

**ESSENTIAL**



# Science

## Basic 9

Facilitator's Guide



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**ESSENTIAL**

# Science

## Basic 9

**Facilitator's Guide**

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## Welcome and orientation

A warm welcome to you, Teacher. We hope that you will find this Teacher's Guide for Basic 9 Science useful and easy to use.

### Teacher's Guide orientation

The introduction section covers the introductory pages to the Science curriculum for Basic 7–9 (the Common Core Programme or CCP), outlined as follows:

- *Rationale* – why the study of science is important and what it involves.
- *Aims* – how learners are expected to develop by studying science.
- *Profile of expected learning behaviours* – the three learning domains which are the basis for instruction and assessment, namely:
  - knowledge, understanding and application
  - process skills
  - attitudes and values.
- *Creative pedagogical approaches* – these include principles of learner-centred teaching, inclusion, differentiated teaching, instructional scaffolding, exposure to information and communications technology (ICT) tools, and emphasis on the development of core competencies.
- *Instructional expectations* – a summary of your expected role as teacher.
- *Organisation and structure of the curriculum* – the scope of content covered over three years for B7, B8 and B9.
- *Suggested time allocation* – how many periods a week.
- *Assessment* – modes of assessment and the benchmarks for reporting school-based assessment (SBA).

On pages xiv–xvi, we offer you guidelines on assessment.

The remainder of this Teacher's Guide follows the structure of the Learner's Book. It is divided into the five sections (Note that Strands are referred to as Sections in the Learner's Book) that run throughout the four years of the Science CCP, namely:

1. Diversity of matter
2. Cycles
3. Systems
4. Forces and energy
5. Humans and the environment.

The Sections, in turn, are divided into Topics (for each sub-strand) and these are divided into Modules and Units. For each unit, we give you a brief overview ('Unit in a nutshell'). We then focus on each activity covered in the unit, listing the resources you will need to do the activity as well as the answers to the activity. Where relevant, we give some tips for doing the activity.

The intention of the CCP is to provide learners with an education of heart, mind and hands. We wish you a rewarding year of teaching and hope that you and your learners will have fun.

# Introduction to the curriculum and assessment

## Rationale

Science is a collaborative and creative human endeavour arising from our desire to understand the world around us and the wider universe. The study of a Science CCP from Basic 7 through Basic 9 enables learners to build on what they have learned from Basic 1 to Basic 6, and to further develop their knowledge of and about science.

We are surrounded by technology and the products of science every day. Government policy decisions that affect every aspect of our lives are based on scientific evidence. As learners grow up in an increasingly technologically and scientifically advanced world, they need to be *scientifically literate* to understand relevant issues and be able to live successfully.

Economic, political, social and physical development of a country is hinged on science, technology and innovation. Science has changed our lives and it is vital to Ghana's future development.

To provide a real science education, teachers should facilitate learning in an enabling science classroom that allows learners to discover and understand the world around them and lays the ground for science and science-related studies at higher levels of education. Learners should be encouraged to:

- understand how science can be used to explain what is occurring
- predict how things will behave
- analyse the causes and effects of phenomena in our environment.

The study of science also involves the development of attitudes and concerns about sustainable development. Science should, therefore, be taught using practical and minds-on approaches so that learners find it fun and relevant and adopt science as a culture.

## Aims

The CCP science curriculum is aimed at developing scientifically literate individuals who are good problem solvers, have the ability to think creatively and have both the confidence and competence to participate fully in Ghanaian society as responsible local and global citizens. The specific aims are for learners to:

1. develop a spirit of curiosity, creativity, innovation and critical thinking for investigating and understanding their environment
2. develop skills, habits and attitudes necessary for scientific inquiry
3. communicate scientific ideas effectively
4. use scientific concepts relevant to their lives to explain the world around them
5. design activities for exploring and applying scientific ideas and concepts
6. develop skills for using technology to enhance learning
7. develop a humane and responsible attitude toward the use of all resources in Ghana and elsewhere
8. show concern and understanding of the interdependence of all living things and the Earth on which they live
9. use materials in their environment in a sustainable manner
10. live a healthy, quality life.

