers of the Earth in terms of their material state.
7.5.3.1 Model the different layers of the Earth using a boiled egg or germinating coconut fruit.
7.5.4.1 State that volcanic activities and earthquakes are caused by the movements of the Earth's plates.
7.5.5.1 Identify signs/indicators of these natural processes to help us prepare to avoid or minimise disastrous consequences when they occur.
7.5.6.1 State that minerals are the building blocks of all rocks.
7.5.7.1 Identify some common rocks and describe the minerals contained in them.
7.5.8.1 Use Mohs scale of hardness to identify common minerals.
7.5.9.1 Identify the valuable minerals, e.g. gold, diamond, nickel.
7.5.10.1 Identify and describe the three types of rocks: igneous, sedimentary, metamorphic.
7.5.10.2 Illustrate the process of the rock cycle using a schematic diagram.

7.5.10.3 Give examples of rock weathering and erosion processes.
7.5.11.1 List and explain types of weathering.
7.5.12.1 Identify the different human activities that cause weathering and erosion.

Answers

Suggested assessment activity

1 Refer to page 85 of the Learner's Book.

2 **Igneous rocks**: Igneous rocks are crystalline solids that form directly from the cooling of magma. This is an exothermic process (it loses heat) and involves a phase change from the liquid to the solid state. The Earth is made of igneous rock—at least at the surface where our planet is exposed to the coldness of space. Igneous rocks are given names based on two things: composition (what they are made of) and texture (how big the crystals are).
Sedimentary rocks: In most places on the surface, the igneous rocks that make up the majority of the crust are covered by a thin veneer of loose sediment, and the rock is made as layers of this debris get compacted and cemented together. Sedimentary rocks are called secondary, because they are often the result of the accumulation of small pieces broken off pre-existing rocks.
Metamorphic rocks: Metamorphic rocks get their name from 'meta' (change) and 'morph' (form). Any rock can become a metamorphic rock. All that is required is for the rock to be moved into an environment in which the minerals that make up the rock become unstable. In most cases, this involves burial, which leads to a rise in temperature and pressure.

3 The evidence that suggests the Earth's core is liquid is the liquid magma that comes out of the Earth when a volcano erupts.

4 **Earthquakes**: People who are indoors should stay where they are and get under a desk or table, or stand against an interior wall. People should stand clear of exterior walls, glass, heavy furniture and appliances. People who are outdoors should move to an open area and away from buildings, power lines or anything else that could fall on them. In a mountainous area, people should be aware of the potential for landslides. People near the ocean need to be aware that tsunamis can occur after large earthquakes and move to high ground. **Tsunamis**: People in low-lying coastal areas should move to high ground. **Volcanoes**: If a warning is sounded, evacuate the area immediately. If there is no warning, seek shelter immediately.

Challenge questions

Learner's Book page 84

1 Learners' answers will vary. Sample answers: soil, gravel, rocks, minerals, metals.

2 Earthquakes occur when the plates push up against each other, building up pressure until the rocks undergo a sudden explosive slippage, causing an earthquake. Volcanoes can occur when plates collide and one slips under the other one, causing magma to be forced up between the plates.

3 Rocks are made of minerals.

4 Acid rain occurs when pollutants in the air dissolve in rainwater. Acid rain can kill fish and animals in rivers and lakes, kill forests and make soils too acidic for plants to grow in. It can also cause damage to buildings and statues.

Unit 5.1: Our Earth

Activity 1: Modelling the Earth's interior

Learner's Book page 85

Processes and skills	Resources	Teacher's support notes	Answers to questions
Observe a model of the Earth's interior	• boiled eggs—one for each group	Work in groups. Explain what a model is to the learners. Note that the boiled egg is a model of the Earth. **Caution:** Do not allow the learners to eat the eggs, even after the activity.	**1** Drawings should include the shell, albumen and yolk. **2** Shell: hard coating protecting the egg. Albumen: white part of the egg, quite thick. Yolk: yellow core of an egg. **3** Shell represents crust; albumen represents mantle; yolk represents core.

Answers

Unit questions

Learner's Book page 87

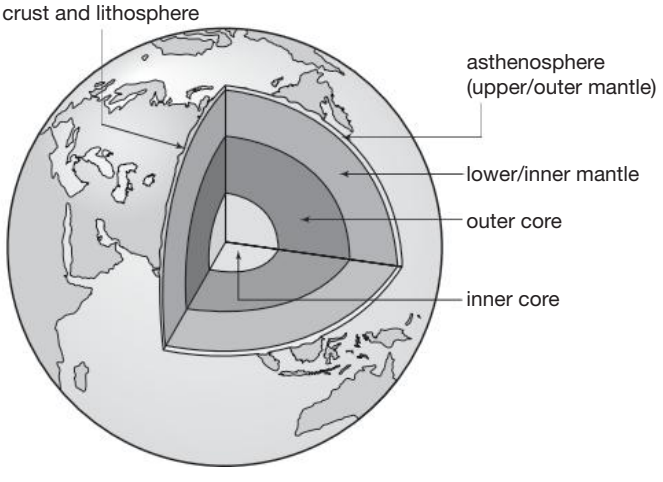
1 The crust is the layer of the Earth on which we live. It contains the land and seas.

2 **a** Thickest: under the continents; **b** Thinnest: under the sea

3 Inner core, outer core, mantle, crust

4 **a** Mantle; **b** Inner core; **c** Outer core; **d** Asthenosphere (part of mantle), outer core; **e** Crust, upper mantle, lower mantle, inner core

5



6 The *crust* is broken into huge slabs of rock called *plates*. These *plates* 'float' on the continually moving molten rock of the *mantle*.

7 Earthquakes and volcanoes

8 Earthquakes occur when the plates push up against each other, building up pressure until the rocks undergo a sudden explosive slippage, causing an earthquake.

9 Learners' answers will vary. Sample answers: for a mining company; at a geological office; in the mountains looking and digging for special types of rocks that contain minerals.

10 Learners' answers will vary. Sample answers: analysing rock samples to determine the types of minerals they contain; studying the effects of earthquakes.

11 Learners' answers will vary. Sample answers: keep accurate records and write reports; be fit enough to walk into the bush and mountains for exploration.

12 To make sure the rock is strong and stable enough to hold the weight of the skyscraper

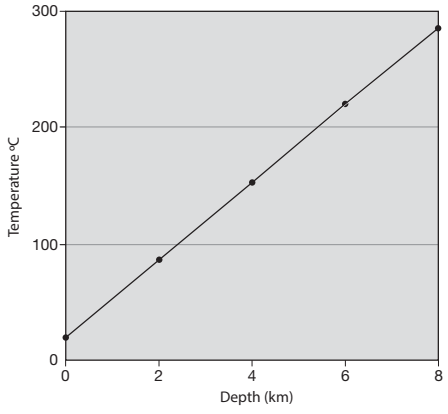
13 The correct statements are:

a The inner core of the Earth is solid.

b The iron and nickel in the *outer core* give the Earth its magnetic field.
c The crust is very *thin* compared to the total volume of the Earth.
d Mines are *never* deep enough to go into the mantle.

14 If there were no magnetic field, the Earth would not be protected from some of the Sun's harmful rays.

15



16 **a** 50°C at 1 km; **b** 180°C at 5 km; **c** 340°C at 10 km; **d** Approximately 680°C at 20 km

Unit 5.2: Rocks and minerals

Activity 2: Identifying rocks and minerals

Learner's Book page 88

Processes and skills	Resources	Teacher's support notes
Describe samples and determine whether they are rocks or minerals	• samples of rocks and minerals, e.g. feldspar, basalt, mica, granite	You could also use samples from rivers, the beach and the school grounds. Minerals have a regular structure throughout, with a definite chemical composition and characteristic crystalline structure. Rocks are made up of minerals.

Activity 3: Studying minerals

Learner's Book page 88

Processes and skills	Resources	Teacher's support notes
Study and describe a sample of a mineral	• sample of quartz • hand lens	You could also use other minerals that are available in your school.

Activity 4: Identifying minerals using 'scale of hardness'

Learner's Book page 89

Processes and skills	Resources	Teacher's support notes
Place samples of rock in order of hardness	• mineral samples (e.g. magnetite, quartz, calcite, azurite), iron nail, glass, steel, knife	You could also use other minerals that are available in your school.

Activity 5: Studying granite rock

Learner's Book page 90

Processes and skills	Resources	Teacher's support notes
Investigate the properties and formation of granite	• granite rock • hand lens	You could also use other rocks that are available in your school.

Answers

Unit questions

Learner's Book page 91

1 Geologists study the structure of the Earth, including its rocks and minerals.

2 Minerals are the building blocks of all rocks. They are natural substances in which the particles are arranged in patterns.

3 Learners' answers will vary. Sample answers: quartz, mica, feldspar, calcium carbonate, diamond.

4 Crystal structure, colour, streak, hardness

5 **a** Mohs hardness scale is a scale to determine the hardness of minerals. It has a scale from one to ten.

b Mineralogist

6 A petrologist studies rocks by collecting rock samples, looking at their properties and working out which minerals they contain.

7 An ore is a rock or mineral that contains elements that can be extracted.

8 Learners' answers will vary. Sample answers: granite, limestone, clay, sand, basalt.

9 Ores can be both rock and mineral.

10 An ore is a rock or mineral that contains elements that can be extracted.

11 **a** Haematite; **b** Bauxite

12 Learners' answers will vary. Sample answers: azurite and chalcopyrite both contain copper.

13 Geology is the study of the Earth, including its rocks and minerals. Petrology is the study of rocks.

14 Native minerals are made up of only one metal element.

15 In Solomon Islands, the powder from sandstone and charcoal is mixed with water and applied to dancers' bodies and faces as decoration.

16 Ochre is powdered weathered minerals and rocks that are used by various native peoples worldwide.

17 Haematite: red; kaolin: white; charcoal: black

18 It is crushed to a powder. (You could substitute another material that is used in the village for painting.)

19 The correct statements are:

a *Minerals are the building blocks of all rocks.*

b The two most common elements that make up the Earth are oxygen and *silicon*.

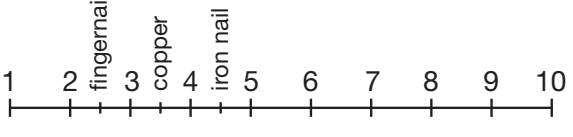
c Gold and silver are metals, *or native minerals*.

d Mineralogy is the study of minerals.

20 Silicon and oxygen are the two most common elements on Earth, so they are found commonly in rocks combined as silicates.

21 **a** True; **b** False **c** False.

22 **a** and **b**



23 Talc, calcite, apatite, quartz, diamond

24 **a** Yes; **b** No; **c** Yes; **d** Yes

25 **a** Minerals: feldspar, quartz, mica; **b** Rock: gneiss

Unit 5.3: Types of rocks

Activity 6: Identifying igneous rocks

Learner's Book page 92

Processes and skills	Resources	Teacher's support notes
Investigate and identify samples of igneous rock	• two samples of igneous rocks, e.g. obsidian, basalt • hand lens	You could also use other igneous rocks that are available in your school.

Activity 7: Identifying sedimentary rocks

Learner's Book page 93

Processes and skills	Resources	Teacher's support notes
Investigate and identify two sedimentary rocks	• two samples of sedimentary rocks, e.g. sandstone, siltstone	You could also use other sedimentary rocks that are available in your school.

Activity 8: Identifying metamorphic rocks

Learner's Book page 95

Processes and skills	Resources	Teacher's support notes
Investigate and identify samples of metamorphic rock	• two samples of metamorphic rock, e.g. gneiss, marble • hand lens	You could also use other metamorphic rocks that are available in your school. **Note:** in Fig. 5.3.10 in the Learner's Book, the photograph labelled 'granite' should be labelled 'gneiss'.

Answers

Unit questions

Learner's Book pages 97–98

1 *Ignis* means fire.

2 **a** Magma is molten rock below the ground. Lava is molten rock above ground.
b Intrusive rocks are below ground. Extrusive rocks are above ground.
c A dyke is intrusive igneous rock that cuts through several rock layers. A sill runs along a particular layer.

3 The cooling rate is determined by the depth of the magma or where the lava flows or explodes. The slower the rate of cooling, the larger the crystals.

4 Learners' answers will vary. Sample answers: basalt, granite.

5 Learners' answers will vary. Sample answers: Basalt is used to build roads. Granite can be used to make kitchen benchtops.

6 Learners' answers will vary. Sample answers: sandstone (sand), limestone (remains of sea organisms).

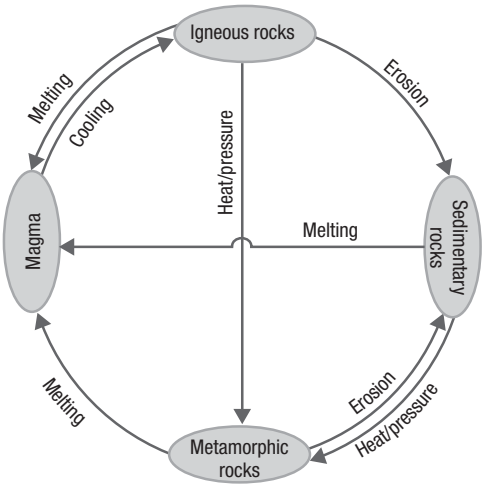
7 Particles stick together under pressure; water passes through, carrying with it minerals that cement the particles together.

8 Heat and pressure

9 Marble (limestone), slate (shale)

10 Marble is very hard and strong.

11



12 Rocks are classified according to how they are formed.

13 They may be exposed by erosion or by the movement of tectonic plates in the Earth's crust.

14 **a** Sediment: small broken-down bits of rocks or animal and plant remains. **b** Lithification: the sticking together of compressed pieces of rock.

15 Coal consists of compressed plant remains, so it contains more fuel than uncompressed plant matter does.

16 Learners' answers will vary. Sample answers: Igneous rocks are new rocks made from molten material. Sedimentary rocks are layered rocks made from broken-down bits of other rocks. Metamorphic rocks are changed rocks made from rocks that have been changed by heat and/or pressure.

17 **a** Igneous: basalt; **b** Metamorphic: slate; **c** Sedimentary: limestone; **d** Metamorphic: gneiss or schist; **e** Sedimentary: mudstone; **f** Igneous: granite; **g** Igneous: basalt

Extension question

Learner's Book page 98

Learners' answers will vary.

Activity 9: Observing cooling rates of crystals

Learner's Book page 98

Processes and skills	Resources	Teacher's support notes	Answers to questions
Observe the effect of cooling rates on crystal size	• copper sulfate • two 100 mL beakers • two 500 mL beakers • one 250 mL beaker • stirring rod • Bunsen burner • tripod • gauze mat • heat-proof mat • safety glasses OR • two transparent plastic cups • two 1 L ice-cream containers • 375 mL Milo tin • kerosene/gas stove	Heat the solution gently.	**1** Refer to learners' responses. **2** Refer to learners' responses. **3** The solute molecules gather in clusters and the crystal begins to grow. It continues growing until eventually, it can no longer remain 'dissolved' in the solution and it falls out (as chemists like to say) of solution. Now other solute molecules begin growing on the surface of the crystal and it keeps on getting bigger until there is an equilibrium reached between the solute molecules in the crystal and those still dissolved in the solvent.

Activity 10: Making concrete

Learner's Book page 98

Processes and skills	Resources	Teacher's support notes	Answers to questions
Make various types of concrete	• cement (dry, powdered) • sand • finely crushed rock • plastic teaspoon • paper or plastic cups • water	Use disposable cups.	**1** In an experiment we always want to keep all other variables the same and only change the variable that we want to test, in this case the type of ingredient. **2** The sample made from 2 teaspoons of sand and 4 teaspoons of cement was the strongest. **3** Chemical change, because a new substance is formed that looks and acts differently from what was there before.

Unit 5.4: Weathering and erosion

Activity 11: Erosion and its effects

Learner's Book page 99

Processes and skills	Resources	Teacher's support notes	Answers to questions
Identify which type of erosion is occurring and its effects and prevention	• Fig. 5.4.1, Learner's Book, page 99	You can also use pictures from other sources for this activity.	Learners' answers will vary. Sample answers: **1** A man standing in an area where a landslip has occurred **2** Deforestation leading to erosion of the exposed topsoil. Effects are a change of landscape, potentially leading to a change in the use of the land and any affected land downhill, to the worst case of damage to people's property and loss of life. **3** Restrictions on deforestation, such as no clear-felling of trees, selective harvesting and replanting to stabilise the topsoil **4** Rivers: revegetation (planting trees and plants) on river banks; beaches: revegetation, building boardwalks and sea walls; farms: revegetation, crop and livestock rotation; building or road construction sites: installing a sediment barrier and perimeter banks.

Answers

Unit questions

Learner's Book page 102

1 **a** Soil: rocks broken down into smaller and often very fine particles; **b** Decomposition: chemical weathering; **c** Weathering: breaking down of rocks; **d** Sediment: material that is washed away

2 Weathering is the breaking down of rocks. Erosion is the movement of weathered material.

3 When water freezes, it expands.

4 Learners' answers will vary. Sample answers: **a** Mechanical weathering: temperature changes, freezing water, water (river, glacier, waves) and air movement that scours rock; **b** Biological weathering: root growth, seed germination, animal movement and burrowing.

5 Learners' answers will vary. Sample answer: biological, mechanical and physical weathering.

6 Wind, water movement (rain, creeks and rivers, glaciers, waves), landslides and slippages
7 Learners' answers will vary. Sample answers: Pollution has added destructive chemicals to the air, mainly sulfur dioxide, creating acid rain. Humans plant trees and the roots of these trees can cause cracks as they grow.
8 Sulfur dioxide
9 As a by-product of industrial activity, such as from factories
10 Acid rain increases chemical weathering because the acidic pollutants that have dissolved in the rain react with the materials they come in contact with and break down the materials.
11 We all need to help protect the environment.
12 Learners' answers will vary. Sample answers: Plant trees to help stop erosion; walk or ride a bike or paddle a canoe instead of driving a car to reduce air pollution.
13 Boulders are large pieces of rock. Sand is made from broken down pieces of rock.
14 The liquid in the bottle will expand as it freezes, causing the bottle to break.
15 Chemical weathering caused by acid rain
16 The fine details that expose a high surface area to the air, e.g. nose, ears, markings on cloth and faces
17 There are increased pollution levels in the city, due to intensive human activity.
18 Learners' answers will vary. Sample answer: They measure, record and find methods to control the harmful effects of human activity on our environment.
19 Learners' answers will vary. Sample answer: There is a lot of evidence to suggest that humans contribute to erosion and weathering. Humans have changed the surface of the Earth dramatically in the past 200 years by mining, using explosives and by building roads, houses and cities. Pollution from human activities has damaged rocks, trees and buildings. Human activities have also changed water and wind flow, contributing to erosion.

Extension questions

Learner's Book page 102

1 **a** Learners' answers will vary. Sample answers: Rivers: revegetation (planting trees and plants) on river banks; beaches: revegetation, building boardwalks and sea walls; farms: revegetation, crop and livestock rotation; building or road construction sites: installing a sediment barrier and perimeter banks
b Learners' photographs or diagrams will vary.
c Learners' posters will vary.
2 **a** River deltas are landforms found at the mouth of a river that are formed when sediment is deposited as the water flows from the river into the ocean, sea, lake or reservoir.
b Sandbanks and sandbars in rivers are formed when sand deposits build up to create a shallow area.
3 Refer to learners' responses.

Chapter review

Answers

Learner's Book page 103

1 See the illustration on page 44 of the Teacher's Guide.
2 Learners' answers will vary, but refer to the illustration of the rock cycle in Fig. 5.3.15 on page 96 of the Learner's Book and the illustration of acid rain in Fig. 5.4.3 on page 100 of the Learner's Book.
3 Weathering is the breaking down of rocks. Erosion is the movement of weathered material.

4 Rivers: revegetation (planting trees and plants) on river banks; beaches: revegetation, building boardwalks and sea walls; farms: revegetation, crop and livestock rotation; building or road construction sites: installing a sediment barrier and perimeter banks

5 Wegener's theory proposed that the continents had once been joined, and over time had drifted apart.

6 Earthquakes and volcanoes occur in Solomon Islands because we are located close to the plate boundaries where movements usually occur. Cyclones develop over the sea when the water temperature is high and the winds are suitable.

7 Minerals are the building blocks of all rocks. Rocks are made up of minerals.
Many minerals have a distinctive crystal structure. Because each mineral has a different crystal structure and colour, they reflect light differently.
Pigment is the colour of the mineral. Streak is the colour of the powdered mineral and can often be seen by rubbing a mineral on an unglazed white tile.
Ores are rocks or minerals that contain elements that can be profitably extracted. For example, iron is extracted from an ore called haematite.

8 Igneous rocks are new rocks made from molten material. Sedimentary rocks are layered rocks made from broken-down bits of other rocks. Metamorphic rocks are changed rocks made from rocks that have been changed by heat and/or pressure.