## Learning domains/profile of expected learning behaviours

There are three integral learning domains that form the basis for instruction and assessment, namely:

- knowledge, understanding and application
- process skills
- attitudes and values.

The learning indicators specified in the curriculum and covered in the activities in the Learner's Book relate to these three domains and make use of commanding or action verbs (such as 'identify', 'classify' and 'design') that describe or indicate the expected outcome. (In the Learner's Book, the learning indicators are also listed at the beginning of each module under Objectives.)

### Knowledge, understanding and application

Under this domain, learners acquire knowledge through learning experiences. They may also show understanding of concepts by comparing, summarising, rewriting, etc. in their own words and constructing meaning from instruction. Learners may also apply the knowledge acquired in some new contexts. At a higher level of learning behaviour, learners may be required to analyse an issue or a problem. At a much higher level, learners may be required to synthesise knowledge by integrating several ideas to formulate a plan, solve a problem, or compose a story or a piece of music. Further, learners may be required to evaluate, estimate and interpret a concept. At the last level, which is the highest, learners may be required to create, invent, compose, design and construct. The relevant learning behaviours are unpacked as follows:

- **Knowing:** The ability to remember, recall, identify, define, describe, list, name, match and state principles, facts and concepts. Knowledge is the ability to remember or recall concepts already learned and this constitutes the lowest level of learning.
- **Understanding:** The ability to explain, summarise, translate, rewrite, paraphrase, give examples, generalise, estimate or predict consequences based upon a trend. Understanding is generally the ability to grasp the meaning of some concepts that may be verbal, pictorial or symbolic.
- **Applying:** This dimension is also referred to as 'use of knowledge'. It is the ability to use knowledge or apply knowledge, apply rules, methods, principles, theories, etc. to situations that are new and unfamiliar. It also involves the ability to produce, solve, plan, demonstrate, discover, etc.
- **Analysing:** The ability to break down concepts/information into its component parts, to differentiate, compare, distinguish, outline, separate, identify significant points, etc. It is the ability to recognise unstated assumptions and logical fallacies and the ability to recognise inferences from facts, etc.
- **Synthesising:** The ability to put parts or ideas together to form a new whole. It involves the ability to combine, compile, compose, devise, plan, revise, organise and create, and generate new ideas and solutions.
- **Evaluating:** The ability to appraise, compare features of different things and make comments or judgements, contrast, criticise, justify, support, discuss, conclude, make recommendations, etc. Evaluation refers to the ability to judge the worth or value of some concepts based on some criteria.
- **Creating:** The ability to use information or materials to plan, compose, produce, manufacture or construct other products. Creating is the highest form of thinking and learning, and is the area in which generally most learners perform poorly.

## Process skills

These are specific activities or tasks that indicate performance or proficiency in the learning of science. They are the core of inquiry-based learning.