9

Job title	Main tasks	Skills required
Geologist	Examine, classify and describe animal and plant fossils found in sedimentary rocks	Be able to work alone or as part of a team; careful and patient; eye for detail
Palaeontologist	Study the composition and structure of the Earth	Be able to work alone or as part of a team; keep accurate records; write reports; work safely
Environmental scientist	Measure, record and find methods to control the harmful effects of human activity on our environment	Be able to work as part of a large team; write clear, accurate reports; apply scientific method

Extension question

Learner's Book page 103

The research can be substituted with field trips or an excursion to a mining site, excavation, quarry, cave or pit.

Chapter 6: Solutions, solutes and solvents

Strand: Natural and processed materials

Suggested class time: 16 periods

Sub-strand statement

This sub-strand deals with solutions and mixtures. When two or more pure substances are mixed together, they form a mixture. Some pure solid substances (solids) dissolve in liquids (solvent) to form a solution. Some pure substances do not dissolve in liquids. Mixtures can be separated by physical and mechanical methods. Water is a universal solvent; is very important to our lives. Our body is made of about 90% water. We need to drink clean water every day. Traditionally, we have methods of water purification.

General learning outcomes

Learners should:

7.6.1 Know what pure substances, solutions and mixtures are.
7.6.2 Be able to make different solutions.
7.6.3 Be able to separate insoluble and soluble substances from mixtures.
7.6.4 Know some hazardous solvents and solutions.
7.6.5 Appreciate the process of getting clean drinking water.
7.6.6 Be able to show local purification methods.
7.6.7 Understand the importance of sewage purification.

Specific learning outcomes

Learners should be able to:

7.6.1.1 Identify some examples of the three types of mixtures: solutions (salt and water), suspensions (sand and water) and colloids (milk in water).
7.6.2.1 Produce a solution by dissolving solute in solvent: sugar (solute) in water (solvent), salt (solute) in water (solvent), kiln powder (solute) in water (solvent), etc.
7.6.3.1 Select appropriate methods to separate substances from mixtures—insoluble substances: decanting, sieving, filtering, gravity separation, centrifugation, magneting; soluble substances: evaporation, distillation, chromatography, centrifugation.
7.6.4.1 Identify common solutions and solvents around them that are hazardous.
7.6.5.1 Select sources of clean drinking water for human use: in the school, at home, in the community/village, etc.
7.6.6.1 Use local water purification methods: settling and decanting.
7.6.7.1 Identify methods of sewage treatment and explain its importance.

Answers

Suggested assessment activity

1

Substances	Separating method
Sand from sand–water mixture	Decanting
Water from salt solution	Evaporation
Salt from salt water mixture	Evaporation
Drugs from prepared medicine	Filtering

2 Learners' answers will vary. Sample answers: Squeezing coconut milk and drying clothes.
3 Refer to learners' posters.
4 We must keep our water free from contamination to avoid germs entering our water sources.

Challenge questions

Learner's Book page 104

1 A mixture is a combination of two or more chemically pure substances.
2 Oil and water do not mix; the oil floats on top of the water.
3 Sea water is a mixture of different types of salts and water.
4 Place the sand and salt in a pan and add water. Heat the water until the salt dissolves. Allow the sand to settle at the bottom of the pan, then pour off the salty water. In another pan, boil the salty water away until only salt is left in the pan.
5 In the ocean or under the ground in the water table

Unit 6.1: Types of mixtures

Activity 1: Testing solubility in water

Learner's Book page 106

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate and observe the solubility of different substances in water	• salt • sugar • ground-up coloured chalk • copper sulfate • flour • soil • household and other substances provided by the teacher • test tubes • test tube holder • water • rubber stopper(s) • spatula(s) • safety glasses	Learners will see evidence of the solubility of the different substances in water. Teachers can select other substances that are available to be tested.	**1** Salt: soluble; sugar: soluble; ground-up coloured chalk: insoluble; copper sulfate: soluble; flour: insoluble; soil: insoluble **2** So the soluble substance does not saturate the solution and therefore appear to be insoluble **3** **a** Sugar; **b** Soil

Activity 2: Temperature and solubility

Learner's Book page 107

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate and observe how temperature affects the solubility of two different substances (sodium chloride and glucose)	• test tubes • test tube holder and rack • Bunsen burner • safety glasses • spatula • sodium chloride (table salt) • glucose (sugar)	Take extra care when learners are dealing with hot objects and harmful chemicals.	**1** Heat increases the solubility of most substances. **2** At the same temperature, more sugar than salt dissolves in the same amount of water. **3** In general, the solubility of gases decreases as the temperature increases. So when water is heated up, air bubbles form as the water cannot hold the dissolved air with increasing temperature. **4** Refer to learners' responses.

Activity 3: Surface area and solubility

Learner's Book page 107

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate and examine the relationship between surface area and rate of dissolving	• two sugar cubes • two beakers • water OR • chalk dust and different sized lumps of chalk	Make sure that learners understand and recognise the difference between large and small surface areas. This will play a very important role in ensuring that the aim of this practical is achieved. Use different materials if necessary, e.g. use chalk dust and lumps of chalk if sugar cubes are not available.	**1** Increasing the surface area of the solute leads to a faster rate of dissolving than for the sample of lesser surface area. **2** All the crushed cube is used so that both samples are equal in mass and volume, thereby ensuring a fair test. **3** The water level and temperature should be kept the same for both experiments to ensure equal test conditions. This will enable a fair comparison to be made.

Answers

Unit questions

Learner's Book pages 110–111

1 Solutions are formed when one substance (called the solute) dissolves in another (called the solvent).

2 (**b**)

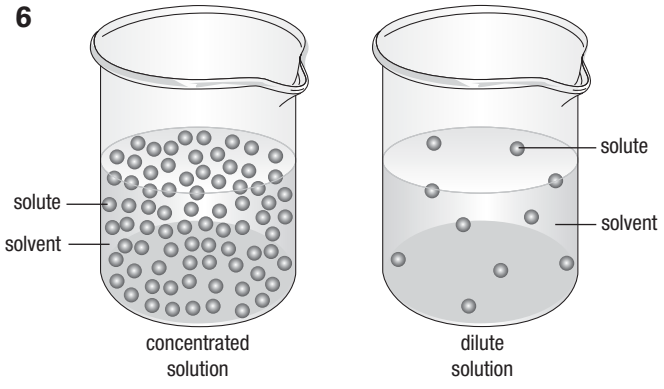
3 (**a**)

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

5

	Concentrated solution	Dilute solution
Differences	More solute is added to a given volume of solvent.	Less solute is added to a given volume of solvent.
	A given amount of solute is dissolved in a smaller volume of solvent.	A given amount of solute is dissolved in a bigger volume of solvent.
	The solution is thicker.	The solution is thinner.
	The solution is more dense.	The solution is less dense.
Similarities	Both solutions are mixtures where the solute has dissolved in the solvent.	

6



7 In a suspension, the solute particles are bigger than those in a solution and will settle to the bottom of the container if left long enough.

8 **a** Chalk; **b** Mud; **c** Worn metal pieces

9 Learners' answers will vary. Sample answers: Certain medicines in which the solid settles to the bottom, paint, muddy water.

10 The particles in a colloid are bigger than those in a solution, but smaller that those in a suspension.

11 Paint is the solute.

12 Learners' answers will vary. Sample answers: **a** Salt, sugar; **b** Chalk, oil

13 (c)

14 A dilute solution is made when very few solute particles are in a large number of solvent particles.

15 Saturated solution; an example is caramel, made from a saturated solution of sugar in water.

16 **a** Aim: To determine whether cordial is a solution or a suspension

b Concentration, total volume of water, brand and colour of cordial, temperature (there may be other answers)

c Keep quantities small.

Design: Learners' designs for the experiment may vary. One idea is to use filtration. If cordial is a suspension, the particles would be collected by filter paper.

17 Some medicines are suspensions that may separate if left for some time. If not shaken and mixed, parts of the medicine may not be taken as intended.

18

Mass of solvent (g)	Mass of solvent (g)	Mass of solution (g)
100	12	112
60	30	90
115	65	180

Extension questions

Learner's Book page 111

1 **a** An alloy is a metal made by combining two or more metallic elements, which results in greater strength and resistance to corrosion.

b It combines two or more metallic elements.

c Learners' answers will vary. Sample answers: kitchen utensils, pots and pans (steel, stainless steel).

d Learners' answers will vary.

2 Learners' answers will vary.

Unit 6.2: Separating insoluble substances

Activity 4: Filtration

Learner's Book page 113

Processes and skills	Resources	Teacher's support notes	Answers to questions
Observe and investigate how to separate a filtrate from its residue, using the filtration process	• crushed (powdered) coloured chalk and copper sulfate mixture • conical flask • beaker (100 mL) • funnel • filter paper • stirring rod • safety glasses	Make sure that the filter paper is correctly folded before it is placed into the cone section of the funnel. If filter paper is not available, use other papers that can do the same job, e.g. papers with wider pores like small strainers. **Note:** In order to answer question 1, learners should compare the size of the particles *before* placing the powders in the solution.	**1** Refer to learners' responses. **2** Note: This question should read: 'Produce a magnified diagram explaining how the *residue* is trapped by the filter paper. Use different symbols for the chalk, copper sulfate and water particles.' Answer: Learners' diagrams should show the fine holes in the filter paper and the larger particles of residue (chalk) not able to pass through, while the copper sulfate passes through in solution. **3** Learners should suggest evaporating off the water by heating the solution to dryness.

Activity 5: Magnetic separation

Learner's Book page 114

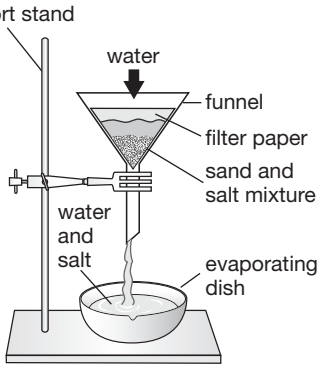
Processes and skills	Resources	Teacher's support notes	Answers to questions
Observe and investigate the separation of iron filings from a mixture of sand	• a container with a mixture of sand and iron filings • sheets of A4 paper • sheets of newspaper • a magnet • a small transparent plastic bag • a small empty container for iron fillings after separation	Make sure that learners put the magnet in the plastic bag. This prevents the iron filings from sticking onto the magnet and damaging it. If there are not enough magnets, learners can work in small groups or take turns.	**1** The piece of paper is placed between the mixture and the magnet to allow easy removal of the iron filings from the magnet, simply by taking the magnet away from the paper. **2** To prevent the iron filings sticking to the magnet and damaging it **3** In recycling, magnets are used to remove the metals from piles of rubbish.

Answers

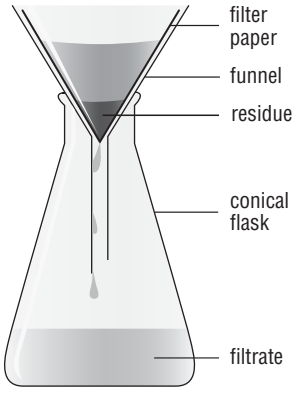
Unit questions

Learner's Book page 115

1



2 Sieving is used when there are different-sized particles in a mixture. It involves passing materials through different-sized holes. You may collect the material or items larger than the holes (as in fishing using a net) or smaller (as in sieving flour using a sieve).
3 **a** False; **b** True
4 The residue is the material trapped by the filter.
5 In a washing machine, the centrifuge spins and forces the water out through holes in the wall of the machine. In a laboratory centrifuge, the spinning forces heavier particles to the bottom of the test tubes.
6 Learners' answers will vary. Sample answers:
Dust mask: when sanding a surface before painting, a dust mask is used to stop fine particles from entering the lungs. Coffee machine: the filter paper removes the finely ground coffee beans and powder from the final drink.
7



8 Sieving is used; large pieces of rock are dropped while smaller pieces pass through a filter consisting of appropriately sized holes.
9 **a** Magnetic; **b** Sieving; **c** Put the mixture of salt and sand in water; mix and heat if necessary until the salt has dissolved; filter the salt water out of the sand with a filter paper; heat the salt water solution until the water evaporates, leaving only the salt. **d** Centrifugation.
10 Salt water is a solution where the solvent and solute particles are the same size. Both pass through the filter paper. Note: Learners' diagrams should show particles of salt and water that are the same size.

Unit 6.3: Separating soluble substances

Activity 6: Separation by evaporation

Learner's Book page 116

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate the separation of dissolved substances from their solutions, using the evaporation method	• Bunsen burner • salt solution or soft drink • heat-proof mat • evaporating basin • tripod stand • gauze mat • safety glasses • tongs OR • gas stove, kerosene stove or firewood • empty tin of taiyo as evaporation basin	Teachers can separate learners into small groups. Make sure that learners are very careful when doing this experiment, to prevent any accidental burns. Make sure that evaporation is completed before learners safely collect the solid crystal particles. You can make a salt solution by dissolving salt in hot water.	**1** Learners will notice less volume of water, bubbles forming in the water, and some particles become apparent. **2** It is important to stop heating so the solid substance isn't burnt once the water has fully evaporated. **3** The water has changed from a liquid to a gas (water vapour) and escaped into the air.

Activity 7: A simple distillation

Learner's Book page 117

Processes and skills	Resources	Teacher's support notes	Answers to questions
Observe and investigate the collection of a sample of pure water, using the distillation method	• Bunsen burner • gauze mat • heat-proof mat • conical flask • tripod stand • watch-glass • wooden test tube holder • salt solution • beaker • 3 paperclips • large container of water • safety glasses OR • gas stove, kerosene stove or firewood • small cooking pot with lid instead of conical flask and watch-glass • empty tin of taiyo as a beaker for collecting distilled water	Make sure that learners are working safely, as this activity involves fire, heat and boiling water. You can make a salt solution by dissolving salt in hot water.	**1** By comparing the colours observed when burning, learners will notice that the colour of the distillate burning is the same as for the plain water, i.e. salt is not present in the distillate. **2** The same paperclip should not be used for all three flame tests as some residual salt on the paperclip would burn during each test and so confuse the result and give the impression that salt is present in each of the three solutions.

Activity 8: Chromatography of colours

Learner's Book page 119

Processes and skills	Resources	Teacher's support notes	Answers to questions
Observe and investigate the separation of the colours in ink	• water-based ink pens (e.g. Textas) • eye dropper or medicine dropper • water • beaker • filter paper	It is better if several different coloured water-based ink pens are used, e.g. black, blue, red. Ask learners to observe the differences in the separation of colours in each of the ink colours. This includes the differences in the rate of separation and the spread of different colours on the filter paper. If filter paper is not available, other plain papers such as A4 paper for photocopying and printing may be used. Teachers should try these other types of papers prior to the activity to make sure they are suitable.	**1** Learners' answers will vary, depending on the inks used. **2** The speed each colour pigment travels depends on the size of the particles in the pigment and on how strongly the pigment is attracted to the paper. So the smaller particles in the pigment and those less attracted to the paper will travel fastest.

Answers

Unit questions

Learner's Book page 120

1 When a solution evaporates, *crystals* of solute may be left behind.

2 A salt pan is a shallow lake in which salt water is placed. The water evaporates, leaving salt behind. Salt pans are used in large-scale salt production.

3 Distillation involves evaporation, but the evaporated liquid, called the distillate, is collected rather than allowing it to escape into the air.

4 The two stages are evaporation and condensation. To separate a mixture of liquids, the liquid can be heated until it becomes a gas, which is then condensed back into liquid form and collected.

5 Learners' answers will vary. Sample answers: whisky production, perfume production, pure (distilled) water production.

6 In distillation, a fraction is a substance that can be separated (distilled) from the mixture.

7 Learners' answers will vary. Sample answers: petrol used to fill cars; lubricants and waxes to lubricate engines and make candles; bitumen to make roads.

8 Learners' answers will vary. Sample answers: **a** Towel; **b** Charcoal filters

9 Chromatography can be used to separate colours in inks, food dyes and other mixtures of colours.

10 They move through a medium at different rates depending on the size of the particles in the pigment.

11

Separation method	Brief description	Example
Evaporation	The mixture is boiled so that the solvent evaporates. This will leave behind the solute.	Salt from sea water
Distillation	Materials are evaporated from a mixture and collected in a special apparatus.	Drinking water from salt water
Absorption	A substance is taken in by another substance.	Charcoal in a gas mask absorbs poisonous gases.
Chromatography	The separation of colours is caused by colours moving at different rates through a medium.	Filter paper chromatography may be used to separate colours in a marker pen.

12 Boiling requires a large amount of energy and is therefore expensive. Salt pans use the Sun's energy to evaporate water, which is cheap and fast.

13 The chemical that they contain is poisonous.

14 Learners' answers will vary depending on the exact method and equipment that they choose, but should be based on a distillation set-up.

15 **a** Absorption; **b** Evaporation; **c** Centrifuging and distilling; **d** Chromatography; **e** Absorption

16 **a** Special material or foot powder to absorb the smelly moisture; **b** Evaporation will remove the water, leaving the salt; **c** Centrifuging removes the water from the clothes and distillation removes the washing powder and dirt from the water; **d** Chromatography separates the different coloured dyes in inks and allows identification of individual ink types; **e** A carbon filter will absorb the paint fumes.

Unit 6.4: Water supply and sewage

Activity 9: Water purification

Learner's Book page 121

Processes and skills	Resources	Teacher's support notes	Answers to questions
Observe and investigate how dirty water can be purified to a level that is safe to drink	• empty 2 L ice-cream or large margarine container • sand • stones • muddy water • 2 beakers (250 mL each) • tripod stand • stirring rod OR • containers in which it is easy to make a small hole underneath without cracking or breaking can also be used if ice-cream or margarine containers are not available. Other containers can also be used instead of beakers.	Learners can use a 5 cm nail to make a hole in the bottom of the container. Make sure that learners put a layer of stones in the container first (at the bottom), followed by a layer of sand (at the top). Make sure that learners place the beaker or collecting container directly under the container containing stones and sand before pouring the muddy water. This will prevent any spillage on the table or floor.	**1** Learners should provide a description of the effectiveness of the filtration by including a comparison of the muddy water with the 'purified water'. **2** Added stages to the basic method could include additional layers of materials and refiltration of the solution.

Activity 10: Testing flocculation chemicals

Learner's Book page 122

Processes and skills	Resources	Teacher's support notes	Answers to questions
Observe and investigate some of the chemicals that cause flocculation	• 250 mL beaker of muddy water (suspension) • filter paper • conical flask • funnel • stirring rod • some of the following: copper sulfate, iron(II) chloride, copper chloride, sodium carbonate, sodium bicarbonate, ammonium sulfate, magnesium sulfate, calcium sulfate • safety glasses	Teachers should try to obtain some of the chemicals listed in the resource column before carrying out this activity. Note that some of the listed chemicals may be present in some common household substances such as cleaning detergents. Teachers need to be creative and also make sure that the chemicals used are safe for the learners to handle with care. Explain to learners that the clumped chemicals are called 'floc', rather than 'flocculent'.	**1** This will depend on the type of soil in the 'muddy' water. Iron(II) chloride is likely to be among those producing most flocculation. **2** The chemicals that caused flocculation reacted with the particles in suspension because these can readily be clumped together. Particles in a solution cannot be separated by filtration. **3** You could separate the clumped particles (floc) from the solution through decanting or possibly filtration.

Answers

Unit questions

Learner's Book page 124

1 Lakes, rivers, oceans
2 Mixture
3 Impurities are absorbed into rain droplets from the air.
4 **a** Chlorine; **b** Fluoride
5 Flocculation is the clumping together of particles in a mixture, caused by a chemical electrolyte.
6 Sewage is waste water; sewerage is the network of pipes that sewage passes through.
7 Toilet, basin, shower
8 Bacteria
9 In a septic system, sewage breaks down due to the action of bacteria and is released into the soil. This leaves a thick sludge that separates by gravity at the bottom of the tank.
10 Swimming pools contain more bodily waste in relatively high concentrations, so there are more germs to be killed.
11 The water that feeds into our reservoirs moves through the catchment area first, picking up contaminants.
12 The tree roots take up the ground water and use the minerals in it. The trees then release pure water back through their leaves.
13 Detergents and other liquids pass into the soil (where some filtration occurs) rather than into the storm water pipes and eventually the ocean.
14 The risk of disease would be much greater.
15 To stop the smell from the sewer coming up the pipe

Extension questions

Learner's Book page 124

1 Learners' answers will vary.
2 Learners' answers will vary.
3 Learners' answers will vary. Sample answer:

Process	Approximate amount of water used
Making paper	26–64 L of water to make about one ream of paper (500 sheets)
Making soft drinks	2.7 L of water to produce 1 L of soft drink
Growing rice	140 L of water to grow 100 g of rice

4 Learners' answers will vary, but should reflect that the development of sewerage systems has led to improvements in public health.
5 Learners' answers will vary. Sample answers: **a** Composting toilets use the natural processes of decomposition and evaporation to recycle human waste. As water makes up over 90% of the waste that enters the toilet, the system relies on evaporation to release a lot of the waste back into the atmosphere through a vent system. The small amount of remaining solid material is used to fertilise soil by natural decomposition. **b** Advantages: converts human waste and makes it useful; uses less water than conventional toilets; reduces the need for waste treatment plants. Disadvantages: often more expensive; if not cleaned properly and regularly can be smelly and become a health hazard; new practices and techniques need to be learnt in order to install the toilets properly.
6 **a** Acid rain occurs when pollutants in the air dissolve in rainwater. Acid rain can kill fish and animals in rivers and lakes, kill forests and make soils too acidic for plants to grow in. It can also cause damage to buildings and statues.
b Northeastern USA, southeastern Canada, central Europe, Scandinavia, parts of India and China

7 It is recommended that the teacher organises a guest speaker. It is important to ensure that learners have prepared a series of questions so that they make the most of the visit.

Chapter review

Answers

Learner's Book page 125

1 Learners' answers will vary. Sample answers: toothpaste, oven cleaner, soft drink, cream.
2 **a** Turpentine; **b** Paint
3 A solution contains small particles of solute that do not settle out. A suspension contains larger particles of sediment that do settle out.
4 A substance that will not dissolve is said to be *insoluble*.
5 **a** Dilute; **b** Concentrated
6 **a** Sieving is where different-sized particles are separated using a grid or mesh.
b Filtration is where a special filter (e.g. paper) allows only tiny particles (e.g. air, water, dissolved substances) through.
7 Crude oil is separated using fractional distillation.
8 Learners' answers will vary. Sample answer: waxes—used to make polishes and candles; petrol—used to power a car and a lawn mower; kerosene—used as fuel for aeroplanes and home heating.
9 Gravity separation
10 Learners' answers will vary. Sample answers: separating blood, spin-drying clothes, separating milk and cream.
11 Absorption; charcoal has many fine pores that can absorb dangerous gases.
12 Chromatography is a technique that can be used to separate colours in inks, food dyes and other mixtures of colours. In forensic science, chromatography can be used to determine what is in a mixture. For example, people can be tested for drug use by analysing their urine to determine if there are drugs or drug by-products present.
13 Rainwater absorbs contaminants or chemicals from the atmosphere.
14 To help prevent tooth decay
15 To allow settling of other substances
16 Floc is the substance produced by the clumping together of parts of a mixture.
17 The solute particles are about the same size as the solvent, and are spread evenly throughout the solvent.
18 **a** Turpentine; **b** Soap or caustic soda; **c** Acetone
19 A gram of caster sugar, because of its increased surface area. To perform an experiment you would have to keep constant: the type of sugar, the water temperature, no stirring, same-sized containers.
20 **a** Distillation; **b** Sieving; **c** Filtering
21 **a** Solvent = water, solute = copper sulfate
b Solubility increases
c As the temperature rises the water particles move further apart, allowing more copper sulfate particles to be accommodated.
d 44 g, twice the water doubles the sites for the solute
e Line graph
f Diagrammatic answer required. Learners' diagrams should be similar to the set-up shown in Fig. 6.3.2 on page 116 of the Learner's Book, which shows how evaporation can be used to separate a dissolved substance from a solvent.

Chapter 7: Introduction to cells

Strand: Life and living

Suggested class time: 12 periods

Sub-strand statement

This sub-strand deals with living things, which are made up of small parts called cells. We can see cells with the aid of a microscope. Without a cell, there is no life. Cells are arranged in groups called tissues. Tissues do a particular job. Cells form into more cells by cell division. A collection of tissues in a living thing makes an organ. A collection of organs makes a system. A group of body systems makes up an organism.

General learning outcomes

Learners should:

7.7.1 Know the parts and uses of the microscope.
7.7.2 Demonstrate how to use the microscope correctly.
7.7.3 Understand that all living things are made up of cells.
7.7.4 Know plant cells and animal cells.
7.7.5 Know that a living cell has parts that do specific jobs.
7.7.6 Know that a collection of cells make up a tissue.
7.7.7 Appreciate the functions of specialised cells in both plants and animals.
7.7.8 Know that some living organisms are made up of only one cell.
7.7.9 Be able to show that a living organism's body can be made up of millions of different types of cells.

Specific learning outcomes

Learners should be able to:

7.7.1.1 Identify the parts of the microscope and describe their uses: eyepiece, objective lens and stage.
7.7.2.1 Perform steps for the correct use of the microscope.
7.7.2.2 Prepare a simple specimen using onion skins and observe.
7.7.3.1 Explain that a cell is the smallest (basic) unit of all living things.
7.7.4.1 Identify the basic parts of a living animal and plant cell.
7.7.4.2 Identify parts present in a plant cell, but absent in an animal cell.
7.7.5.1 State the function of each part of a cell: nucleus; chloroplast; cell wall; cell membrane; cytoplasm.
7.7.6.1 State that: a group of cells make a tissue, a group of tissues make an organ, a group of organs make a system.
7.7.6.2 Identify examples of different living: tissues (muscle, skin, bone); organs (lung, heart, liver); systems (reproductive, digestive).
7.7.7.1 Identify specialised cells in animals and plants and state their functions.
7.7.8.1 Identify and recognise different types of single-celled organisms.
7.7.9.1 Use a diagram to show the developmental stages from cells to organ.
7.7.9.2 Identify examples of different systems that are found in animals and plants, and list the organs that make up each system.

Answers

Suggested assessment activity

1 Eyepiece, coarse focusing knob, barrel, arm, fine focusing knob, objective lenses, clips, stage, diaphragm, mirror, base

2

Features	Animal cell	Plant cell
Nucleus	*Present*	*Present*
Cell membrane	*Present*	*Present*
Cytoplasm	*Present*	*Present*
Cell wall	*Absent*	*Present*
Chlorophyll	*Absent*	*Present*
Large water vacuole	*Absent*	*Present*

3 A single-celled organism does not need a lot of energy to survive and can reproduce very quickly. However, they have a short lifespan and they are more vulnerable to damage and death. A multicellular organism can grow to any size. Its many different cells are specialised for specific jobs that allow multicellular organisms to perform more functions than unicellular organisms. They have a longer lifespan. However, they require a lot of energy to survive and reproduce. The reproduction system is complex.

Challenge questions

Learner's Book page 126

1 The photograph has been taken with a transmission electron microscope.
2 Cells can be thought of as the building blocks of life. All living things are made up of cells, e.g. whales, germs, trees, pond slime.
3 They both have cells.
4 Unicellular (or single-celled) organisms, i.e. organisms that are made up of just one cell
5 Nervous system, circulatory system, digestive system, reproductive system, respiratory system, urinary system

Unit 7.1: The microscope

Activity 1: Focus on the news

Learner's Book page 129

Processes and skills	Resources	Teacher's support notes	Answers to questions
Make a wet mount and view it using a light microscope	• microscope • microscope lamp • a section of newspaper containing small print • eye dropper • glass microscope slide • cover slip	In this activity, learners will learn how to use a microscope safely and correctly. Teachers must guide learners in preparing the wet mount to be observed under the microscope. Demonstrate how to do this before allowing learners to prepare their own.	**1** Refer to learners' observations. **2** Refer to learners' observations.

Activity 2: Observing everyday objects using a microscope

Learner's Book page 129

Processes and skills	Resources	Teacher's support notes	Answers to questions
Observe common objects at various magnifications	• microscope • microscope lamp • glass microscope slides • cover slips • eye droppers • small samples suitable for viewing under a microscope, e.g. a sugar crystal (both plain and caster), salt, copper sulfate, hair, clothing fibres, leaf, insect, writing sample (in ballpoint pen ink) • mini grid (optional)	This activity will help learners to make systematic observations about various objects when viewing them at different magnifications on a microscope. The skills learned in Activity 1 will help learners in this activity. The teacher should help learners to observe the objects at various magnifications and to draw images at these magnifications.	**1** Refer to learners' observations. **2** Refer to learners' observations. **3** Learners' answers will vary. Sample answers: to identify hair samples, to identify clothing fibres.

Answers

Unit questions

Learner's Book pages 131–132

1 **a** A microscope is a device used to produce magnified images of small objects.
b *Microscopic* describes something so small that a microscope is needed to see it clearly.

2 Learners' diagrams should be similar to Fig. 7.1.2, on page 127 of the Learner's Book.

3 Ocular lens

4 Hans and Zacharias Janssen and Hans Lippershey (separately) in 1609

5 Learners' drawings should show: (1) Place specimen on stage; (2) Adjust light source; (3) Begin with the lowest magnification; (4) Move object lens away from the specimen; (5) Adjust coarse focus; (6) Adjust fine focus.

6 Learners' answers will vary. Sample answers: handle with care, hold the base when carrying, keep the objective lens clear of the specimen.

7 The study of metals

8 Instead of using light, an electron microscope uses a beam of tiny negatively charged particles called electrons that are transmitted through a thinly sliced specimen. An image is then produced and projected onto a screen.

9 Scanning Electron Microscope

10 Monocular and stereo. Stereo microscopes are commonly used to view specimens in finer detail.

11 **a** × 800; **b** × 100; **c** × 500;

d

Eyepiece magnification	Objective lens magnification	Total magnification
× 10	× *20*	× 200
× *15*	× 20	× 300
× 5	× 20	× *100*
× *10*	× 100	× 1000
× 30	× *20*	× 600

12 **a** 1500; **b** Up to 1,000,000

13 Refer to learners' responses.

14 Refer to learners' responses.

15 200 mm or 20 cm

16 Specimens require less preparation. (Note: this question is incorrectly numbered as 17 in the Learner's Book.)

17 (Note: this question is incorrectly numbered as 18 in the Learner's Book.)

Similarities	Differences
Both have lenses	Light = glass; SEM = magnets
Both produce magnified images	Light = × 1500; SEM = × 1,000,000

Extension questions

Learner's Book page 132

1 Learners' answers will vary. Posters should include the steps listed in the answer to Question 5 above.

2 Learners' answers will vary.

3 A micrometer measures by using a screw mechanism that amplifies small distances (that are too small to measure directly) into large rotations of the screw that are big enough to read from a scale.

4 Millimetre = mm; micrometre = µm

5 Learners' answers will vary, but may include the following processes: dehydration, staining, embedding materials, chemical fixation and cryofixation.

Unit 7.2: Plant and animal cells

Activity 3: A bird's egg—a single large cell

Learner's Book page 133

Processes and skills	Resources	Teacher's support notes	Answers to questions
Identify the parts and functions of a hen's egg	• hen's egg • cup or Petri dish	Learners will observe the parts of the hen's egg, and draw and label the diagram correctly. If a hen's egg is not available, an egg from another bird (e.g. megapode) can be used.	**1** Germinal disc; this is where the sperm enters the egg. **2** On the small, circular, white disc, called the germinal disc, on the surface of the yolk. **3** Yolk **4** They hold the yolk in the egg white.

Activity 4: Comparing animal and plant cells

Learner's Book page 135

Processes and skills	Resources	Teacher's support notes	Answers to questions
Finding the differences and similarities between plant and animal cells	• diagrams of animal and plant cells (see Fig. 7.2.4 and 7.2.6, pages 134 and 135 of the Learner's Book)	Learners will observe diagrams of plant and animal cells, looking for differences and similarities.	**1** Animal cell: cell nucleus, cell membrane, cytoplasm, vacuole, mitochondria; Plant cell: cell nucleus, cell wall, cell membrane, vacuole, chloroplast, mitochondria, cytoplasm. (Note: Fig. 7.2.6 should also have a 'cytoplasm' label as plant cells contain cytoplasm.) **2** Plant cell has chloroplast, animal does not; plant cell has a cell wall, animal cell does not; animal cell has several small vacuoles, plant cell has one large vacuole. **3** Muscles require a lot of energy and mitochondria are the powerhouse of the cells.

Activity 5: Onion and banana cells

Learner's Book page 136

Processes and skills	Resources	Teacher's support notes	Answers to questions
Observe and draw plant cells	• microscope • potassium iodide stain • lamp • filter paper • glass microscope slide • eye dropper • water • cover slip • onion skin • banana sample • wooden spatula or icy pole stick	The teacher must demonstrate to learners the safe use of equipment and chemicals before learners do the activity. Learners will prepare an onion skin and a banana sample on slides to observe. Learners must make systematic observations and do accurate drawings and measurements.	**1** For banana cells, the iodine will stain the starch grains. If we used iodine for the onion cells we would see the cell nuclei stained. **2** Learners should identify one of the samples as easier to observe, and explain why. They may find the banana easier due to the contrast provided by the iodine stain. **3** Learners should describe observations such as the size and shape of the cells, the appearance of the cell walls, whether they can see nuclei, etc.

Answers

Unit questions

Learner's Book page 136

1 Robert Hooke
2 1839
3 All living things are made up of cells. New cells are created by old cells dividing in two. All cells are similar but not identical.
4 Bacteria
5 **a** Cell nucleus; **b** Cytoplasm; **c** Cell membrane; **d** Mitochondria; **e** Cell wall
6 Learners' answers will vary. Sample answers: skin cells, nerve cells, blood cells, muscle cells.
7 The green substance in plant cells is chlorophyll in the chloroplasts of the cell. Chlorophyll allows the plant to carry out photosynthesis.
8 **a** Plants need photosynthesis to make their food; **b** The hard outer wall or layer of the plant cell; **c** Tough fibre that makes up the cell wall
9 Learners' answers will vary. Sample answers: plant cell has chloroplast, animal does not; plant cell has a cell wall, animal cell does not; animal cell has several small vacuoles, plant cell has one large vacuole.
10 Organelles are found in a cell. Each organelle does a separate job inside the cell to control the cell's functions. Organs are found in the body, and each one does a separate job in controlling the body's functions.
11 An organism is a living thing that is able to live independent of other organisms.
12 About one-hundredth of a full stop
13 More than 100 million million cells
14 Refer to learners' responses. Diagrams should be similar to those in Fig. 7.2.4 and 7.2.6 on pages 134 and 135 of the Learner's Book. (NOTE: Fig. 7.2.6 on page 135 of the Learner's Book should also have a 'cytoplasm' label as plant cells contain cytoplasm.)
15 Muscles require a lot of energy and mitochondria are the powerhouse of the cells.
16 **a** Plant cell: sap; **b** Animal cell: air, water, wastes, food particles.

17

Feature	Animal cell	Plant cell
Cell membrane	Yes	Yes
Cell wall	No	Yes
Cytoplasm	Yes	Yes
Cell nucleus	Yes	Yes
Vacuole	Several small	One large
Chloroplast	No	Yes

18 Animals usually have some form of skeleton holding all the cells in place and protecting their inner organs and systems. Hence animal cells do not need a tough cell wall. Plants do not have this type of skeleton and each cell needs to be able to stand upright and protect itself. Hence they need a tough cell wall.

19 There are more specialised animal cells than plant cells because animals are more complex than plants and need more cells to carry out all the different functions that animals do. (Plants have fewer types of cells because they are far simpler organisms than animals.)

Unit 7.3: Specialised cells

Activity 6: Viewing prepared slides

Learner's Book page 138

Processes and skills	Resources	Teacher's support notes	Answers to questions
Observe prepared microscope slides of specialised plant and animal cells	• prepared slides of various specialised plant and animal cells • microscope • lamp	Learners make observations and interpret recorded data according to the aims of the study. Provide learners with the necessary information to get the appropriate results.	**1** Learners' answers will vary. Sample answers: The cells are all slightly different sizes and shapes, but all appear to have structures inside them. The plant cells appear more organised. **2** Prepared slides may more accurately display what you are looking for. They also allow potentially dangerous or rare materials to be seen. **3** Refer to learners' responses.

Activity 7: Life in a drop of water

Learner's Book page 139

Processes and skills	Resources	Teacher's support notes	Answers to questions
Observe and draw single-celled organisms in pond water	• some pond water, or other water containing single-celled organisms (e.g. a hay infusion) • microscope • lamp • glass • microscope slide • cover slip • eye dropper	Remind learners of the basic rules of using a microscope so they can obtain a good, clear view of the samples. Learners will be observing single-celled organisms. These can be very hard for them to see at first, so the teacher must help learners to identify the organisms. Learners must use appropriate diagrams and symbols when reporting on their investigations.	**1** Refer to learners' observations. **2** Refer to learners' observations: flagellates use a long tail to help them move; ciliates have tiny hairs that wave; amoeba flow rather than swim; sporozoans don't move themselves but move with other cells. **3** Will depend on the sample used. May include amoeba, paramecium and others.

Answers

Unit questions

Learner's Book page 140

1 **a** White blood cells; **b** Nerve cells; **c** Red blood cells; **d** Muscle cells

2 Diagrammatic answer required. Learners' answers will vary. Sample answers:
- blood cells carry food and oxygen around the body and fight off infection from bacteria and viruses
- muscle cells enable movement
- nerve cells send messages from the brain to the muscles
- skin cells cover the body and provide a barrier to infection
- bone cells help support the body and protect internal organs.

3 About 200 different types of specialised body cells

4 Learners' answers will vary. Sample answer: root hair cells, guard cells, conducting cells, photosynthetic cells

5 If a plant had no guard cells it would probably dry out, wilt and die because it could not control water loss.

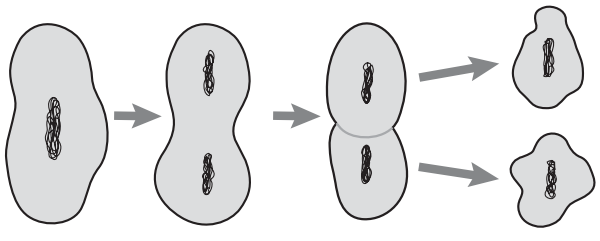
6 Photosynthetic cells are normally located on the top of a leaf because that is where the sunlight will fall. Very little photosynthesis would happen if the cells were on the underside of the leaves.

7 Unicellular organism

8 Learners' answers will vary. Sample answer: flagellates, ciliates, amoebas, sporozoans.

9 Learners' answers will vary. Sample answers: the flu (influenza), malaria, the common cold, chicken pox, measles, mumps, HIV-AIDS.

10 Diagrammatic answer is required.



11 Diagrammatic answer required. Learners' diagrams should be similar to those in Fig. 7.3.9 on page 139 of the Learner's Book.

12 A whip-like tail that is found in some protists and helps them to move

13 Ciliates

14 The two types of plant conducting cells are xylem (transports water and minerals) and phloem (transports the food of plants, i.e. glucose). The idea of having two types of conducting vessels is good because each tube/vessel is specialised in transporting its material.

15 Euglena are plant-like protists that have chloroplasts and cell walls.

Extension questions

Learner's Book page 140

Learners' answers will vary. Sample information that should be included in the brochure:

a Malaria is caused by protists that are introduced to the body of humans and other animals by an infected female mosquito. The protist passes through the mosquito's saliva and into the circulatory system and ultimately the liver where they mature and reproduce.

b The signs and symptoms of malaria are fever, shivering, chills, headache, sweats, diarrhoea and anaemia.

c Those most likely to get malaria are people in tropical regions of Asia, Africa and Central or South America, especially people with lower immunity levels, e.g. babies and old people.

d Malaria can be prevented by avoiding mosquito bites, e.g. wearing long, loose clothing; using insect repellents and avoiding outdoors at dusk and dawn; sleeping under mosquito nets.

e Possible cures or treatments for malaria: anti-malarial medications.

Unit 7.4: Groups of cells

Activity 8: Body systems

Learner's Book page 141

Processes and skills	Resources	Teacher's support notes	Answers to questions
Examine the different types of human body systems and their functions	• diagrams of the human body	In this activity, learners will make observations and interpret the diagrams according to the questions given. The teacher must give clear directions to the learners before they start the activity.	**1 a** A system is a group of organs that work together. **b** A body system is made up of group of organs working together, e.g. a group of muscles work together to form the muscular system. **2** Respiratory system: lungs, trachea; nervous system: brain, nerves; urinary system: kidneys, bladder; reproductive system: penis, testes, uterus, ovaries; circulatory system: heart, veins and arteries; digestive system: stomach, intestines. **3** Tissue is a group of similar cells. Tissues are grouped together to form an organ.

Answers

Unit questions

Learner's Book pages 143–144

1 A zygote is the single fertilised cell from which a human being develops.

2 Many *cells* form *tissue*. Groups of *tissue* make up an *organ*.

3 Learners' answers will vary. Sample answers: lungs, heart, brain, kidneys, testes, ovaries, stomach, large and small intestines.

4 A body system is a group of organs working together to do a particular job in your body. For example, a group of muscles work together to form the muscular system.