- **Equipment handling:** This is the skill of knowing the functions and limitations of various apparatus, and developing the ability to select and handle them appropriately for various tasks.
- **Observing:** Using the senses to gather information about objects or events. This also includes the use of instruments to extend the range of our senses.
- **Classifying:** Grouping objects or events based on common characteristics.
- **Comparing:** Identifying the similarities and differences between two or more objects, concepts or processes.
- **Communicating/reporting:** Transmitting, receiving and presenting information in concise, clear and accurate forms – this can be verbal, written, pictorial, tabular or graphical.
- **Predicting:** Assessing the likelihood of an outcome based on prior knowledge of how things usually turn out.
- **Analysing:** Identifying the parts of objects, information or processes, and the patterns and relationships between these parts.
- **Generating possibilities:** Exploring all the options, possibilities and alternatives beyond the obvious or preferred one.
- **Evaluating:** Assessing the reasonableness, accuracy and quality of information, processes or ideas to inform decision-making. It also involves assessing feasibility.
- **Designing:** Visualising and creating a mental or physical model of a process or event, or objects or gadgets.
- **Measuring:** Using standard and non-standard instruments or devices to accurately determine size, amount, degree or quantity.
- **Interpreting:** Organising and evaluating data in terms of its worth – good, bad, reliable, unreliable; making inferences and predictions from written or graphical data; extrapolating and deriving conclusions. Interpretation is also referred to as ‘information handling’.
- **Recording:** Putting data or measurements in a table (tabulating) or in graph form; making well-labelled drawings.
- **Generalising:** Using the conclusions arrived at in an experiment or observation of events to say what could happen in similar situations.
- **Designing of experiments:** Developing hypotheses (assumptions/proposed explanations); planning and designing of experiments to test hypotheses or reach conclusions; persistence in the execution of experiments; modification of experiments, where necessary, to fine-tune.

## Attitudes and values

To be resourceful, competent and reflective citizens, willing and capable of solving personal problems and society's problems, learners should be exposed to situations that challenge them to raise questions and attempt to solve problems. Learners, therefore, need to acquire positive attitudes, values and psycho-social skills that will enable them to participate in debates and take a stand on issues affecting themselves and others.

### Attitudes

- **Curiosity:** The inclination to wonder about and seek information about how things work.
- **Perseverance:** The ability to pursue a problem to a satisfying conclusion.
- **Flexibility in ideas:** Willingness to change an opinion in the face of more plausible evidence.
- **Respect for evidence:** Giving weight to the facts or the results of an investigation.
- **Reflection:** The habit of critically reviewing ways in which an investigation has been carried out to identify possible faults, mistakes or improvements.

## Values

At the heart of this curriculum is the belief in nurturing honest, creative and responsible citizens. As such, every part of this curriculum, including the related pedagogy, should be consistent with the following set of values.

- **Respect:** This includes respect for the nation of Ghana, its institutions, laws and culture, and respect among its citizens and friends of Ghana.
- **Diversity:** Ghana is a multicultural society in which every citizen enjoys fundamental rights and responsibilities. Learners should be taught to respect the views of all persons and to see national diversity as a powerful force for national development. The curriculum promotes social cohesion.
- **Equity:** The levels of socio-economic development across the country are uneven and Ghana's learners are from diverse backgrounds. There should be equal opportunities for all. Learners should strive for fairness and to care for each other.
- **Commitment to achieving excellence:** Learners should be taught to appreciate the opportunities provided through the curriculum and persist in doing their best in whatever field of endeavour as global citizens. The curriculum encourages innovativeness through creative and critical thinking and the use of contemporary technology.
- **Teamwork/collaboration:** Learners are encouraged to be committed to team-oriented working and learning environments. This also means that learners should have an attitude of tolerance to be able to work and live peacefully with others.
- **Truth and integrity:** The curriculum aims to develop learners as individuals who will consistently tell the truth, irrespective of the consequences, and be morally upright, with an attitude of doing the right thing even when no one is watching. They are to be true to themselves and willing to live the values of honesty and compassion. Equally important is practising positive values as part of the ethos or culture of the workplace, which includes integrity and perseverance.

## Creative pedagogical approaches

The creative pedagogical approach (CCP) emphasises the following approaches and principles:

- Learner-centred classrooms/teaching
- Inclusion
- Differentiation
- Scaffolding
- Information communications technology (ICT)
- Core competencies.

### Learner-centred classrooms/teaching

Learners are active participants in their own learning. The curriculum encourages the creation of a learner-centred classroom in which learners take ownership of their learning. They should engage in meaningful 'hands-on' activities and should be actively engaged in looking for answers, working in groups to solve problems, researching information, and analysing and evaluating information. Learner-centred classrooms provide the opportunity for deep and profound learning.