5

Body system	List of its parts	Brief description of what it does
Nervous system	Brain, spinal cord and nerves	Sends, receives and processes tiny electrical messages detected and carried by nerves
Circulatory system	Heart and blood vessels	Carries food and oxygen to cells; carries waste materials from cells for separation before being removed from the body
Digestive system	Teeth, stomach and intestine	Breaks down food into substances small enough to be absorbed into the bloodstream; some separation of waste occurs here
Reproductive system	Sex cells and organs	Male: produces sperm cells and semen; contains the apparatus required for sexual reproduction Female: produces egg cells; contains the apparatus for sexual reproduction and development of a baby
Respiratory system	Trachea, lungs and diaphragm	Oxygen is inhaled and transferred to the blood for circulation to other parts of the body; carbon dioxide is removed from the blood; carbon dioxide is exhaled
Urinary system	Kidneys, bladder	Kidneys filter out wastes and control the amount and contents of body fluids

6 **a** tissue: B; **b** an organ: C; **c** a body system: E
7 **a** Circulatory; **b** Nervous; **c** Urinary or digestive; **d** Digestive; **e** Respiratory
8 Nervous: brain, spinal cord, nerves; circulatory: heart, arteries, veins, capillaries; digestive: mouth, stomach, small intestine, large intestine; reproductive: penis, testes, prostate, vagina, uterus, ovaries; respiratory: lungs, trachea, diaphragm; urinary: kidneys, bladder, urethra.
9 Pivot: the head swivelling on the top of the spine; hinge: knee and elbow joints; ball and socket: hip joint
10 **a** Flower; **b** Leaf; **c** Leaf, Stem, Roots; **d** Roots; **e** Bulb
11 The way humans move, i.e. using the skeletal and muscular systems

Chapter review

Answers

Learner's Book page 145

1 A compound microscope is a microscope that contains two or more lenses.
2 Learners' answers will vary. Sample answers: handle with care; begin focusing so the objective lens moves away from the specimen; handle the microscope carefully by the base and arm when moving it; never put the microscope near the edge of the table or bench in the laboratory.
3 Eyepiece, coarse focusing knob, barrel, arm, fine focusing knob, objective lenses, clips, stage, diaphragm, mirror, base
4 Cork
5 Diagrammatic answer required. Learners' diagrams should be similar to Fig. 7.2.3 on page 134 of the Learner's Book.
6 Diagrammatic answer required. Learners' diagrams should be similar to Fig. 7.2.4 on page 134 of the Learner's Book.
7 Diagrammatic answer required. Learners' diagrams should be similar to Fig. 7.2.6 on page 135 of the Learner's Book. (NOTE: Fig. 7.2.6 should also have a 'cytoplasm' label because plant cells contain cytoplasm.)
8 **a** Cell membrane: controls the flow of substances in and out of a cell
b Cell wall: provides support in plants
c Cytoplasm: the chemical factory, containing hundreds of chemicals
d Vacuole: the storage area, containing air, water, wastes and food particles in animals, and sap in plants
e Cell nucleus: the control centre, containing coded instructions for what it does and how it reproduces
f Chloroplasts: contain chlorophyll that traps the light required for photosynthesis
9 Specialised cells do particular jobs that could not be done by single cells living alone.
10 Learners' answers will vary. Sample answers: nerve cells send messages; muscle cells assist with movement; blood cells carry food and oxygen around the body; skin cells cover the body and provide a barrier to infection; bone cells help support the body and protect internal organs.
11 Euglena is a flagellate. Paramecium is a ciliate.
12 Unicellular
13 Learners' answers will vary. Sample answers: guard cells open and close stomata; root hair cells absorb water from the soil; conducting cells transport food and water; photosynthetic cells process photosynthesis.
14 × 1000
15 Each type allows for the examination of different features and at different magnifications.
16 Learners' answers will vary. Sample answers: Compound: cheap and allows viewing up to × 1000 magnification; TEM: can magnify up to a million times enabling the viewing of the

delicate internal structure of cells and other specimens; SEM: allows higher magnification and the ability to examine surface features in three dimensions.

17 Learners' answers will vary. Sample answers: membrane, nucleus, cytoplasm, mitochondria, vacuole.

18

Date	Scientist	Discovery
1609	Hans Janssen and his son, Zaccharius	Invented the compound microscope
1665	Robert Hooke	Designed a prototype of the modern compound light microscope and looked at cork cells; named 'cells'
1839	Theodore Schwann and Mathias Schleiden	Proposed the cell theory of life
1930	Ernst Ruska	Invented the transmission electron microscope, enabling viewing of the delicate internal structure of cells

19 **a** Multicellular: mammals, fish, birds, reptiles; unicellular: protists, bacteria

b Advantages: many systems work together, able to move over longer distances, damage repairable. Disadvantages: more difficult to move if large, large food requirements, systems need to be regulated, slow reproduction, complex transport systems required.

c Advantages: fast reproduction, easy to absorb and remove substances from the body. Disadvantages: easily affected by changes in environment, vulnerable to damage, e.g. death.

d Learners could answer either way depending on how the above information is prioritised.

e Multicellular—many cells in the body

20 **a** Body system; **b** Tissue

21 Learners answers will vary. See Fig. 7.4.2 to 7.4.8 on pages 142 and 143 of the Learner's Book for diagrams. Sample answers:

Body system	Brief description
Nervous system	Sends, receives and processes tiny electrical messages detected and carried by nerves
Circulatory system	Carries food and oxygen to cells; carries waste materials from cells for separation before being removed from the body
Digestive system	Breaks down food into substances small enough to be absorbed into the bloodstream; some separation of waste occurs here
Reproductive system	Male: produces sperm cells and semen; contains the apparatus required for sexual reproduction Female: produces egg cells; contains the apparatus for sexual reproduction and development of a baby
Respiratory system	Oxygen is inhaled and transferred to the blood for circulation to other parts of the body; carbon dioxide is removed from the blood; carbon dioxide is exhaled
Urinary system	Kidneys filter out wastes and control the amount and contents of body fluids

Chapter 8: Light and colours

Strand: Energy and change

Suggested class time: 12 periods

Sub-strand statement

This sub-strand deals with light and colours. The Sun is main source of natural light. However, some organisms produce their own light. Light rays travel in a straight line. When a light ray hits a flat surface it reflects back at an angle. You see images in mirrors because of the reflection of light. Light rays bend when they enter a different medium. They either bend towards the normal or away from the normal. Light also produces different colours. These colours are produced when light rays are separated. We see these colours in a rainbow or when light is passed through a prism.

General learning outcomes

Learners should:

7.8.1 Know what luminous and non-luminous objects are.
7.8.2 Appreciate the use of luminous objects in our everyday life.
7.8.3 Be able to show that light travels in a straight line and it bends as it enters different mediums.
7.8.4 Be able to show the reflection of light from plane and curved surfaces.
7.8.5 Be able to use curved mirrors and lenses.
7.8.6 Be able to show that we see objects because light scattered from them enters our eyes.
7.8.7 Know that the seven main colours of white light form the colour spectrum and that red, blue and green are the primary colours.

Specific learning outcomes

Learners should be able to:

7.8.1.1 Identify luminous and non-luminous objects.
7.8.2.1 Describe different uses of some important luminous objects in our everyday life, e.g. kerosene lamps, light bulbs, torch light, Sun, fireflies.
7.8.3.1 Use simple experiments to demonstrate that light travels in a straight line: casting shadows using sunlight or torch light, see through straight and bent pipe.
7.8.3.2 Demonstrate bending of light rays by passing the rays through glass or water.
7.8.4.1 Conduct simple experiments to show the reflection of light on plane and curved surfaces.
7.8.5.1 Draw the different types of lenses and show light rays as they move away from the lenses.
7.8.5.2 Demonstrate the use of curved mirrors and lenses: rear view mirrors as safety mirrors in vehicles; security mirrors in shops and supermarkets; in telescopes, binoculars and microscopes.
7.8.6.1 Demonstrate that dark surfaces absorb light and white surfaces reflect light, e.g. pass light through black and white surfaces.
7.8.7.1 Recognise the rainbow as the natural spectrum of colour.
7.8.7.2 Use a prism (or water trough and mirror) to observe the spectrum.

Answers

Suggested assessment activity

1 Refer to Fig. 8.1.8 on page 148 of the Learner's Book. The incident ray is the incoming ray to the mirror. The reflected ray is the ray coming away from the mirror.
2 The colours of the rainbow are red, orange, yellow, green, blue, indigo and violet.

3 Sunlight is refracted (or split up into basic colours) through tiny water drops that act like a prism to create a rainbow.
4 Refer to learners' responses.

Challenge questions

Learner's Book page 146

1 Because they are non-luminous objects
2 When light strikes the smooth road, it reflects into our eyes as though it contains water droplets.
3 To produce images from objects
4 To ensure that the whole shop can be viewed in the mirror
5 Because the fish will appear closer to our eyes than it really is
6 Blue light is scattered more than the other colours of the spectrum and the scattered blue rays seen against the dark background of space cause the sky to appear blue.
7 True

Unit 8.1: Light

Activity 1: The pinhole camera

Learner's Book page 149

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate and show that light travels in a straight line	• small cardboard box (e.g. taiyo box) • aluminium foil • tracing paper • masking tape • candle • scissors	Explain to learners how a pinhole camera works. Learners should be able to differentiate the types of images that they see in everyday life, e.g. inverted, upright, magnified, diminished, real and virtual. In this experiment, the inverted image that is formed is a real image because real rays actually pass through it. Mirror images are virtual images because the actual rays do not actually pass through them. Use ray diagrams to show learners how the rays meet to form the image.	1 The tracing paper 2 Upside down 3 **a** The image is smaller; **b** The image is larger.

Activity 2: The law of reflection

Learner's Book page 151

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate the law of reflection	• light box and power supply • ruler • mirror • protractor • plain paper	Explain the law of reflection to learners, i.e. the angle of incidence is equal to the angle of reflection, where incident ray, reflected ray and the normal lie in the same plane. Angle of incidence is the angle between the incident ray and the normal. Angle of reflection is the angle between the reflected ray and the normal. The normal is the line perpendicular to the surface.	1 The back of the mirror will be the point at which the incident ray is reflected. 2 The angle of incidence is always equal to the angle of reflection. 3 Learners' answers will vary. Sample answer: on a bright moonlit night, the Earth is lit as the result of reflected light rays from the Sun onto the Moon.

Activity 3: Image location

Learner's Book page 151

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate and locate the image in a plane mirror	• mirror • plain paper • ruler • pin or small object (e.g. a nail in a small block of wood)	Explain to learners that the rays (line of sight) are reflected off the surface of the mirror. Our eyes only accept rays that are coming to it. When we look in a mirror, we see an image of ourselves the same distance behind the mirror—it appears that the rays are coming from behind the mirror, but they are not.	**1** The lines of sight should cross each other at the image position. **2** Reflected **3** Angle of reflection or reflection angle **4** Refer to learners' measurements. **5** The image distance is the same as the distance in question 4.

Activity 4: The periscope

Learner's Book page 152

Processes and skills	Resources	Teacher's support notes	Answers to questions
Apply the law of reflection of light by constructing a working periscope	• cardboard sheet • sticky tape • two mirrors (each about 5 × 7 cm, though smaller will do) • scissors	Explain to learners how a periscope works. A periscope is used at a lower level to see objects above. It is usually used in submarines to see things on the surface some distance away.	**1** The angle should be 45°. **2** The length of the cardboard should be twice as long as the dimension given. **3** For submarines to view objects on the surface from under water; to view objects on the second floor of a building from the ground floor.

Answers

Unit questions

Learner's Book pages 153–154

1 Because the basketball reflect lights from other light sources

2 Learners' answers will vary. Sample answers:
- **a** Sun, candle, light, light produced from a firefly in the night, light bulb, light produced from a mushroom in the night
- **b** Moon, reflected light from mirror, planets, reflected light of a computer screen, tennis ball

3 Learners' answers will vary. Sample answers: Sun, traffic light, light bulb.

4 A glow-worm is an example of a *bio*luminescent creature.

5 A shadow is formed when an object blocks the light rays aimed at a surface.

6 A penumbra is a much larger partial shadow produced from a large light source. This light source also produces a small shadow called an umbra.

7 Assuming the light source is small, when an object moves towards a screen the shadow will decrease in size.

8
- **a** Reflection occurs when a light ray bounces off a surface.
- **b** Diffuse reflection is a poor reflection of light from a rough surface.
- **c** The law of reflection states that the angle of the incoming ray is always equal to the angle of reflection.
- **d** The normal is a line between the angle of incidence and angle of reflection. It is perpendicular to the surface.

9 Learners' answers will vary. Sample answer: a page of this book.

10 **a** Incident ray; **b** Angle of incidence; **c** Angle of reflection; **d** Reflected ray; **e** Normal

11 Learners' answers will vary. Sample answers: in clothing shops for customers to try on clothes; rear view mirrors in cars.

12 We know light does not need a material to travel through as it must travel through a lot of empty space (a vacuum) between the Sun and the Earth to reach us.

13 Diagrammatic answer required. The shadow should be smaller and sharper (penumbra is smaller) when the object is closer to the screen.

14 Our shadows would be perfectly sharp.

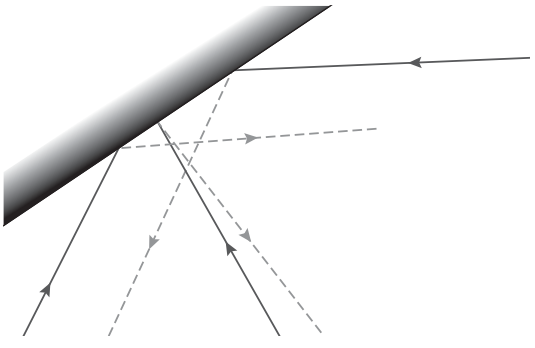
15 EMERGENCY VEHICLE

16 **a** The object is above and in front of the viewer; **b** The image is in front of the viewer.

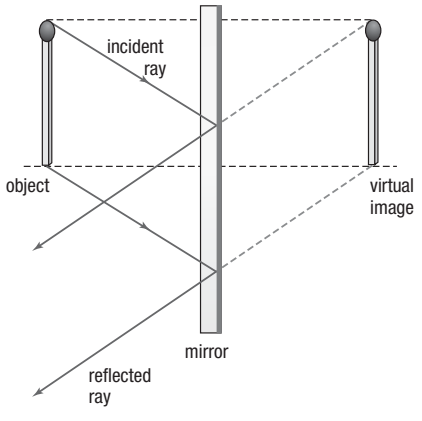
17 Learners' answers will vary. Sample answers: by a dentist to examine teeth; in microscopes.

18 Learners' answers will vary. Sample answers: **a** telescope, camera, projector, binoculars; **b** Telescope is used to see objects in space; camera is used to take photographs and videos; projector is used to magnify images and videos; binoculars are used to see distant objects.

19 The angle of incidence should be equal to the angle of reflection. Use a protector to measure the angles of incidence then draw the corresponding reflected rays.

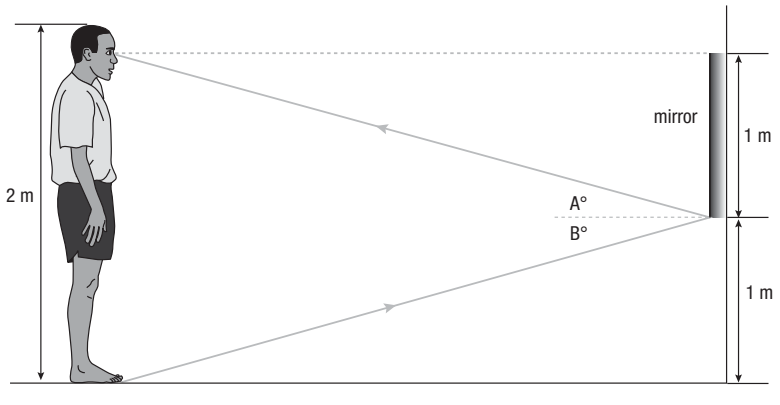


20 The distance of the image from the mirror should be equal to the object (match stick) in front of the mirror.



21 The mirror needs to be 90 cm long, placed 90 cm above the ground.

22 Diagrammatic answer required.



Extension questions

Learner's Book page 154

1. A solar eclipse occurs when the Moon passes between the Sun and the Earth, and the Sun is partially blocked by the Moon. A lunar eclipse occurs when the Sun, Earth and Moon are aligned exactly as the full Moon passes directly behind the Earth.
2. A kaleidoscope is made of two or more mirrors or reflective surfaces positioned at an angle to each other, usually forming a V-shape or a triangle. A tube or case holding a collection of objects is positioned at one end of the mirrors, and there is an eyehole at the other end.
3. An aurora is a natural light display in the sky, particularly in the Arctic and Antarctic regions, caused by the collision of energetic charged particles with atoms in the high altitude atmosphere.

Unit 8.2: Bending light

Activity 5: Measuring angle of incidence and angle of refraction

Learner's Book page 155

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate the relationship between the angle of incidence and the angle of reflection	• light box and single-slit slide • 12 volt power source • sheet of paper • ruler • polar graph paper (or protractor) • semicircular slab of Perspex	Explain to learners that as the angle of incidence increases the angle of refraction also increases but not directly proportional to each other. It is the sine of the angle of incidence that is directly related to the sine of the angle of refraction. Learners should also understand that when light travels from a more dense medium to a less dense medium, e.g. from glass to air, light bends away from the normal. Light is refracted towards the normal when travelling from a less dense medium to a more dense medium, e.g. from air to water.	**1** Because you can see the angle of incidence and angle of reflection **2** The angle of incidence should be more than the angle of refraction when light travels from a less dense medium to a denser medium. **3** Refer to learners' responses. The graph of angle of incidence against angle of refraction is not straight, showing that the relationship between the angle of incidence and the angle of refraction is not linear. **4** The graph would have a different line (less steep) compared to the less dense medium. The angle of refraction for a more dense medium is much smaller than the angle of refraction for a less dense medium. This will give a much less steep line.

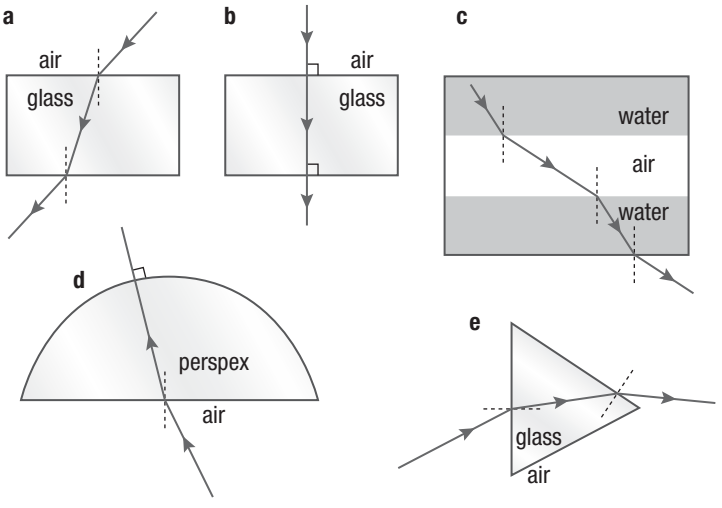
Answers

Unit questions

Learner's Book pages 157–158

1. Refraction is the bending of a light ray as it passes into a different substance.
2. Learners' answers will vary. Sample answer: objects immersed in water appear bent when viewed from the air.
3. Optical density
4. Bike reflectors are shaped (cut) at the back to ensure the angle of the incoming light is greater than the critical angle where total internal reflection occurs.
5. **a** The light ray will refract away from the normal; **b** Total internal reflection will occur.

6 **a** Refer to the Learner's Book, page 158, for the diagrams.
b The dotted lines in each diagram are the normal.
c Diagrammatic answer required.



Extension question

Learner's Book page 158

Learners should be able to see the coin as the angle of the ray to the eye moves away from the normal when it goes from the water to the air.

Unit 8.3: Lenses and curved mirrors

Activity 6: Images in a convex lens

Learner's Book page 162

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate the images formed by different convex lenses	• convex lens • white card or screen • Plasticine or lens holder • metre ruler • candle or small globe with power supply	Tell learners that a convex lens is sometimes called a converging lens. An incoming ray parallel to the principal axis is refracted through the principal focus (F). Images that form from a convex lens can be either real or virtual, depending on the position of the object. Real images are inverted while virtual images are upright.	**1** When bringing the object closer to the lens, the real inverted image will increase in size or magnify. If you move the object closer than the principal focus, the image will be upright and is virtual. **2** **a** A real image is formed when the object is beyond the principal focus. **b** A virtual image is formed when the object is between the principal focus and the pole. **c** No image is formed when the object is on the principal focus. **3** The same pattern of the image position will be observed except for their distances.