The teacher as a facilitator needs to create a learning environment that:

- makes learners feel safe and accepted
- helps learners to interact with varied sources of information in a variety of ways
- helps learners to identify a problem suitable for investigation through project work

- connects the problem with the context of the learners' world so that it presents realistic opportunities for learning
- organises the subject matter around the problem, not the subject
- gives learners responsibility for defining their learning experience and planning to solve the problem
- encourages learners to collaborate in learning
- expects all learners to demonstrate the results of their learning through a product or performance.

## Inclusion

Inclusion means ensuring access and learning for all learners, especially those disadvantaged.

The curriculum promotes:

- learning that is linked to the learners' backgrounds and to their prior experiences, interests, potential and capacities
- learning that is meaningful because it aligns with learners' abilities (e.g. learning that is oriented towards developing general capabilities and solving the practical problems of everyday life)
- the active involvement of the learners in the selection and organisation of learning experiences, making them aware of their importance and enabling them to assess their own learning progress.

## Differentiation

Differentiated teaching means tailoring instructions to meet learners' individual needs. Differences between learners (in learning styles, interest and readiness to learn) are accommodated so that all learners in a group have the best chance of learning. Also, no learner should be held back by any other.

- *Differentiation by outcome* works well for open-ended tasks or projects. Learners are all given the same stimulus, material or task and answer at their own level of ability.
- *Differentiation by task* involves setting different tasks for learners of different abilities or grading the level of the task.
- *Differentiation by support* involves offering extra support to weaker learners.

## Scaffolding

Instructional scaffolding involves the use of a variety of instructional techniques that move learners progressively towards a stronger understanding, and ultimately, greater independence in the learning process. Common scaffolding strategies include:

- giving learners a simplified version of a lesson, assignment or reading, and then gradually increasing the complexity, difficulty or sophistication over time
- describing or illustrating a concept, problem or process in multiple ways to ensure understanding.

## Information communication technology (ICT)

Learners need to be exposed to various ICT tools, including calculators, radios, cameras, phones, televisions, computers and related software, e.g. Microsoft Office packages such as Word, Excel and PowerPoint.

Familiarity with ICT tools provides opportunities for learners to fit into the global world and the world of work.

## Core competencies

The core competencies describe a body of skills necessary for learners to develop to become critical thinkers, problem solvers, creators, innovators, good communicators, collaborators, culturally identified individuals, digitally literate and global citizens who have a keen interest in their personal development.

These competencies include:

- critical thinking and problem solving (CP)
- creativity and innovation (CI)

- communication and collaboration (CC)
- cultural identity and global citizenship (CG)
- personal development and leadership (PL)
- digital literacy (DL).

## Instructional expectations in the CCP Science curriculum

This serves as a summary of your role as teacher as intended by the CCP for Science. Your role includes the following:

- Guide and facilitate learning by generating discourse among learners and challenging them to accept and share responsibility for their own learning based on their own individual differences.
- Select Science content, adapt and plan lessons to meet the interests, knowledge, understanding, abilities and experiences of learners.
- Work together as colleagues within and across disciplines and grade levels to develop communities of Science learners who exhibit the skills of scientific inquiry and the attitudes and social values conducive to Science learning.
- Systematically gather data about learners' progress and understanding, using various assessment methods.
- Use assessment to guide your Science teaching and to provide feedback to both learners and parents.
- Design and manage learning environments that provide learners with time, space and resources needed for learning Science.

## Organisation and structure of the Science curriculum/scope

The content, covered over the four years, is summarised in the following table. Each strand is divided into two to five topics (sub-strands). With three exceptions, these are the same throughout the three-year programme.