Activity 7: Images in a concave lens

Learner's Book page 162

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate the images formed by different concave lenses	• concave lens • white card or screen • candle or light globe and power source	Tell learners that a concave lens is sometimes called a diverging lens. An incoming ray parallel to the principal axis is refracted so that it appears to come from the principal focus (F) and diverge (spread apart). A concave lens can only form virtual images that are upright and smaller than the object.	**1** Only a virtual, reduced-in-size image can be formed. The position of the virtual image will be focused on the screen when the screen is placed between the lens and the object. This image is always smaller than the object. **2** The upright virtual image is between the principal focus and the lens. The image can vary in size but is always smaller than the object.

Activity 8: Telescopes and microscopes

Learner's Book page 163

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate how the telescope and the microscope form images	• two convex lenses—one thin (e.g. focal length 25 cm) and one thick (e.g. focal length 5 cm) • cardboard • scissors • tracing paper or other transparent material (e.g. thin plastic from a shopping bag) • lamp • small object to view	Tell learners that in a telescope a thin lens (objective lens) focuses on a distant object and forms a real image on the principal focus near the eyepiece lens; the thick lens (eyepiece), then forms the virtual image at the principal focus near the objective lens. There are two images formed in the telescope: the upright image near the objective lens is a virtual image and the inverted image near the eyepiece lens is a real image. The two images are formed on the principal focus of each lens. In a microscope, the objective lens forms a real image inside the focal length and the eyepiece lens then magnifies the first image to produce a final virtual image.	**1** The telescope is used to view far-away (distant) objects such as stars and planets, while the microscope is used to view very small objects such as cells. **2** Removing the screen will remove the real image but the virtual image will be seen on the principal focus of the eyepiece.

Activity 9: Constructing a field telescope

Learner's Book page 163

Processes and skills	Resources	Teacher's support notes
Construct a portable telescope using cardboard tubes	• two convex lenses—one thin (e.g. focal length 25 cm) and one thick (e.g. focal length 5 cm) • cardboard tubes • scissors	Explain to learners that the lens at the far end of the telescope is an objective lens and should have a long focal length. This lens should be a thin one. The eyepiece lens should have a short focal length and should be thick. The alignment of this lens is very important in a telescope.

Activity 10: Curved mirrors

Learner's Book page 164

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate the images formed by convex and concave mirrors	• convex mirror • concave mirror • candle • screen • Plasticine	Tell learners that convex mirrors form only virtual images. Images are always upright and smaller than the object. Concave mirrors can form both real and virtual images, depending on the position of the object from the mirror.	**1 a** Concave: the real image will increase in size (magnify) and remain upright. **b** Convex: the image will increase in size but not bigger than the object. The image is always virtual, upright and smaller than the object. **2** Images in the concave mirror can be real and virtual. The convex mirror only gives virtual images.

Activity 11: Lenses and a light box

Learner's Book page 165

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate the refraction of light through various lenses	• light box • multiple-slit slide • 12 volt power supply • light box lenses set • sheet of paper	Tell learners that refraction is the bending of a light ray towards or away from the normal. It always happens when a ray of light travels from a denser to a less dense medium or vice versa. Refraction can be described as the increase in speed or decrease in speed when travelling from one medium to another. Bending away from the normal means the speed is increasing, while towards the normal means the speed is decreasing.	**1 a** Convex lens: rays converge and come together to a point known as the principal focus (F). **b** Concave lens: rays diverge and spread apart from the principal focus (F). **2** The distance of the principal focus (F) from the convex lens—known as the focal length (f)—is shorter for the wide lens compared with the thin lens. **3** The rays that go through the optical centre (pole) of the lens are unaffected. They travel straight through. **4** Refer to learners' observations and responses.

Answers

Unit questions

Learner's Book pages 165–167

1 **a** Concave lens; **b** Plano concave lens; **c** Bi-convex lens; **d** Plano concave; **e** Plano convex

2 **a** Converging lens; **b** Diverging lens

3 Diagrammatic answer required. Both diagrams should demonstrate the following rules: firstly, a ray from the object parallel to the principal axis is refracted through F; secondly, a ray that is incident to the pole (optical centre) is unaffected and is moving straight through. The point where the two refracted rays meet is where the image should be.

4 The correct statements are:

a *Virtual* images formed by convex lenses are always bigger than the original object.

b Virtual images formed by convex lenses are always bigger than the original object.
c Concave lenses can form only virtual images.
d Images in a concave lens are always the right way up.
e *Virtual* images in a concave lenses are always the right way up.

5 Learners' answers will vary. Sample answer: microscope, telescope.
6 If binoculars did not contain triangular prisms, the images seen would be inverted.
7 Convex and concave. Refer to diagrams in Fig. 8.3.1 on page 159 of the Learner's Book. In a convex mirror, the side that curves outwards is mirrored. In a concave mirror, the side the curves inwards is mirrored.
8 Concave
9 **a** A thick lens produces a short focal length and a small-sized image; **b** A thin lens produces a much longer focal length and a large-sized image.
10 **a** Convex lens: magnified real image is formed inverted; **b** Concave lens: diminished upright virtual image is formed
11 Convex lens; the 'hot spot' on the paper is the principal focus
12 The slide must be upside down in a projector, so that when it is projected to the screen it will appear upright.
13 We see real images in movies because light rays go through the images.
14 **a** Convex mirror; **b** Concave mirror
15 Large virtual images can be achieved when the object is on the focal length (between F and the pole). A distant object such as the Moon cannot be placed on the focal length of the lens.
16 The thin lens should be used for the objective lens and the thick one for the eyepiece.
17 **a** Similarities: used to view distant objects; **b** Differences: telescopes use lenses, while binoculars use prisms
18 Short-sightedness: concave lens; long-sightedness: convex lens
19 You can use a convex lens to focus an image of the Sun by placing paper or sawdust on the principal focus of the lens.
20 The magnification (M) can be calculated using this formula: M = image height ÷ object height. Note: in the last row, the measurements need to be converted to the same unit, i.e. 80 mm/160 mm or 8 cm/16 cm.

Object height	Image height	Magnification
2 cm	6 cm	3
5 cm	20 cm	4
25 mm	5 mm	0.2
16 mm	4 mm	0.25
8 cm	160 mm	2

Extension questions

Learner's Book page 167

Questions **1** and **2** are optional because they require learners to find information from other sources, which may be difficult for schools without a library. If learners are able to complete the investigations, organise them to work in groups and present their findings to the class.

3 The thicker the lens, the shorter the focal length.
4 Yes, it does matter that the lens is hollow inside. An incident ray will then have four interfaces at which refraction will take place: from air to the glass or Perspex surface of the lens; from the lens to the air inside the lens; from this air to the inner surface of the lens; and from the outer surface of the lens to the air. Learners should design an experiment that will show differences between the solid and hollow lenses by determining the focal lengths for the lenses and examining the type, orientation and position of the images produced.

Unit 8.4: Colour

Activity 12: Dispersion: splitting white light

Learner's Book page 168

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate the dispersion of a beam of white light into a spectrum using a triangular prism	• triangular glass or Perspex prism • light box and power supply • slide with single slit • white paper	Explain to learners that white light can be split into colours, known as the visible spectrum. White light contains many colours, but the seven main ones are the colours of the rainbow: red, orange, yellow, green, blue, indigo and violet. The colours can be displayed by shining the white light through a triangular prism.	**1** **a** Violet; **b** Red. **2** The colours can be recombined using two prisms.

Answers

Unit questions

Learner's Book pages 170–171

1 Triangular prisms

2 **a** Red, orange, yellow, green, blue, indigo, violet; **b** Learners' answers will vary. Sample answer: Rose owns yellow geese back in Vietnam. (The first letter of the words in the sentence are the same as the first letters of the colours.)

3 **a** Scattering—particles of gas and dust alter the direction of light rays; **b** Blue coloured light is scattered the most.

4 At sunset and sunrise, the Earth is furthest from the Sun, so sunlight travels further through the atmosphere. By the time the light reaches Earth, almost all the blue rays have been scattered and the light that reaches us is mainly red or orange.

5 Water molecules have non-parallel sides that refract light and behave like prisms in the sky, splitting the white light into different colours.

6 A primary rainbow has red at the top and blue at the bottom; a secondary rainbow is the opposite, with blue at the top and red at the bottom.

7 **a** Red, blue, green; **b** Cyan, magenta, yellow

8 Complementary colours are those that mix to form white light, e.g. red and cyan; green and magenta; blue and yellow.

9 **a** Magenta; **b** Red

10 Learners' diagrams should show that:
- **a** the green filter will absorb all the colours except green, which will pass through
- **b** the green filter will absorb the blue light and nothing will pass through
- **c** the green filter will absorb the blue in the cyan light and only green light will pass through.

11 **a** Blue; **b** Green; **c** Black

12 Cyan, magenta, yellow, black

13 Magenta and yellow

14 Diagram C

15 Various combinations of coloured spots called phosphors are made to glow by electron beams. Our eyes merge these to produce colour images.

16 Light energy is converted to heat in the filter.

17 B would be confused with blue, so the last letter of the word 'black' is used instead.

18 a

blue
black
black

b

red
green
blue

Extension questions

Learner's Book page 171

1 Learners' answers will vary.
2 Learners' answers will vary.
3 Learners' answers will vary.
4 Learners' answers will vary.
5 Learners' answers will vary.

Activity 13: Mixing colours

Learner's Book page 172

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate the mixing of coloured light using various combinations of coloured filters	• light box and power supply • variety of coloured slides • white paper	Explain to learners that the colours that are different from the colours of the rainbow are the results of mixing of colours, e.g. brown, pink and purple. **Table 1 results:** Magenta Yellow Cyan White White White **Table 2 results:** White White	**1** **a** Blue; **b** Red **2** The results may not have been perfect and the white light not quite white due to any of the following factors: dust on the mirrors and/or light source, colour in the paper, imperfect colouring of slides, colour in the light source.

Activity 14: Seeing things in a different light

Learner's Book page 173

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate the colour of objects when viewed under different coloured lights	• light box and power supply • variety of coloured slides • variety of coloured cards	Explain to learners that the colours that you see in your eyes are the colours that reflect into your eyes. For example, when you see a red flower, the red coloured light reflects into your eyes. The rest of the colours of the rainbow are absorbed by the flower. When you see a white shirt, all the coloured light reflects into your eyes, nothing is absorbed by the shirt. When you see a black shirt, all the coloured light is absorbed into the shirt. No coloured light is reflected into your eyes.	**1** **a** Red, magenta, yellow; **b** Blue, green, cyan **2** This is a subjective question. Look for justification of the learners' responses. **3** The coloured cards and the coloured slides may look a different colour in varying coloured light than they do in white light, so labels help to identify the cards. **4** Dark colours rather than pitch black may be seen due to white light leaking from the light box or from other sources within or outside the room.

Chapter review

Answers

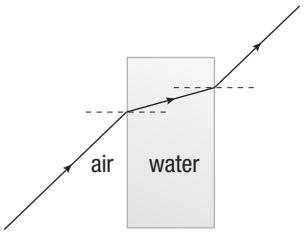
Learner's Book pages 174–175

1 When a light ray travelling in air strikes a glass boundary, it bends *towards* the normal. The speed of the ray in the glass is *less* than it is in air.

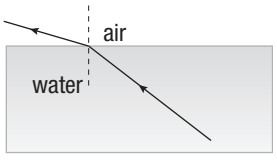
2 **a** True; **b** True; **c** True (an example is when light enters warmer air from colder air); **d** False; **e** True

3 Communications and medical equipment

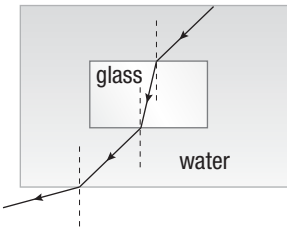
4 **a**



b



c



5 **a** Light travelling along inside an optical fibre undergoes several internal *reflections*.

b Learners' answers will vary. Sample answer: Optical fibres are used in endoscopes. These flexible tubes contain optical fibres and can be passed through the mouth into the digestive system to provide doctors with images (magnified about four times) of the stomach and intestinal lining. Optical fibres can also be used instead of copper wire to transmit data and communications.

c Learners' answers will vary. Sample answer: Endoscopes provide accurate and realistic images to help doctors diagnose and treat medical conditions. In communication, more information may be carried and there is increased data security.

6 **a** Cyan; **b** Green

7 **a** Virtual; **b** Virtual

8 Learners' answers will vary. Sample answer: Concave mirrors, such as those used in some shaving and make-up mirrors or by dentists, produce an enlarged or magnified virtual image of an object placed close to the mirror. Convex mirrors, such as those used at dangerous intersections, in shops and in rear-vision mirrors in vehicles, provide a wider view.

9 **a** Concave: b, d, e; **b** Convex: a, b, c, d, f

10 Refer to Fig. 8.3.2 on page 159 of the Learner's Book for an indication of the requirements for the ray diagram for convex mirrors. Only a virtual image can be formed using a concave lens, which makes part (a) of this question impossible.

11 **a** Real, same size, inverted; **b** Real, diminished, inverted; **c** Virtual, enlarged, upright; **d** Virtual, diminished, upright

12 Eyepiece and objective. Both lenses are convex (thin for objective and thick for eyepiece).

13 **a** The objective lens forms a real image and the eyepiece lens then magnifies this image to produce a final virtual image.
b A convex mirror provides a view of the whole shop.
c Binoculars consist of two telescopes (which consist of lenses) and use triangular prisms to redirect the light and ensure images are the right way up.
d A concave mirror reflects the light from a bulb through condenser lenses, which concentrate the light to pass it through a slide and then through the projection lens, which produces a magnified real image on a screen.

14 Learners' answers will vary. Sample answers: **a** Projector; **b** Microscope.

15 Refer to learners' responses. Diagrams should be coloured according to the labels.

16 **a** Orange; **b** Blue; **c** Violet

17 **a** One; **b** Two

18 The red light that is left to be scattered is scattered more dramatically by the greater number of particles in the atmosphere.

19 Learners' diagrams should show that:
a the blue filter will absorb all the colours in the white light except blue, which will pass through
b the red filter will absorb the blue component of the magenta light and red light will pass through
c the cyan filter will absorb the red component of the yellow light and only green light will pass through
d the blue filter will absorb all the colours in the white light except blue, which will pass through. Then the green filter will absorb the blue light, so nothing will pass through.

20 **a** Black; **b** Black; **c** Green

21 Green

22 Red

Chapter 9: Elements, compounds and mixtures

Strand: Natural and processed materials

Suggested class time: 12 periods

Sub-strand statement

This sub-strands deals with elements, compounds and mixtures. An element is a pure substance that contains only one kind of particle. A compound is a substance that contains two or more elements that are chemically joined together. A mixture is a substance that also contains more than one element or material but they are not joined chemically. Mixtures can be separated physically by various methods depending on the type of mixture. While compounds cannot be separated physically, they can be separated through chemical means.

General learning outcomes

Learners should:

7.9.1 Know that an element consists of only one kind of particle.

7.9.2 Know that elements are either metals or non-metals.

7.9.3 Know that a compound is a substance formed by combining two or more elements chemically.

7.9.4 Be able to show that a mixture is made from two or more substances but they are not chemically combined.

7.9.5 Be able to separate mixtures by physical methods.

7.9.6 Understand that compounds can only be separated by chemical processes.

7.9.7 Appreciate the ability of elements to form compounds.

Specific learning outcomes

Learners should be able to:

7.9.1.1 Give some examples of elements in the environment:

- **i** aluminum—aluminium cans, aluminium boats, aluminium foil
- **ii** gold—gold earrings, gold wedding rings, gold medals
- **iii** silver—silver coins, silver medals
- **iv** iron—reinforcing rods, roofing sheet, scrap metal

7.9.2.1 Give examples of metal and non-metal elements:

- **i** metals: aluminum, iron, copper
- **ii** non-metal: carbon, oxygen, chlorine

7.9.3.1 Identify examples of common household compounds: water, salt, sugar, washing powder, soap, etc.

7.9.4.1 Produce mixtures from common substances: coffee and sugar, water and sugar, gravel and sand, water and lemon, etc.

7.9.5.1 Separating mixtures using different physical methods: evaporation (salt and water), filtration (mud and water).

7.9.6.1 Illustrate that it is difficult to separate a compound once it is formed: flour, sugar, yeast and water from bread.

Answers

Suggested assessment activity

1 **a** Mixture; **b** Compound; **c** Mixture; **d** Compound; **e** Compound

Challenge questions

Learner's Book page 176

1 Iron
2 Cl
3 No
4 Ashes and carbon dioxide
5 To prevent them from spoiling
6 The same tablet crushed
7 False

Unit 9.1: Elements, compounds and mixtures

Activity 1: Flame tests

Learner's Book page 179

<table>
<tr><th>Processes and skills</th><th>Resources</th><th>Teacher's support notes</th><th>Answers to questions</th></tr>
<tr>
<td>Identify various elements using the flame test</td>
<td>• paperclips
• tongs
• Bunsen burner
• heat-proof mat
• beaker of water
• various chloride salts (e.g. strontium chloride, sodium chloride, copper chloride, potassium chloride)
• watch-glass</td>
<td>When elements burn, they produce characteristic flame colours.

In this activity, learners observe while the teacher burns samples of elements. Learners record the resulting flame colours.

CAUTION: This should be done as demonstration only.</td>
<td>1
<table>
<tr><th>Element</th><th>Symbol</th><th>Flame colour</th></tr>
<tr><td>Sodium chloride</td><td>NaCl</td><td>Bright yellow</td></tr>
<tr><td>Copper chloride</td><td>$CuCl_2$</td><td>Bluish</td></tr>
<tr><td>Strontium chloride</td><td>$SrCl_2$</td><td>Red</td></tr>
<tr><td>Potassium chloride</td><td>KCl</td><td>Purple</td></tr>
</table>
2 Sodium chloride: sodium; copper chloride: copper; strontium chloride: strontium; potassium chloride: potassium.
3 The presence of the characteristic flames of the elements indicate the elements in the compound.
4 Contamination of the water and paperclip with previous elements may falsify the constituent elements in the compounds that are tested later.
5 The technique can be used to identify elements in an unknown compound and hence determine the identity of the compound.</td>
</tr>
</table>

Activity 2: Mathomat molecules

Learner's Book page 181

Processes and skills	Resources	Teacher's support notes	Answers to questions
Construct diagrams of molecules	• Mathomat OR • green fruits of different sizes • midrib from coconut OR • different coloured circles	Different sizes of fruits can be used to represent different types of atoms (elements). Different coloured circles can also be used to represent different atom types (elements). **Note:** Make sure that learners understand that these constructions are only models. A single atom or molecule is too small to see with our own eyes. Millions of atoms group together to form what we see and touch.	Learners can build models of the molecules given in the table on page 182 of the Learner's Book.

Activity 3: Breaking down substances

Learner's Book page 182

Processes and skills	Resources	Teacher's support notes	Answers to questions
Identify elements in various substances	• small samples of various materials (paper; plastic straw; aluminium foil; wood, e.g. toothpick; cloth; green leaf; wool; cotton wool; bread) • Bunsen burner • heat-proof mat • metal tongs • safety glasses • squares of contact adhesive to stick samples into workbook OR • open fire • tongs made of wire or bamboo	Burning is a reaction of materials with oxygen in the air, giving soot, which is the element carbon. All organic materials contain carbon. When paper is burnt, oxygen reacts with it, giving carbon dioxide, water and carbon as excess materials that result from incomplete combustion.	Refer to learners' responses.

Answers

Unit questions

Learner's Book page 183

1 An element is a pure substance containing only one type of atom. It cannot be broken down into any other substances.

2 By heat or the action of other chemicals

3 92

4 Oxygen and silicon

5 Properties of metals: solid at room temperature (except for mercury), shiny, high melting point, high density, malleable (able to be shaped), ductile (able to be stretched into wire), good conductor of heat and electricity

6 Learners' answers will vary. Sample answer: copper—electrical wire, gas pipes, coins, alloys; iron—pipes, nails, bridges, ships.
7 Properties of non-metals: solid, liquid or gas; dull; low melting point; low density; brittle; not ductile; poor conductor of heat and electricity
Uses: Learners' answers will vary. Sample answer: carbon—bicycle frames, filters, graphite for fishing rods and pencils; nitrogen—fertilisers, explosives.
8 An atom is the smallest piece of a substance that still has the properties of that substance.
9 An atom is the smallest piece of an element. An element is made up of identical atoms, e.g. the element carbon is made up of carbon atoms.
10 A compound is a substance that is made up of different kinds of atoms that are chemically combined, or bonded, together.
11 Molecular, e.g. water, which is made up of hydrogen and oxygen; and lattice, e.g. sodium chloride (table salt), which is made up of sodium and chloride
12 A mixture contains two or more substances (elements or compounds) that are mixed together but are not chemically bonded.
13 Elements contain only one type of atom; compounds are made of elements chemically combined; mixtures can contain elements and/or compounds that are not chemically combined.
14 Answers will include three of the following: Carbon (C), calcium (Ca), copper (Cu), chlorine (Cl), chromium (Cr).
15 Answers will include six of the following: Hydrogen (H), boron (B), carbon (C), nitrogen (N), oxygen (O), fluorine (F), iodine (I), potassium (K), sulfur (S), uranium (U), tungsten (W).
16 Answers will include two of the following: Sodium (Na), potassium (K), iron (Fe), tungsten (W), tin (Sn), gold (Au), lead (Pb), mercury (Hg), silver (Ag).
17 **a** Neon; **b** Phosphorus; **c** Lithium; **d** Magnesium
18 **a** H; **b** He; **c** S; **d** Na
19 **a** Mixture; **b** Compound; **c** Mixture
20 Silicon dioxide (sand) and sodium chloride (table salt)
21 **a** Ship's hull: metal, strong, malleable; **b** Fishing rod: non-metal, light, non-conductor of electricity; **c** Electrical wires: metal, malleable, ductile, conducts electricity; **d** Barbecue hot plate: metal, conducts heat, malleable
22 Diagrammatic answer required. Learners' answers will vary but may be similar to the models of molecules in Fig. 9.1.9 on page 180 of the Learner's Book.
23 **a** Metal: aluminium; **b** Non-metal: oxygen; **c** Metal: copper; **d** Metal: mercury

Extension questions

Learner's Book page 183

a Learners' answers will vary. Sample answer: Gold has been known for thousands of years. There is no known date for the first discovery of gold, but there is evidence of it being used as early as 1400 BC in Egypt.
b Learners' answers will vary. Sample answer: Gold is used for jewellery, money, medicine and in electronics, because it is highly conductive.
c Learners' answers will vary. Sample answer: Gold is found in ores. The ore is mined then the gold extracted and purified.
d Learners' answers will vary. Sample answer: Safety issues relating to gold are mainly associated with mining operations used to extract the element. Gold is inherently safe and is used in dentistry and in some medications that are swallowed.
e Learners' answers will vary. Sample answer: Gold is heavy, dense, soft and malleable, and has a bright and shiny surface.

Chapter review

Answers

Learner's Book page 183

1 **a** K; **b** Na; **c** Cl; **d** Ar

2 Learners' answers will vary. Sample answers:
Properties of metals: solid at room temperature (except for mercury), shiny, high melting point, high density, malleable (able to be shaped), ductile (able to be stretched into wire), good conductor of heat and electricity.
Properties of non-metals: solid, liquid or gas; dull; low melting point; low density; brittle; not ductile; poor conductor of heat and electricity.

3 Mercury

4 Molecular and lattice

5 Two hydrogen atoms and one oxygen atom

6 Learners' answers will vary. Sample answer: Compounds are made of elements that are chemically combined. Mixtures can contain elements and/or compounds that are not chemically combined.

7 A substance that is malleable is able to be shaped.

8 Atoms can link together in small groups to form new substances called compounds. Millions of compounds are possible because there are so many ways the 100 or so different types of atoms can be combined.

Chapter 10: Living structures and plant reproduction

Strand: Life and living

Suggested class time: 12 periods

Sub-strand statement

This sub-strand deals with living structures and processes. All living things grow, reproduce and respond to their environment. Reproduction is the process in all living things that enables continuation of life. There are two kinds of reproductive systems: asexual and sexual. Asexual reproduction involves one parent and sexual reproduction involves two parents. Animals and plants have special systems for reproductive functions. In flowering plants the flower is the reproductive system which produces fruits and seeds. Seeds germinate to make new plants.

General learning outcomes

Learners should:

7.10.1 Know that there are two kinds of reproduction.
7.10.2 Know forms of asexual and sexual reproduction.
7.10.3 Be able to show that a flower is the reproductive part of a plant.
7.10.4 Know that seeds are parts of the plant that will germinate and grow into new plants.
7.10.5 Appreciate that seed dispersal contributes to plant distribution.
7.10.6 Be able to show germination in a plant.
7.10.7 Understand that plant reproduction has stages.

Specific learning outcomes

Learners should be able to:

7.10.1.1 Identify some living things that reproduce:
- **i** sexually—human, fish, mango
- **ii** asexually—banana, potato, slippery cabbage.

7.10.2.1 Identify living organisms that reproduce asexually by: budding, splitting, vegetative regeneration, spores.
7.10.2.2 State that in sexual reproduction each parent (male and female) produces special sex cells that join together to form a new organism.
7.10.2.3 Name some animals that reproduce sexually by:
- **i** externally—fishes, frogs
- **ii** internally—humans, birds, snakes.

7.10.3.1 Perform dissection of a flower to identify the reproductive parts, e.g. hibiscus flower.
7.10.4.1 Identify parts of a seed as: testa, cotyledon, embryo, plumule, radicle.
7.10.5.1 Identify a range of seed dispersal methods: wind, animal, water, explosion.
7.10.6.1 Carry out the germination process of corn and bean seeds (hypogeal and epigeal).
7.10.7.1 Draw the sequence of events in the life cycle of a plant:
- **i** mature plant
- **ii** flowering
- **iii** pollination and fertilisation
- **iv** seeding
- **v** germination
- **vi** new young plant develops

Answers

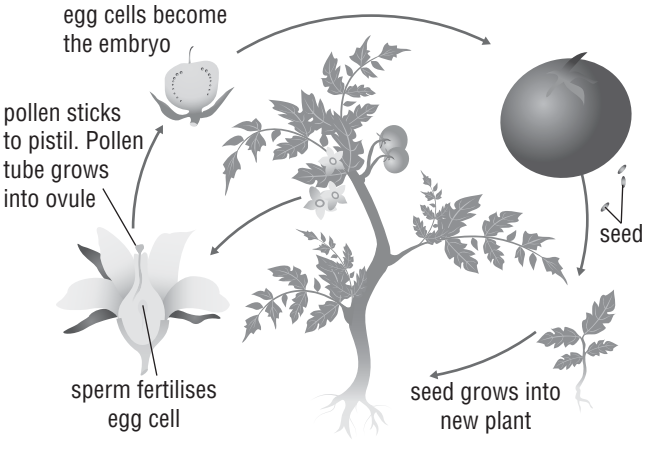
Suggested assessment activity

1 **a** Bacteria: fission; **b** Yeast: budding; **c** Fern: spores; **d** Starfish: fragmentation and regeneration

2 Advantage: no need for two parents.

3 The male part is called the stamen. The stamen contains small stalks called filaments. On the ends of the filaments are anthers, which produce pollen grains. Pollen grains are the male cells that will fertilise the female cells.
The female part is called the carpel. At the top of the carpel is the stigma. The stigma is sticky and is ready to catch pollen grains. The stigma is connected to the ovary by the style. Inside the ovary are the ovules containing the eggs (ova).

4



Challenge questions

Learner's Book page 184

1 One parent is needed for asexual reproduction; two parents are needed for sexual reproduction.

2 A plant or animal that has both male and female reproductive organs and produces both types of sex cells

3 Because of the environment they live in

4 The seed absorbs water and swells up; this causes the testa to split, enabling the radicle (young root) and the plumule (young shoot) to grow out of the seed. The radicle grows down into the soil to anchor the plant; the plumule opens up and starts to absorb sunlight and make its own food by photosynthesis.

5 Dispersal through water (the seeds fall into and are carried by water); wind (the seeds fall out of the fruit and are carried by wind); explosion (the fruit splits open suddenly, throwing out the seeds); and animals (the fruits and seeds are eaten by animals and later pass out in their droppings; these seeds may be carried a long way).

Unit 10.1: Types of reproduction

Answers

Unit questions

Learner's Book pages 188–189

1 **a** Budding, spores, fission; **b** Budding is when a new organism forms, attached to an old one. Spores are released and reproduce when the environment is appropriate. Fission is when a cell divides in two.

2 Bacteria: fission; yeast: budding; ferns: spores; starfish: fragmentation and regeneration.

3 Spores are tough, light in weight, sticky and float in water and can therefore be easily carried by the wind, water and animals.

4 Learners' answers may vary. Sample answer: Spores are brushed onto fur and brushed off elsewhere.
5 Vegetative reproduction is when a new plant is produced from parts of a plant, e.g. cuttings of stems (cassava), bulbs (onion), tubers (potato).
6 Sexual reproduction makes it likely that some organisms will have characteristics that will help them survive.
7 Fertilisation is the successful fusing of two gametes.
8 A hermaphrodite has both male and female reproductive organs.
9 Sperm: produced by male sex organ (testis); ova: produced by female sex organ (ovary).
10 Male and female gametes must be released at the same time; gametes properly formed and fully developed; environment must be right.
11 The correct statements are:
   a The release of an ovum by the female is called *ovulation*.
   b *Only a few* fertilised eggs survive to maturity.
12 Nectar is deep inside the flower to encourage insects to enter the flower, because the pollen gets brushed onto and off them in the process.
13 Learners' answers will vary. Sample answers: internal fertilisation—the gametes and the embryo are more protected, receive sufficient nourishment, fewer are born. External fertilisation—they are more vulnerable to the external environmental conditions and predators, large number of offspring, not all offspring survive.
14 The correct statements are:
   a In asexual reproduction, *one parent* is needed.
   b Fission is a type of *asexual* reproduction.
   c If the daughter cell is identical to the parent cell, a mutation has *not* occurred.
15 No, clones do not always look like their parents. Natural mutations occur and the environment also has an influence.
16 Organisms that reproduce by spores release millions of spores from time to time. These can be spread over a great area, increasing the chance of survival. Organisms that reproduce by budding only produce one or two new organisms at a time.
17 They still have normal life spans and cannot always regenerate—for example, if they lose too much of a body part.
18 Human body temperature—37°C—suits them best.
19 **a** The cutting can develop into a new plant by the cells in the cutting splitting into exact replicas, called daughter cells.
   b Vegetative reproduction.
20 This flexibility enables them to survive in different environments.
21 Learners' answers will vary. Sample answer: In asexual reproduction, there is no change in the offspring.
22 Learners' answers will vary. Sample answer: Cloning could be used for the wrong purpose, e.g. to produce humans.
23 **a** 4; **b** 64; **c** 4096; **d** 17 179 869 184.
24 Producing a very large number of offspring increases the chances that at least one will survive.

Extension questions

Learner's Book page 189

1 Refer to learners' responses.
2 **a** Vegetative reproduction is used in agriculture to produce new plants that are genetically identical to the parent plant, e.g. banana suckers, sugar cane stems. This is important in agriculture in Solomon Islands where better quality plants are planted to produce many suckers or tubules. These suckers or tubules are distributed to farmers to plant.

b Refer to learners' responses.
c Refer to learners' responses.

Activity 1: Asexual reproduction in plants

Learner's Book page 190

Processes and skills	Resources	Teacher's support notes	Answers to questions
Examine and identify asexual reproduction in plants	• an onion and a potato with eyes • knife OR • other plants could be substituted for the onion and potato, e.g. strawberry runners, Chinese willow-stem cuttings or orchid bulbs	In this activity, learners will examine asexual reproduction in a potato and an onion. The teacher must do a demonstration before allowing learners to do this activity on their own.	**1** The creation of new individuals is considered reproduction, and the absence of sex cells fusing makes it asexual. **2** You would expect the eye of the potato to grow. However, the rest of the potato is the food supply to the eye, so it is more likely to grow if it remains attached to the potato.

Activity 2: Examination of spores

Learner's Book page 190

Processes and skills	Resources	Teacher's support notes	Answers to questions
Examine spores using a stereo microscope	• stereo microscope • fern leaf with visible spores • tweezers • filter paper	The activity will help learners to make systematic observations of a fern leaf to examine the spore vessels. The teacher must help the learners to identify the spores and count the number of spores observed. Remind the learners of the skills of using a microscope.	**1** Learners' answers will vary, but it is most likely very difficult due to the resilient nature of spores. **2** Learners' answers will vary, but many spores are usually contained in each spore vessel. **3** Fern spores should be easily spread due to their small size as they are light enough to be carried by even a gentle breeze. **4** Wind, water, animals

Unit 10.2: Plant reproduction

Activity 3: How do flowers vary in their structure?

Learner's Book page 191

Processes and skills	Resources	Teacher's support notes	Answers to questions
Examine the structure of different flowers	• dissecting instruments • hand lens • two large flowers of different types, e.g. sweet pea, lily, lemon, orchid, pawpaw, hibiscus, frangipani	Learners will examine the structure of different types of flowers.	**1–5** Learners' answers will vary depending on the type of flowers.

Activity 4: Flower dissection

Learner's Book page 192

Processes and skills	Resources	Teacher's support notes	Answers to questions
Examine the reproductive parts of a flower	• dissecting instruments • hand lens • large flower, e.g. hibiscus, bush lime, pawpaw, bean, tomato, helicon, orchid, lily	Learners will dissect flowers of different plants to observe their reproductive parts. The teacher must help the learners to identify the male and female reproductive parts of the flowers.	**1** Learners' answers will vary, but fertilisation is more likely in flowers whose anthers are close to the stigma or large amounts of pollen. **2** **a** The size, structure and location of the parts will vary slightly but all will be present. **b** Sexual reproduction

Answers

Unit questions

Learner's Book page 193

1 A flower is the reproductive part of a flowering plant.

2 Learners' answers will vary, but diagrams should be similar to Fig. 10.2.1 on page 191 of the Learner's Book.

3 Petals: attract insects to flower for pollination; sepals: protect the young flower when it is folded up in a bud; stigma: receives and catches pollen grains; anthers: produce pollen grain; ovary: contains ovules.

4 To attract insects for pollination

5 Stamen; anthers produce pollen grain

6 Carpel; ovules produce eggs (ova)

7 In flowering plants, the sperm are produced in the male parts of the flower called *anthers*. They are carried inside *pollen* grains to the female *cells*, a process called *pollination*. After fertilisation, the bottom of the carpel swells to form the *fruit*. The ovules form the *seed*.

8 Petals are the coloured parts of the flower and sepals are the green parts that protect the flower in bud. The stamen is the male part of the flower and the carpel is the female part.

9 It helps to transfer pollen grains from the anthers to the stigma.

10 Pollination is the transfer of pollen from the anthers to the stigma. It can occur by wind, insects or water.

11 The cells in the ovary go through cell division (mitosis) to form a fruit.

12 When a pollen grain lands on the stigma, a pollen tube grows out of the pollen grain down into the stigma. The tube grows down until it reaches the ovary. Inside the ovary are ovules, each of which contains a female gamete (egg cell or ovum). The male gamete (sperm cell) inside the pollen grain travels down the tube and fertilises a female gamete by joining with it.

13 Pollination is when the pollen grain transfers from the anther to the stigma. Fertilisation is when the male gamete (sperm cell) transfers from the stigma to the ovary and fuses with a female gamete (egg cell or ovum). Learners' sketches may be similar to Fig. 10.2.2 and 10.2.3 on page 192 of the Learner's Book.

14 Learners' answers will vary. Sample answers:
Insect-pollinated flowers: large and brightly coloured; produce scent and nectar; pollen grains spiked or sticky.
Wind-pollinated flowers: small and not colourful; no scent or nectar; large amount of light pollen produced.

15 Brightly coloured flowers and nectar help to attract insects for pollination.

Unit 10.3: Fruits and seeds

Activity 5: Seed dispersal activity

Learner's Book page 195

Processes and skills	Resources	Teacher's support notes	Answers to questions
Classify fruits and seeds according to the way they are dispersed	• about 10 different types of fruits and seeds • hand lens	Seeds may be dispersed to avoid overcrowding at one particular location. Learners should be able to identify how different seeds are able to disperse to certain locations.	**1–4** Learners' answers will vary, depending on the seeds and fruits they observe. Some examples are: Wind dispersal: kapok, dandelion, thistle, sycamore. The seeds fall out of the fruit and are carried away by the wind. Water dispersal: mangrove, coconut. Fruits fall into the water and are carried by flowing water to other places. Animal dispersal: all fleshy fruits, berries, bidibidi, hook grass. The fruits and seeds are eaten or partly eaten by animals and later pass out in their droppings. The fruit has hooks or barbs that attach to fur of mammals or feathers of birds. Explosion dispersal: legumes, beans. The fruit splits open suddenly and violently, throwing out its seeds.

Answers

Unit questions

Learner's Book page 195

1 The seeds grow inside fruits and nuts. Fruits and nuts are food for other living organisms.

2 The testa protects the inside of the seed.

3 To feed the young plant during germination and the early growing stages before leaves are formed

4

Seed parts	What happens to this part of the seed?
Testa	Covers the seed
Cotyledon	Stores food for the young plant or embryo
Plumule	Becomes the shoot of the young plant
Radicle	Becomes the roots of the young plant

5 The sperm from the pollen grain fuses with the egg.

6 A seed is the entire reproductive part of the plant, containing the embryo and cotyledon.

7 Flowering, pollination, fruiting, germination

8 (NOTE: This question has been wrongly numbered as 1.) Learners' answers will vary. Sample answers: flower—explosion; bean—animals; mango—animals; coconut—water; palm—water.

9 (NOTE: This question has been wrongly numbered as 2.) The spreading of seeds is called *dispersal*. When they reach favourable conditions, the seeds *germinate* to produce new plants.

10 (NOTE: This question has been wrongly numbered as 3.) Learners' answers will vary.
Sample answers:
Wind: dandelion, thistle, sycamore.
Animals: hook grass, bidibidi, all fleshy fruits, berries.
Water: mangrove, coconut.
Explosion: touch-me-not, legumes, beans.

Unit 10.4: Germination

Activity 6: What changes take place when a seed germinates?

Learners' Book page 196

Processes and skills	Resources	Teacher's support notes	Answers to questions
Identify conditions for seed germination	• five test tubes • cotton wool • bean seeds • water • dark cupboard • refrigerator	Germination can happen only in certain conditions. In this activity, learners should identify the conditions needed for seed germination and the stages in the germination process. The teacher must provide learners with the necessary information to get the appropriate results.	**1** The shoot and the roots come out of the seed. **2** Test tubes A and C **3** Test tube A **4** The seeds in both test tubes germinated quickly but A grew tall and C was short. **5** Warmth, oxygen and water

Answers

Unit questions

Learner's Book page 198

1 Epigeal germination: the cotyledon emerges from the seed coat and rises above the ground. Hypogeal germination: the cotyledon remains below ground, while the stem above the cotyledon pushes through the soil surface.

2 Germination is the restarting of growth by the embryo inside a seed. To germinate, seeds need moisture, oxygen and a suitable temperature.

3 **a** The radicle grows down into the soil to anchor the plant.
b The plumule open up and starts to absorb sunlight and make its own food by photosynthesis.
c The cotyledon provides the food for the young plant when germinating.

4 Testa splits, radicle emerges from testa, radicle grows down into the soil, hypocotyl straightens, root hairs develop, cotyledons pulled out of the soil, cotyledons exposed to sunlight.

5 Seeds need moisture, oxygen and a suitable temperature to germinate. Light is not needed for most seeds. You could test this by seeing if a seed will germinate in a dark cupboard or room.

6 In most plants, food and energy for the seeds come from the cotyledons. The cotyledon is produced from a fertilised ovum.

7 A life cycle is the sequence of events in the life of an organism.

8 Learners' answers will vary. Diagrams should be similar to Fig. 10.4.4 on page 197 of the Learner's Book.

9 Learners' answers will vary. Sample answer: seeds are released from fruit and grow into new plants; sperm fertilises egg cell; pollen sticks to pistil; pollen tube grows into ovule; egg cell becomes an embryo; embryo grows into plant and produces fruit that contains seeds.

10 For growth to occur, each plant must have adequate water, carbon dioxide and mineral salt to make food, and enough oxygen for its respiratory needs. The right conditions, such as good soil, optimum temperature and adequate sunlight, are also necessary.

Chapter review

Answers

Learner's Book page 198

1 Petal attraction, pollination, fertilisation, fruit formation, seed dispersal, germination

2 Male: stamen, pollen; female: carpel, ovule, stigma

3 Ovary

4 The correct statements are:
- **a** Pollen contains the male sex cell and is produced in the *anther*.
- **b** Pollination occurs when pollen from an anther travels and lands on the stigma.
- **c** Seeds develop after the pollen fertilises the *ovum (or egg cell or female gamete)*.
- **d** Sepals are leaf-like structures at the base of the flower.
- **e** The *sticky* substance on the stigma *catches the pollen grains*.

5 Learners' answers will vary. Sample answers:
Fission: bacteria, some algae, some fungi.
Budding: yeasts; many cnidarians such as coral, jellyfish, sea anemones.
Spores: many fungi, mosses, ferns, algae.
Fragmentation and regeneration: starfish, earthworms, mushrooms, many flowering plants.