LEVEL		B7		B8		B9
STRAND (SECTION)		SUB-STRANDS (TOPICS)		SUB-STRANDS (TOPICS)		SUB-STRANDS (TOPICS)
DIVERSITY OF MATTER	1	Materials	1	Materials	1	Materials
	2	Living cells	2	Living cells	2	Living cells
CYCLES	1	Earth Science	1	Earth Science	1	Earth Science
	2	Life cycle of organisms	2	Life cycle of organisms	2	Life cycle of organisms
	3	Crop production	3	Crop production	3	Crop production
	4	Animal production	4	Animal production	4	Animal production
SYSTEMS	1	The human body systems	1	The human body systems	1	The human body systems
	2	The solar system	2	The solar system	2	The solar system
	3	The ecosystem	3	The ecosystem	3	The ecosystem
	4	Farming systems	4	Farming systems	4	Farming systems

LEVEL		B7		B8		B9
STRAND (SECTION)		SUB-STRANDS (TOPICS)		SUB-STRANDS (TOPICS)		SUB-STRANDS (TOPICS)
<b>FORCES AND ENERGY</b>	1	Energy	1	Energy	1	Energy
	2	Electricity and electronics	2	Electricity and electronics	2	Electricity and electronics
	3	Conversion and conservation of energy	3	Conversion and conservation of energy	3	Conversion and conservation of energy
	4	Force and motion	4	Force and motion	4	Force and motion
	5	Agricultural tools	5	Agricultural tools	5	Agricultural tools
<b>HUMANS AND THE ENVIRONMENT</b>	1	Waste management	1	Waste management	1	Waste management
	2	Human health	2	Human health	2	Human health
	3	Science and industry	3	Science and industry	3	Science and industry
	4	Climate change and green economy	4	Climate change and green economy	4	Climate change and green economy
	5	Understanding the environment	5	Understanding the environment	5	Understanding the environment

**Table 1:** Science curriculum of the CCP, Basic 7–9

## Suggested time allocation

A total of four periods a week, each period consisting of 50 minutes.

## Assessment

Assessment is the process of collecting and evaluating information about learners and using the information to improve their learning. Assessment is at its most powerful when it is development-focused, rather than just mark-focused.

Learners are assessed on:

- knowledge, skills, attitudes and values
- the core competencies of critical thinking and problem solving (CP), creativity and innovation (CI), communication and collaboration (CC), cultural identity and global citizenship (CG), personal development and leadership (PL), and digital literacy (DL).

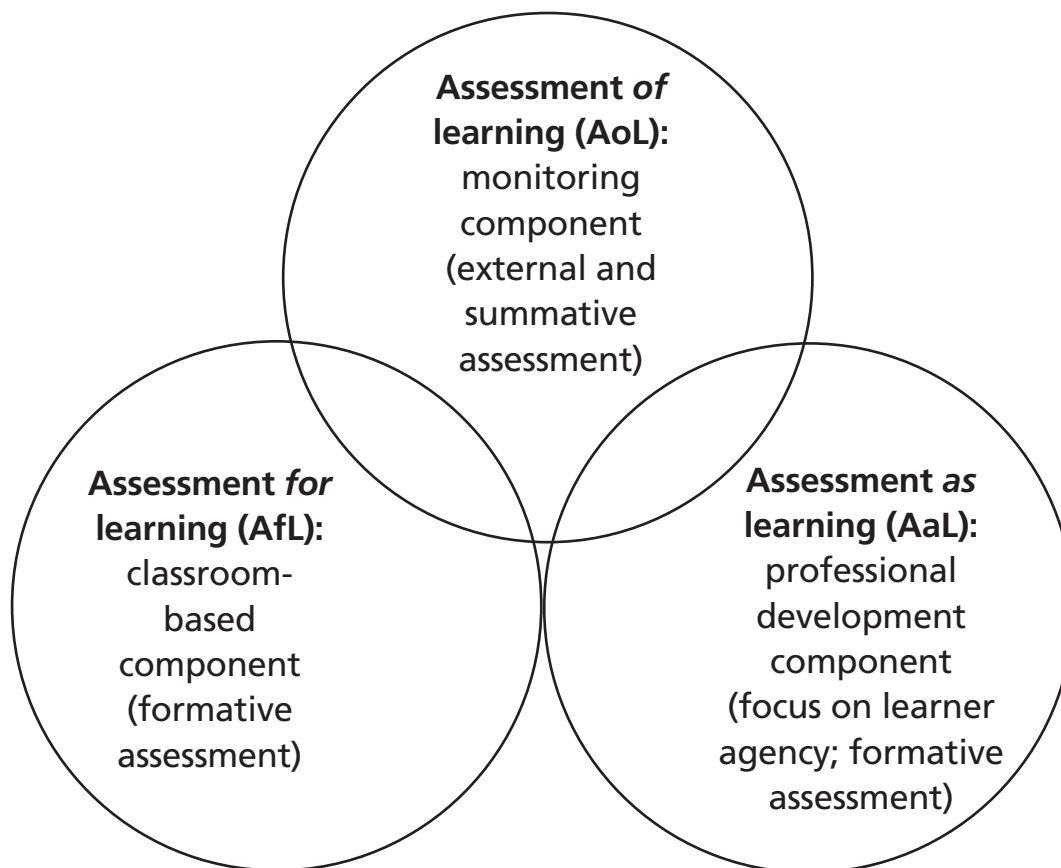
In addition, they are assessed on:

- the 4Rs, including Reading, wRiting, aRithmetic and cReativity.

## Modes of assessment

The CCP suggests that assessment involves three modes of assessment, namely assessment for learning, assessment as learning and assessment of learning. We illustrate these three modes of assessment in the diagram on the next page.





Source: *SA Journal of Education* (<http://www.sajournalofeducation.co.za/index.php/saje>)

**Figure 1:** Three modes of assessment

The table below shows which assessment tasks are suitable for the different modes of assessment.

Assessment for learning	Assessment as learning	Assessment of learning
Class exercises	Portfolio	CAT
		CAT
Quizzes	Journal entries	End-of-term assessment
Class tests (written, oral, aural and/or practical)	Project work	End-of-term assessment
Class assessment task (CAT)	Checklist	
	Questionnaire	

**Table 2:** Examples of assessment tasks for the different modes of assessment

## Reporting school-based assessment (SBA)

A nationwide grading system for the CCP is given in the table below. It shows how the mark or score relates to the level of proficiency.

Level of proficiency	Benchmark	Grade level descriptor
1. Highly proficient (HP)	80% and above	Learner shows high level of proficiency in knowledge, skills and values and can transfer them automatically and flexibly through authentic performance tasks.
2. Proficient (P)	68–79%	Learner demonstrates sufficient level of proficient knowledge, skills and core understanding; can transfer them independently through authentic performance tasks.
3. Approaching proficiency (AP)	54–67%	Learner is approaching proficiency in terms of knowledge, skills and values with little guidance and can transfer understanding through authentic performance tasks.
4. Developing (D)	40–53%	Learner demonstrates developing level of knowledge, skills and values but needs help throughout the performance of authentic tasks.
5. Emerging (E)	39% and below	Learner is emerging with minimal understanding in terms of knowledge, skills and values but needs a lot of help.

**Table 3:** Levels of proficiency, benchmarks and the grade level descriptors

## Assessment tools

Both you, as teacher, and the learners should assess learning. Learner assessment includes peer assessment and self-assessment.

- **Teacher assessment:** You observe learners at work and intervene or give guidance or feedback where necessary; you take note of learners' comments and questions in class; you mark work or tests.
- **Peer assessment:** Learners give comment or feedback; they swap books with a partner and mark each other's work.
- **Self-assessment:** Learners mark their own answers or compare their work with a partner, or other members of the group or class; they self-reflect.

We offer the following to help you with assessment:

- Some activities have an assessment suggestion which usually refers you to one of the generic rubrics on pages 193–195 at the end of this Teacher's Guide. You or the learners can use these for assessment of drawings, graphs, posters, reports, models and oral presentations.
- Each of the five sections covered in the Basic 9 Learner's Book ends with an assessment. You will find the marking memos for these at the end of each section in this Teacher's Guide.
- Learners can do some of the assessments for informal assessment. They then mark their own answers, or swap books with a partner for marking.
- Learners can do one or more of the assessments as an open book test for formal assessment.