6 Vegetative propagation is when a piece of a plant breaks off and becomes a new plant.

7 A small piece of the original plant is placed in soil until it forms roots.

8 **a** The smallest seed, which could be easily passed by an animal; **b** The seed with sharp hooks, which can stick to the fur of animals.

9 Learners' answers will vary. Sample answer:
Runners: lateral branches that arise close to the ground and grow along the surface.
Suckers: shoots that arise from the underground part of the plant and grow upwards.
Bulbs: underground, reduced stems surround by fleshy, close-set leaf base.

10 In asexual reproduction, a new organism is formed without the fusion of gametes. In sexual reproduction, a new organism is formed with the fusion of gametes.

11 Wind, water, animals, explosion

12 Cross-pollination is when pollen from one flower enters the ovule of another flower. Self-pollination is when pollen from an anther is transferred to the stigma on the same flower .

13 The seed absorbs water and swells up, enabling the radicle (young root) and the plumule (young shoot) to grow out of the seed. The radicle grows down into the soil to anchor the plant and the plumule opens up and starts to absorb sunlight and make its own food by photosynthesis.

14 Epigeal germination occurs in dicotyledon seeds such as beans and peanuts. The cotyledons emerge from the seed coat, rise above the ground, develop chlorophyll and begin to perform the function of green leaves.

15 In epigeal germination, the cotyledons emerge from the seed coat, rise above the ground, develop chlorophyll and begin to perform the function of green leaves. In hypogeal germination, the cotyledons remain below ground, while the stem above the cotyledon pushes through the soil surface.

Chapter 11: Earth and the solar system

Strand: Earth and beyond

Suggested class time: 12 periods

Sub-strand statement

This sub-strand deals with the Earth and the solar system. The solar system consists of the Sun, the planets and their moons. Numerous comets, asteroids and meteors are also found in the solar system. The Sun is the centre of the solar system. It is the source of energy in the form of heat and light supplied to the planets. The Earth is one of those planets. Each planet moves or orbits in its own path around the Sun. The Earth's orbit takes a year—365 days for one revolution. The planets also spin, like a ball on a stick. The Earth takes one day—24 hours—to complete one spin. The Earth has one body moving around it—the Moon. The Moon's orbit around the Earth takes one month—approximately 28 days. It also influences the tides of the Earth's oceans.

General learning outcomes

Learners should:

7.11.1 Know the solar system is made up of the Sun, the planets and their moons.
7.11.2 Know the planets in the solar system.
7.11.3 Know that the planets move around the Sun, while the moons move around the planets.
7.11.4 Know the properties of the Sun and its importance to life on Earth.
7.11.5 Understand the different types of solar eclipses.
7.11.6 Be able to show that the Earth tilts as it revolves around the Sun.
7.11.7 Know that the Earth spins on its axis as it revolves around the Sun.
7.11.8 Know that our planet has its own moon.
7.11.9 Be able to draw the phases of the Moon.
7.11.10 Understand what occurs during an eclipse of the Moon.

Specific learning outcomes

Learners should be able to:

7.11.1.1 Describe the theory of the solar system.
7.11.1.2 List the planets in order of their distance from the Sun.
7.11.1.3 Describe characteristics of the eight planets.
7.11.2.1 State different facts about the different planets including: mass, diameter, surface, atmosphere, gravity, surface temperature, period of rotation, tilt axis, distance from the Sun, time to orbit the Sun and their moon.
7.11.3.1 Describe the movement of the planets around the Sun.
7.11.3.2 Identify planets that have moons.
7.11.4.1 State the properties of the Sun: mass, diameter, gravity, surface temperature, period of rotation, tilt of axis.
7.11.4.2 List the importance of the Sun to life on Earth.
7.11.5.1 Describe the different solar eclipses: total solar eclipse, partial solar eclipse, annual solar eclipse.
7.11.6.1 Model how the Earth spins on its axis.
7.11.7.1 State that it takes 24 hours for the Earth to make one complete spin on its axis.
7.11.7.2 Demonstrate day and night, using a globe of the Earth.
7.11.8.1 State that our Moon takes 28 days to orbit the Earth.

7.11.8.2 State the properties of the Moon: mass, diameter, gravity, surface temperature, period of rotation, tilt of axis.
7.11.9.1 Draw the different phases of the Moon.
7.11.9.2 Record the phases of the Moon at this time of the year at their school.
7.11.9.3 Explain how the phases of the Moon affect low tide and high tide on planet Earth.
7.11.10.1 Describe and draw the phase of lunar eclipses.

Answers

Suggested assessment activity

1 **a** PETENUN: Neptune; **b** SUNEV: Venus; **c** ARMS: Mars; **d** RATUNS – Saturn; **e** ITUPREJ: Jupiter; **f** SUNRAU: Uranus; **g** TEHAR: Earth; **h** RECYRUM: Mercury.
2 **a** Moons: Earth, Mars, Jupiter, Saturn, Uranus, Neptune; **b** Ring systems: Jupiter, Saturn, Uranus, Neptune; **c** Methane in their atmosphere: Uranus and Neptune have large amounts.
3 The Earth's axis is an imaginary line joining the north and south poles around which the Earth spins.

Challenge questions

Learner's Book page 199

1 Venus
2 Venus, Mercury, Mars, Jupiter, Saturn, Uranus, Neptune
3 In summer, the Earth is tilted towards the Sun.
4 About 6000°C on the surface
5 Maria (plains) on the lunar landscape
6 Learners' answers will vary. Sample answers: Copernicus, Galileo, Brahe, Kepler.

Unit 11.1: The solar system

Activity 1: A model solar system

Learner's Book page 201

Processes and skills	Resources	Teacher's support notes	Answers to questions
Represent the relative sizes and distances of the planets from the Sun	• modelling clay • 'fact file' information from Unit 11.1, Learner's Book • basketball • photocopy of street map of the local school area • trundle wheel	Discuss the solar system with learners and the relative sizes and positions of the planets in relation to the Sun.	**1** Refer to learners' responses. **2** Refer to learners' responses.

Activity 2: Classification of the planets

Learner's Book page 209

Processes and skills	Resources	Teacher's support notes	Answers to questions
Classify the planets using different criteria	• information from Unit 11.1, Learner's Book	List and explain the criteria (size, composition, distance from the Sun) and describe to learners how these criteria can be used to classify the planets.	Learners' answers will vary. Sample answer: Because of its small size and irregular orbit, scientists were uncertain as to whether Pluto was a planet or a comet captured within the Sun's gravitational field. It is now not considered to be a planet. It has been reclassified as a dwarf planet.

Answers

Unit questions

Learner's Book page 210

NOTE: Pluto has been reclassified as a dwarf planet. It is not considered a planet in our solar system. Therefore, the answers below do not include Pluto as a planet.

1 Aristarchus, Copernicus and Kepler

2 **a** Geocentric = Earth-centred; **b** Heliocentric = Sun-centred

3 The geocentric model placed the Earth at the centre of the solar system with the Sun and known planets orbiting around it. The heliocentric model placed the Sun at the centre with the planets orbiting around. Learners' diagrams should be similar to those in Fig. 11.1.1 on page 200 of the Learner's Book.

4 The religious authorities thought that humankind and the Earth had to be the centre of everything. People who disagreed would be punished if they spoke out.

5 Jupiter, Saturn, Uranus and Neptune are known as the gas giants.

6 **a** Neptune; **b** Venus; **c** Pluto; **d** Mars; **e** Saturn; **f** Jupiter; **g** Uranus; **h** Earth; **i** Mercury

7 **a** Jupiter, Saturn, Uranus, Neptune, Earth, Venus, Mars, Mercury
b Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune

8 Terrestrial planets are made of rocks and are similar to the Earth.

9 The ancient planets are the closest to the Earth and are visible to the naked eye so were able to be discovered by ancient astronomers.

10 The modern planets are so called because they were not discovered until the invention of the telescope.

11 Learners' answers will vary. Sample answers: Uranus—tilted at 98° angle, has a large number of moons (21), each season lasts for 21 years and has 11 ring systems; Neptune—has a great dark spot (a huge cyclonic storm), has 8 moons and 5 rings and has great gravitational attraction.

12 Learners' answers will vary. Sample answers: *Mariner 10* (Mercury); *Viking 1, Viking 2* (Mars); *Spirit* and *Opportunity* (Mars); *Voyager 2* (Jupiter, Saturn).

13 *Mars Climate Orbiter* and *Mars Polar Lander*

14 It is more difficult to view them from Earth or to send and accurately manoeuvre space probes over a greater distance.

15 Learners' answers will vary. Sample answers: extremes of temperature, atmospheric pressure, lack of water, lack of atmosphere or inhospitable atmosphere mean that these planets are unlikely to support life.

16 Using Fig. 11.1.21, the estimated diameter of Charon is 1150 km, and its distance from Pluto is approximately 17,250 km.

17

Name	Date	Ideas
Aristotle	384–322 BC	Geocentric model
Aristarchus	310–230 BC	Heliocentric model
Ptolomy	AD 127–145	Geocentric model
Hipparchus	AD 127	Geocentric model
Copernicus	1530s	Heliocentric model
Galileo	1609	Heliocentric model
Brahe	1546–1601	Geocentric model
Kepler	1571–1630	Heliocentric model
Herschel	1781	Discovered Uranus
Galle	1846	Discovered Neptune
Tombaugh	1930	Discovered Pluto

18 **a** Venus; **b** Uranus and Neptune; **c** Neptune; **d** Mercury; **e** Venus; **f** Mars; **g** Uranus; **h** Venus; **i** Mars; **j** Venus; **k** Earth; **l** Saturn; **m** Neptune; **n** Venus; **o** Jupiter; **p** Venus

19 **a** Earth, Mars, Jupiter, Saturn, Uranus, Neptune; **b** Saturn, Uranus, Neptune, Jupiter; **c** Uranus, Neptune

Extension questions

Learner's Book page 210

1 Refer to learners' responses.

2 All of the planets, except for Earth, are named after ancient gods and goddesses.

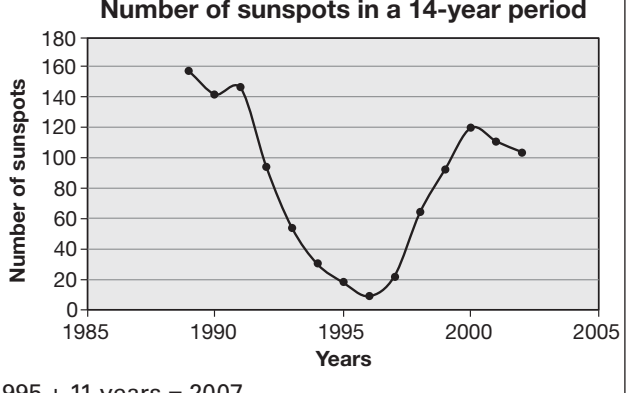
Planet	Named after
Mercury	Roman messenger of the gods
Venus	Roman goddess of love
Earth	Name is based on Germanic and Old English words for 'ground'
Mars	Roman god of war
Jupiter	Roman king of the gods
Saturn	Roman god of agriculture (also father of Jupiter)
Uranus	Greek god of the sky
Neptune	Roman god of the sea

3 Refer to learners' responses.

Unit 11.2: The Sun

Activity 3: The sunspot cycle

Learner's Book page 212

Processes and skills	Resources	Teacher's support notes	Answers to questions
Construct a sunspot line graph, using the approximate numbers of sunspots recorded over a 14-year period	• graph paper • pencil	Explain to the learners that sunspots are lower temperature spots on the Sun's surface. They appear darker because they are thousands of degrees cooler than the surrounding gas.	**1**  **2** 1995 + 11 years = 2007

Answers

Unit questions

Learner's Book page 214

1 Heat and light

2 Plants use the light from the Sun to make their food and animals get their food by feeding on the plants. Other animals even get their food by feeding on animals that eat plants. Therefore, both plants and animals rely on the Sun for food.

3 Plant and animal remains inside the Earth turn into oil. If there were no Sun, there would be no plants and animals, thus no oil deposits.

4 Ultraviolet radiation
5 'Nuclear' means the centre of an atom. 'Fusion' means joining (in this case, of hydrogen atoms).
6 Nuclear reaction
7 Learners' answers will vary. Sample answers: Sunspots, solar flares and prominences.
8 Learners' answers will vary. Sample answers: Sunspots are depressions on the Sun's surface that appear darker because they are several thousand degrees cooler than the surrounding gas. Solar flares come from sunspots and can reach a height of hundreds of thousands of kilometres above the Sun's surface. Prominences are a type of solar eruption and consist of a streamer of glowing gas.
9 **a** and **b** Diagrammatic answer required. Learners' diagrams should be similar to those in Fig. 11.2.7 on page 214 of the Learner's Book.
10 **a** The heat of the Sun evaporates surface water into vapour to form clouds, which later turn into rain. Wind (also created by the Sun, see answer to question 10b below) also increases evaporation.
b The Sun heats up different parts of the Earth by different amounts, which creates pressure differences in the atmosphere, which causes wind.
11 The Sun; 1 AU or 149,600,000 kilometres
12 110 mm or 11 cm
13 It is made of less dense material (e.g. hydrogen), but it is much bigger, just as the volume of a truck full of feathers would weigh more than the steel ball point of a pen.
14 Photosphere, chromosphere, corona
15 **a** The corona
b 2,000,000°C

Extension questions

Learner's Book page 214

Aurora Borealis, or the Northern Lights, occurs around the north magnetic pole, in the Arctic region.

Unit 11.3: Earth's movement in space

Activity 4: A model Earth

Learner's Book page 215

Processes and skills	Resources	Teacher's support notes	Answers to questions
Model night, day and the seasons	• sphere, e.g. ping-pong ball or foam ball • skewer or fine rod • wedge • lamp • piece of string (60 cm)	Remind learners how the Earth spins, resulting in day and night.	**1** To keep the same distance between the lamp (the Sun) and the ball (the Earth) **2** The length of the day and night varies at the different parts of the Earth. **3** Refer to learners' responses.

Answers

Unit questions

Learner's Book pages 217–218

1 An imaginary line joining the North and South poles; the Earth spins on its axis
2 24 hours (one day)
3 365¼ days (one year)

4 **a** True; **b** True; **c** False
5 As the Earth orbits the Sun, it also tilts. This tilt causes different parts of the Earth to experience different heating effects, and thus seasons.
6 23.5°
7 **a** Half a sphere, i.e. a half of the Earth
b A line parallel to the equator
c The longest and shortest days of the year, i.e. when there is most and least sunlight hours
d The two days of the year when day and night hours are equal
8 Diagrammatic answer required. Learners' diagrams should be similar to Fig. 11.3.6 on page 217 of the Learner's Book.
9 At the equator, e.g. Nauru
10 **a** At the North and South poles
b The poles are tilted away from the Sun's rays for half of the year.
11 **a** Seasons occur because of the Earth's tilt, so if there were no tilt, there would be no seasons.
b There would still be night and day as the Earth would still spin on its axis.
12 Temperatures would be more extreme, both higher and lower.
13 Equinoxes are times of equal length night and day; solstices are times of shortest or longest day or night.
14 The equator is always directly in line with the Sun, and receives its light and heat energy over a small area.
15 Night
16 East to west
17 Northern summer occurs during southern winter and vice versa. Northern autumn occurs during southern spring and vice versa.

Extension questions

Learner's Book page 218

1 Refer to learners' responses.
2 Refer to learners' responses. The five climatic zones are: tropical, dry, temperate, cold, polar.
3 **a** About 1600 km/hr; **b** About 107,000 km/hr
4 **a** and **b** Refer to learners' responses.

Unit 11.4: The Moon

Activity 5: Crater formation

Learner's Book page 220

Processes and skills	Resources	Teacher's support notes	Answers to questions
Investigate how craters get their shape	• flour • chocolate icing sugar (or Milo or coffee powder) • shallow tray (e.g. foil tray) • 3 rocks about 1 cm to 7 cm • newspaper • metre rule	Explain to learners how the craters are formed and identify factors that affect the type of crater formed.	**1** The height of the drop, the size of the rock and the shape of the rock **2** For irregularly shaped rocks, the craters will be similar only if the surface of the rock that makes contact is consistent. The height of the drop will also affect the dimensions of the crater. **3** Students should find a way to make impacts at an angle and also consider consistency in the variables influencing the impacts. Some may try to launch the rocks at an angle. Others may place the tray on an angle, which for a consistent force applied to the rocks, i.e. gravity, is the better option.

Activity 6: Phases of the Moon

Learner's Book page 221

Processes and skills	Resources	Teacher's support notes
Construct a flip book to show the main phases of the Moon	• paper • stiff cardboard	Remind learners what the phases of the Moon are and how we identify those phases, which depend on the Moon's orbit of the Earth.

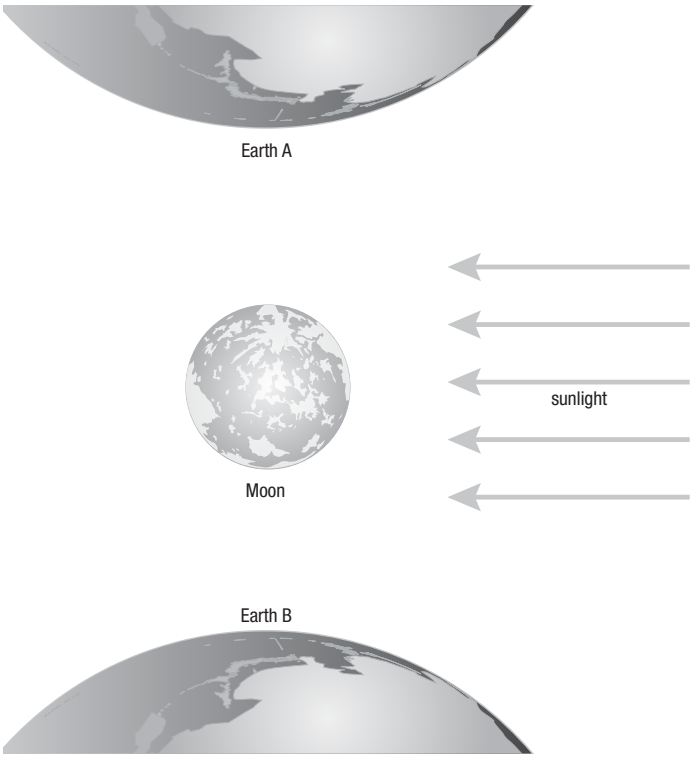
Answers

Unit questions

Learner's Book pages 223–224

1 1969; Neil Armstrong
2 Buzz Aldrin
3 **a** No; **b** Yes
4 Galileo
5 Maria (flat plains) and highlands (mountainous areas)
6 At the poles
7 It was still hot.
8 29.5 days (about one month)
9 The time for the Moon to orbit the Earth is nearly the same as the time the Moon takes to spin on its axis.
10 Phases are how much of the Moon's face we see when it orbits the Earth.
11 Diagrammatic answer required. Learners' diagrams should be similar to the gibbous and crescent moons shown in Fig. 11.4.5 on page 221 of the Learner's Book.
12 The Moon attracts the oceans towards it, enough to cause a bulge in the oceans facing the Moon. The Earth's rotation causes a similar bulge on the other side of the Earth.
13 Four—two high tides and two low tides
14 Diagrammatic answer required. Learners' diagrams should be similar to Fig. 11.4.8 on page 222 of the Learner's Book.
15 A lunar eclipse occurs when the Moon passes into the shadow of the Earth.
16 The Moon has no atmosphere to burn up meteorites.
17 **b** 100
18 Waxing is increasing in visible area, waning is decreasing.
19 **a** Larger tides; **b** Smaller tides
20 **a** During a penumbral lunar eclipse, the Moon moves into a partial shadow of the Earth.
b During a partial lunar eclipse, part of the Moon is in full shadow, and part is in partial shadow.
21 The side of the Moon that is always hidden from the Earth
22 There is no atmosphere on the Moon.
23 Shorter duration

24 Diagrammatic answer required.



25 Diagrammatic answer required. Learners' diagrams should be similar to Fig. 11.4.8 on page 222 of the Learner's Book, with the bulges in the ocean at the top and bottom of the Earth.

Extension questions

Learner's Book page 224

1 Learners' answers will vary.
2 Learners' answers will vary.

Chapter review

Answers

Learner's Book page 225

NOTE: Pluto has been reclassified as a dwarf planet. It is not considered a planet in our solar system. Therefore, the answers below do not include Pluto as a planet.

1 Day: the time taken for a planet to spin once on its axis. Year: the time taken by a planet to orbit the Sun.
2 Equinox
3 Lunar
4 29.5 days
5 One-sixth that of the Earth's
6 Diagrammatic answer required. Learners' diagrams should be similar to Fig. 11.4.5 on page 221 of the Learner's Book.
7 The Sun is our source of light and heat; it allows plants to grow and so support other animal life; it is the source of all energy on Earth.
8 Nuclear fusion reactions occur in the core of the Sun.
9 Sunspots are not as hot as the surrounding areas.
10 Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune
11 Learners' answers will vary.
12 Learners' answer will vary. Sample answers: *Mariner 10*—Mercury; *Viking 2*—Mars; *Voyager 1 and 2*—Jupiter.