## Learning outcomes

Content standard	Indicators and exemplars	Core competencies
<b>Topic 1: Materials</b>		
<b>B9.1.1.1</b> Show an understanding of formation of binary chemical compounds and their uses (acids, bases and salts).	<b>B9.1.1.1.1</b> Identify by name binary chemical compounds and discuss their uses. <b>1.</b> Identify and name chemical compounds from a collection of materials commonly found at home, school and the community such as table salt, water, vinegar, fuel ( <i>take precaution</i> ), soap, detergents, marble and fertilisers. <b>2.</b> Write the chemical symbols of the elements identified in the chemical compounds.	CP5.1, CP6.1
	<b>B9.1.1.1.2</b> Discuss the formation of binary chemical compounds. <b>1.</b> Distinguish among elements, molecules, ions and compounds. <b>2.</b> Write molecular formula of binary compounds and describe their formation. <b>3.</b> Compare and contrast different binary chemical compounds based on their composition and properties. <b>4.</b> Form models to represent chemical compounds such as water, carbon(IV) oxide, iron(II) sulfide and magnesium oxide.	CP5.6, CP6.6, CC9.6, CP5.4, CP6.4, CI5.4
	<b>B9.1.1.1.3</b> Describe the characteristics of common acids, bases and salts. <b>1.</b> Identify acids, bases and salts by their characteristics. <b>2.</b> Create a model of a pH scale and use it to determine the strength of common acids and alkali solutions using indicators.	CP5.8, CI5.4, CI6.5
<b>B9.1.1.2</b> Demonstrate knowledge of atomic bonding in the formation of chemical compounds.	<b>B9.1.1.2.1</b> Recognise that chemical bonds result from the attraction between atoms in a compound. <b>1.</b> Identify types of inter-atomic bonds. <b>2.</b> Describe the formation of inter-atomic bonds. <b>3.</b> Identify examples of substances that exhibit ionic, covalent and metallic bonding.	CC8.1, CC9.2, DL5.3, PL5.1, PL6.8, DL5.5
<b>Topic 2: Living cells</b>		
<b>B9.1.2.1</b> Demonstrate knowledge of specialist cells of dicotyledonous plants and humans, their formation and functions for the existence of the plants and humans.	<b>B9.1.2.1.1</b> Discuss the concepts of specialised cells and how they are formed in dicotyledonous plants and humans. <b>1.</b> Brainstorm to bring out the meaning of specialised cells. <b>2.</b> Discuss how specialised cells are formed in dicotyledonous plants and humans.	CC9.1, CC9.1, CP6.4

Content standard	Indicators and exemplars	Core competencies
	<p><b>B9.1.2.1.2</b> Examine the functions of specialised cells in dicotyledonous plants such as epidermal, guard cells, cambium, xylem in relation to the existence of the plants.</p> <ol style="list-style-type: none"> <li>1. Observe specialised dicotyledonous plant cells such as <i>epidermal</i>, <i>guard cells</i>, <i>cambium</i>, <i>xylem</i> from videos and charts and identify them by their names and shapes.</li> <li>2. Search from books and the internet for information on the functions of the specialised cells of dicotyledonous plants and how they relate to the existence of the plants.</li> </ol>	DL5.3, CP5.1, DL5.3, CP5.1
	<p><b>B9.1.2.1.3</b> Examine the functions of specialised animal cells such as nerve cells, blood cells, muscle cells and sperm cells in relation to the existence of humans.</p> <ol style="list-style-type: none"> <li>1. Observe specialised animal cells such as nerve cells, blood cells, muscle cells and sperm cells from pictures, videos and charts and identify them by their names and make models to represent their shapes.</li> <li>2. Search from books, journals and internet for information on specialised cells in exemplar 1 and how they relate to the existence of humans.</li> </ol>	DL5.3, CP5.1, DL5.3

# Topic 1: Materials

## Module 1

## Acids, bases and salts

### Unit 1.1 Binary chemical compounds

#### Content standard

- B9.1.1.1: Show an understanding of formation of binary chemical compounds and their uses (acids, bases and salts).