13 The answer would have been Pluto but it is no longer considered a planet.
14 A prominence reaches further into space.
15 Diagrammatic answer required. Learners' diagrams should be similar to Fig. 11.2.6 on page 213 of the Learner's Book.
16 Diagrammatic answer required. Learners' diagrams should be similar to the annular eclipse shown in Fig. 11.2.7 on page 214 of the Learner's Book.
17 No.
18 The geocentric model puts the Earth at the centre of the solar system. The heliocentric model puts the Sun at the centre.
19 Supporters: Copernicus, Kepler. Opponents: Aristotle, Ptolemy, Brahe.
20 The religious authorities believed that humankind and the Earth were the centre of everything. If you spoke against these authorities you could be punished.
21 Galileo
22 **a** Tides: the Moon pulls the oceans towards it, causing a bulge in the oceans facing the Moon. The Earth's rotation also causes a similar bulge in the oceans on the other side of the Earth. These are high tides.
b Seasons: as the Earth orbits the Sun, the tilt of the Earth causes different parts of the Earth to experience different heating effects—different seasons, e.g. summer and winter.
c Day/night: the Earth spins on its axis. The part of the Earth receiving light directly from the Sun experiences day, while the other side experiences night.
d Year: the time taken by a planet to orbit the Sun is called a year.
e Lunar eclipse: a lunar eclipse occurs when the Moon passes into the shadow of the Earth.
f Solar wind: the Sun is constantly emitting a stream of particles, called solar winds, into space at speeds of about 500 kilometres per second.
23 Ancient cultures defined the days, seasons, months and years by following the movements of the Sun and the Moon. Many cultures, including Solomon Islanders, developed complex ways of predicting season changes, which enabled them to plan when to plant crops or when to move to a new place in search of seasonal foods.
24 **a** Jupiter, Saturn, Uranus; **b** Mercury, Venus, Earth, Mars; **c** Uranus and Neptune; **d** Mars—it has a similar rotation speed and tilt, and the surface temperatures are not too extreme; **e** Day: 6 Earth days; year: 249 Earth years; **f** Mars— the surface soil is high in red iron oxide (rust)
25 Note: Days and years are given in Earth time.

Planet	Distance from Sun (AU)	Day length	Year length
Mercury	0.39	59 days	88 days
Venus	0.72	243 days	225 days
Earth	1	1 day	365.25 days
Mars	1.52	1.03 days	687 days
Jupiter	5.2	9 h 55 min	11.8 years
Saturn	9.6	10 h 39 min	29.5 years
Uranus	19.2	17 h 14 min	84 years
Neptune	30.1	16 h 7 min	165 years

26 **a** Oxygen, water, thick atmosphere, gravity, carbon dioxide
b No. Conditions are not correct.
c Mars: closest to Earth's size with similar gravity, carbon dioxide in atmosphere and possibly water
d Learners' answers may vary—probably Earth because it is where we live. Also, the Sun supplies the energy we need to live on Earth.

Chapter 12: Ecology

Strand: Life and living

Suggested class time: 8 periods

Sub-strand statement

This sub-strand deals with ecosystems. The life of an organism depends on other organisms and the physical environment. The success of an organism in an environment depends on how well an organism is adapted to the environment. Over time, many organisms have developed features that allow them to survive in their environment. In an ecosystem, food is the source of nutrients for organisms. Nutrients pass from one organism to another through the food chain.

General learning outcomes

Learners should:

7.12.1 Know that an ecosystem is made up of living and non-living things that interact with each other in a particular area.

7.12.2 Know the different levels within a biosphere and biomes.

7.12.3 Know abiotic factors that influence survival of organisms within an ecosystem.

7.12.4 Understand how energy is transferred in food chains and food webs in an ecosystem.

7.12.5 Understand that there are different types of interactions between organisms.

7.12.6 Be able to show plant and animal distribution in the ecosystem.

Specific learning outcomes

Learners should be able to:

7.12.1.1 Identify examples of local ecosystems in their community, e.g. mangrove, forest, river, coral reef.

7.12.1.2 Identify examples of other ecosystems, e.g. desert, grassland.

7.12.1.3 Give an example of an organism interacting with:

- **i** living things, e.g. a cow feeding on a grass, a bird nesting in branches of mangrove trees
- **ii** non-living things, e.g. a fish breathing air in water, a chicken drinking water.

7.12.2.1 Identify levels of the biosphere and the biomes.

7.12.3.1 Give common examples of organisms and identify abiotic factors that influence their survival:

- **i** mangrove tree—salinity, nutrients
- **ii** bonito—sea current, temperature
- **iii** hard coral—sunlight, waves
- **iv** mosquito—water, air heat.

7.12.4.1 Draw and describe food chains and food webs in the following ecosystems: mangrove, coral reef, deep-sea, rainforest.

7.12.4.2 Identify the origin of the energy in the food chain or food web and describe the energy flow.

Answers

Suggested assessment activity

1 **a** False; **b** False; **c** False; **d** True

Challenge questions

Learner's Book page 226

1 Plants need sunlight, fresh water and soil to grow. These are not available on the deep ocean floor.
2 Mangrove
3 A small fish called a remora eats the bits of food that stick on the teeth of a shark.
4 Learners' answers will vary.
5 False
6 Some native plants need fire to release the seeds they need to regenerate.

Unit 12.1: Ecosystems

Activity 1: Organisms in an ecosystem

Learner's Book page 227

Processes and skills	Resources	Teacher's support notes	Answers to questions
Discover different organisms in one ecosystem	• hand lens • forceps • tray	If possible, allow learners to investigate at least three or four different ecosystems.	**1–4** Learners' answers will vary, depending on their observations.

Activity 2: Cut and paste

Learner's Book page 229

Processes and skills	Resources	Teacher's support notes	Answers to questions
Compare different levels of an ecosystem	• photocopies of the diagrams on page 229 of the Learner's Book • scissors • glue	Give photocopies of the diagrams to the learners or have them redraw and place them in the correct order.	The correct order is: world, Australia, forest, tree with leaves, tree trunk with hole.

Activity 3: Identification of different habitats within an ecosystem

Learner's Book page 229

Processes and skills	Resources	Teacher's support notes	Answers to questions
Identify and describe different habitats found in an ecosystem	• pen • exercise book	Read any relevant books regarding different habitats. Make sure that learners understand what a habitat is. Learners should work in groups of four.	**1–2** Learners' answers will vary, depending on their observations.

Answers

Unit questions

Learner's Book page 232

1 **a** Living organisms; **b** Non-living (abiotic) environment; **c** Community
2 Guadalcanal/Isabel (or any island in Solomon Islands)
3 Learners' answers will vary. Sample answers: grasslands, tropics, deserts, subtropics.
4 Learners' answers will vary. Sample answer: in a tropical biome, a habitat could be the protected areas at ground level or the very top of the leaf canopy.
5 High rainfall and high temperatures
6 **a** L; **b** NL; **c** L; **d** NL
7 The correct statements are:
   - **a** The term 'biosphere' refers to that part of the Earth (*including* its atmosphere) in which living organisms can be found.
   - **b** The term 'biome' refers to areas that have *similar* climatic conditions.
   - **c** The term 'habitat' is used to describe a *more* specific area than the term 'biome'.
   - **d** An example of a desert microhabitat would be *a clay-pan*.

8 Learners' answers will vary. Sample answers: Biosphere—Earth; biogeographical region: Solomon Islands; biome—Honiara or Lata or Gizo or Kirakira or Auki; habitat: Panatina Street or Tuvaruhu Street or Rove Street; microhabitat: House P3-33 or Police Quarters.
9 The correct statements are:
   - **a** 'Ecosystem' refers to the *organisms* that live in a specific area, *how they interact with each other and how the non-living environment around them affects them*.
   - **b** The plants and animals in each biogeographical area are unique.
   - **c** Animals that live in a grassland biome in different biogeographical regions are *likely* to show similarities.
   - **d** The island of Guadalcanal is considered a *biogeographical region*.

10 Learners' answers will vary. Sample answer: Hole in branch of tree (microhabitat); tree (habitat); rainforest (biome), Solomon Islands (biogeographical region), Earth (biosphere).
11 Similar biomes have similar climatic conditions. This means that the organisms living there have similar behavioural and physical adaptive features. For example, animals living in alpine regions are likely to have thick, woolly coats as a means of conserving body heat. They are also more likely to hibernate during the colder months.

Extension questions

Learner's Book page 232

Learners' answers will depend on the area they examine. Plants may interact by growing on each other, e.g. vines such as mile-a-minute.

Unit 12.2: Physical attributes of an ecosystem

Activity 4: Features of organisms that support survival against predators

Learner's Book page 233

Processes and skills	Resources	Teacher's support notes	Answers to questions
Determine general features of several organisms that may support their survival against predators	• list of organisms	Provide learners with a list of five organisms to study. If possible, let learners see the actual organisms when studying them.	**1–2** Learners' answers will vary depending on the organisms studied.

Activity 5: The effect of an abiotic factor on plant growth

Learner's Book page 235

Processes and skills	Resources	Teacher's support notes	Answers to questions
Determine the effect of the amount of light on plant growth	• 6 potted seedlings (same species, same stage of development) • 2 covers (one translucent, one opaque)	Make sure the plants are placed in an area with good exposure to sunlight, and that the plants will not be disturbed by people.	**1** In case some seedlings die **2** So that growth is not affected by other factors apart from sunlight and so that growth can be easily measured by comparing seedlings **3** These are used as control plants to show what happens to the seedlings in a normal situation. **4** Learners' answers will vary.

Activity 6: Testing for soil acidity around the schoolyard

Learner's Book page 235

Processes and skills	Resources	Teacher's support notes	Answers to questions
Test the acidity of the soil at various locations around the schoolyard	• 3 or 4 test tubes • distilled water • 3 or 4 beakers • glass stirring rod • litmus paper • filter paper (e.g. coffee filter paper)	The soil samples must be from different areas in the schoolyard.	**1** Distilled water **2** Tap water is chlorinated, so it could affect the result. **3** Refer to learners' responses. **4** Refer to learners' responses.

Answers

Unit questions

Learner's Book pages 237–238

1 When an animal modifies its behaviour to fit into an environment, this is called behavioural adaptation. For example, humans and other animals find shade on hot sunny days. A physical adaptation is passed on to an animal by its parents—the animal does not choose it. For example, some insects use their colour to camouflage themselves against their predators.

2 Instinctive behaviour is automatic, like seeking shade on hot days. Learnt behaviour needs to be taught, e.g. a chick follows and watches its mother chase grasshoppers and dig for worms and therefore learns how to hunt for food.
3 Abiotic features of the environment are non-living.
4 Light, water and air
5 Biotic features of the environment include living things.
6 The correct statements are:
- **a** The non-living factors that influence where an organism can live are called *abiotic* factors.
- **b** The more saturated with water the air is, the *more* humid it is.
- **c** On land, the percentage of oxygen in the air *decreases* with altitude.
- **d** Water that flows quickly has *more* oxygen than water that is still.

7 This is a behavioural adaptation because the animal has control over its behaviour.
8 This is a physical adaptation because over time, camels' nostrils have changed to adapt to the environment.
9 It would have a long beak. This is a physical adaptation and the beak has adapted to help the bird catch fish.
10 **a** True; **b** True; **c** True; **d** False
11 **a** Water temperature, currents; **b** Shelter; **c** Temperature, water (moisture), nutrients in the soil; **d** Temperature, weather, water, shelter
12 The large surface area of an elephant's ears allow for the dissipation of heat, thereby enabling it to cool off more quickly. The abiotic factors involved include temperature, humidity and air currents.
13 Mangroves would have to contend with such abiotic factors as wave action, increased exposure to salt concentration and reduced light at high tide, and wind action, higher levels of light and greater temperature changes during low tide.
14 Water currents and wave action, salinity, temperature and light availability
15 Learners' answers will vary. Sample answers: Temperature, water availability, light availability and the soil type, which determines what foods we eat.
16 Learners' answers will vary. Sample answers: The types of plants available (used for both food and dwelling construction) and the types of animals that are available for food.
17 Marine fish survive in water of a specific salinity. They cannot survive in fresh water.
18 Legume crops work in a mutually helpful (symbiotic) relationship with nitrogen-fixing bacteria. This keeps the soil more fertile for farmers' crops.

Extension questions

Learner's Book page 238

1 Learners can work in groups to present their information on a poster.
- **a** Biotic factors: frogs, predators, humans; abiotic factors: water, sunlight, wind.
- **b** The frog does not need water except during mating.
- **c** The frog uses hind and fore limbs to propel itself in water and also to walk on dry land.
- **d** The adult frog will live on dry land but will need a watery environment during mating.

2 Refer to learners' responses. Habits might include: a pet dog runs to its owner every time the owner gets home.
3 Conduct a class debate on the three issues referred to in the question. Organise learners into three groups of three members each, with each group representing either bushwalkers, land developers or the mining and timber industries. The rest of the class can ask questions after the debate.

Unit 12.3: Food chains and food webs

Activity 7: Richness of an ecosystem

Learner's Book page 241

Processes and skills	Resources	Teacher's support notes	Answers to questions
Determine whether an ecosystem is rich in organisms	• trays • gloves • hand lenses • metre ruler	Choose any ecosystem that is not used by people daily. Learners will also need to count the number of organisms of each species they see.	**1** Learners' answers will vary depending on the ecosystem studied. **2** Learners' answers will vary. **3** Diversity refers to the numbers of different species present in an ecosystem. Abundance refers to the number of organisms of a particular species in an ecosystem. **4** Availability of different sources of food

Answers

Unit questions

Learner's Book pages 243–244

1 Photosynthesis

2 Plants are an example of producers—they produce food that is then available for others in the food chain to consume.

3 **a** False; **b** False; **c** False; **d** True

4 A food web consists of interrelated food chains.

5 Biodiversity refers to the number of different plant and animal species present in a community. If there is a large number of different plant and animal species, this increases the availability of different food sources. This can help a community to survive if one food source is destroyed. For example, a herbivore that eats a variety of plants has more chance of survival than if it only ate one type of plant.

6 Glucose

7 Plants only use a small amount of the Sun's energy. At each level of the food chain, only 5–20 per cent of energy is transferred to the next level. For this reason, the number of plants is greater than the number of animals that eat them.

8 Contains carbon; came from living things

9 The dead bodies of plants and animals are broken down by decomposers such as bacteria and fungi and returned to the soil as organic matter.

10 **a** Mutualism: organisms that live together and provide food for each other, e.g. false clown anemone fish with anemone.

b Commensalism: one species benefits from the interaction but the other is unaffected, e.g. remora and shark.

c Amensalism: one species is harmed while the other is unaffected, e.g. cows walking on and destroying plants.

d Competition: different plants or animals fight for the same resource, e.g. birds.

e Exploitation: one species benefits and the other is harmed, e.g. a cat hunting a lizard.

11 They are all types of exploitation. Predation is when one species kills another for food. Herbivory is when an animal eats only part of a plant; the rest of the plant does not die, but its growth is affected. Parasitism is when an organism (a parasite) lives in or on another organism (the host). The host is not killed, but its health can be severely affected.

12 Learners' answers will vary. Sample answer: Yes, because the Sun supplies the energy used by plants, which are the basis of the food chain, supplying energy to all other organisms.
13 Autotroph: banana plant; heterotroph: pig; omnivore: human being.
14 This is an accurate description of a plant as it produces its own food from water, carbon dioxide and sunlight.
15 **a** Parasitism; **b** Parasitism; **c** Mutualism
16 The fleas are parasites; the dog is their host (parasitism).
17 Cooperative hunting allows the carnivore species to take down bigger and more prey, e.g. a pack of dogs uses less effort than a single dog to kill a wild pig but the pig is big enough to supply food for all the dogs involved.
18 One may be younger than the other, and males generally require more food than females (unless the female is pregnant, in which case she may require more).
19 Grass → mouse → snake → owl
20 The producer is the grass. The primary consumer is the mouse. The secondary consumer is the snake. The tertiary consumer is the owl.
21 Learners' answers will vary, depending on the location.
22 Area B will have the greatest biodiversity because there are more organisms living there (we know this because there are more food chains in this area).

Extension questions

Learner's Book page 244

Learners use their past knowledge and experience to identify animals that have their own strategy to catch their prey. For example, a crocodile may look like a log in a creek or river. When dogs or pigs or even humans come closer to it, the crocodile would attack them.

Appendix 1: Suggested teaching methods

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

Appendix 2: Lesson plan format

Name of school:	**Class teacher:**
Lesson title:	**Date:**
Learning outcomes • 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 • What are the key facts, concepts or procedures that I want learners to understand as a result of this lesson?	
Introduction • How will I get learners motivated, curious and ready to learn? (Allocate 3–5 minutes.)	
Teacher activities • What am I going to do during the lesson in order for learners to achieve the learning outcomes? (Allocate 8–10 minutes.)	**Learner activities** • What are the learners going to do during the lesson in order for them to achieve the learning outcomes? (Allocate 20–25 minutes.)
Conclusion • How will I bring the lesson to a logical and meaningful conclusion? (Allocate 5–7 minutes.)	
Learner assessment • How will I know that learners have achieved what I wanted them to achieve?	
Lesson evaluation • 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 3: Sample learner's record form

Learner's name:				**Year level:**	**Class:**						
Strand	**Sub-strand**	**Assessment event**	**Specific Learning Outcomes and benchmarks** (use appropriate code)		**Achievement levels** (ratings)						**Achievement award** Achieved (A) Partially Achieved (PA 1–4) Not Achieved (NA) Key: 5 = A, 1–4 = PA, 0 = NA
			Code	**Specific Learning Outcome and benchmark**	**5**	**4**	**3**	**2**	**1**	**0**	
Calculation of progressive achievement level for formative assessment:											
Descriptive comments:											
Class teacher:				**Signature:**				**Date:**			

Appendix 4: Sample class monitoring form

Class:			**Term/Semester:**				**Year level:**
Strand:							**Sub-strand:**
Topic/Unit:							**Remarks:** (Comment on learning progress of each learner, e.g. Improved; Steady; Not improved; Seems to improve during the learning process over a term/ semester/year.)
Assessment events	**1**	**2**	**3**	**4**	**5**	**6**	
Coded SLO benchmark							
Class teacher:							**Signature:** / **Date:**

Appendix 5: Sample class analysis form

Class:		Term/Semester:			Year level:	
Strand/Sub-strand:		Total number of learners: 40			Topic/Unit remarks:	
Assessment event	Code	Specific Learning Outcome and benchmark (use appropriate code)	A	PA	NA	Enrichment support	Remedial work
Class teacher:					Signature:	Date:	

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)			Remedial work required	Results after remedial work
	Code	Description of outcomes assessed	A 5 / PA 4, 3, 2, 1 / NA 0		
Class teacher:				Signature:	Date:

Appendix 7: Sample summative assessment recording form

Learner's name:				**Class:**	**Year level:**						
Strand	**Sub-strand**	**Summative task**	**Specific Learning Outcomes and benchmarks** (use appropriate code)		**Achievement levels** (Ratings)						**Achievement award** Achieved (A) Partially Achieved (PA 1–4) Not Achieved (NA) Key: 5 = A, 1–4 = PA, 0 = NA
			Code	**Specific Learning Outcome and benchmark**	**5**	**4**	**3**	**2**	**1**	**0**	
Calculation of progressive achievement level for summative assessment:											
Descriptive comments:											
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**	**PA**	**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**	**PA**	**NA**
Descriptive remarks: (must include results after remedial work has been completed by the learner)				

Results for summative assessment: The progressive achievement level for summative assessment is _____				
Strand:	**Combination of sub-strands:**	**Specific Learning Outcomes and benchmarks** Achieved (A), Partially Achieved (PA) or Not Achieved (NA)		
Descriptive remarks from summative assessment:				
Overall achievement level (combination of formative and summative):	**Overall award:**			
School administration report on learner's behaviour and character:				
Name of class teacher:	**Signature:**			**Date:**
Class teacher comments:				
Name of Head teacher/Principal:	**Signature:**			**Date:**
Head teacher/Principal comments:				

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				
Social Studies	90%	4, AWM, Silver	B	Good work
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 7

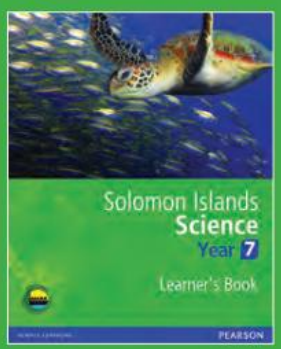
Teacher's Guide

The *Solomon Islands Science Year 7 Teacher's Guide* provides support material to the *Solomon Islands Science Year 7 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.



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