#### Indicator

- B9.1.1.1.1: Identify by name binary chemical compounds and discuss their uses.

#### Exemplars

- Identify and name chemical compounds from a collection of materials commonly found at home, school and the community such as table salt, water, vinegar, fuel (*take precaution*), soap, detergents, marble and fertilisers.
- Write the chemical symbols of the elements identified in the chemical compounds.

#### Unit in a nutshell

- A chemical compound consists of atoms of two or more elements that are bonded together in a fixed ratio.
- Compounds that are made up of only two different elements are referred to as binary compounds.
- Every chemical element has a one-letter or two-letter symbol that represents it.
- The Periodic Table shows the symbols of all the elements.

#### ACTIVITY 1.1.1

#### Identifying common chemical compounds used at home and school

LB page 5

(Groups)  
CP5.1, CP6.1

#### Guidelines

- This is a practical activity in which the learners bring substances from home to analyse in class.
- If necessary, adapt the list of substances to suit your class. Include only substances that are safe, common and inexpensive.
- Make sure that no dangerous substances are included in the list. Substances to avoid include butane and other flammable substances, caustic soda, strong acids or other corrosive substances.
- Guide the learners in assigning individuals within each group to bring the substances to class and ensure there is no duplication or omission of listed items.

- Give the learners a sample table like the one below to copy and use.

Substance	State	Chemical name	Elements
Soap			
Vinegar			
Baking powder			
Water			
Table salt			
Sugar			

- Guide the discussion on the properties of the substances themselves and how these properties differ from those of the individual elements that make up the substances.

### TALK ABOUT

LB page 3

Explain that the prefix 'bi-' means 'twice' or 'two'. Examples of other words: bisect (cut in two), bipolar (with two poles or two opposing parts), bifocals (spectacles with two types of lenses combined in one), binocular (having, or using, two eyes).

## Answers

2.

Substance	State	Chemical name	Elements
Soap	Solid	Sodium hydroxide	Sodium, oxygen, hydrogen
Vinegar	Liquid	Acetic acid	Carbon, hydrogen, oxygen
Baking powder	Solid	Sodium bicarbonate	Sodium, hydrogen, oxygen, carbon
Water	Liquid	Hydrogen oxide	Hydrogen, oxygen
Table salt	Solid	Sodium chloride	Sodium, chlorine
Sugar	Solid	Sucrose	Carbon, hydrogen, oxygen

### EXTENSION ACTIVITY

LB page 5

Ask the learners to do some research to find out which of the properties of compounds give them their functional characteristic. Ask, for example, 'What gives soap its soapy character?' and 'Why does soap clean off dirt?'

### ACTIVITY 1.1.2

#### Writing names and symbols of elements

LB page 6

(Individual)  
CP5.1, CP6.1

## Answers

Element	Symbol	Element	Symbol
Hydrogen	H	Sulfur	S
Helium	He	Chlorine	Cl
Lithium	Li	Potassium	K
Carbon	C	Calcium	Ca
Nitrogen	N	Iron	Fe
Oxygen	O	Copper	Cu
Sodium	Na	Zinc	Zn
Magnesium	Mg	Mercury	Hg
Aluminium	Al	Lead	Pb

## Unit 1.2 Formation of binary chemical compounds

### Content standard

- B9.1.1.1: Show an understanding of formation of binary chemical compounds and their uses (acids, bases and salts).

### Indicator

- B9.1.1.1.2: Discuss the formation of binary chemical compounds.

### Exemplars

- Distinguish between elements, molecules, ions and compounds.
- Write molecular formulae of binary compounds and describe their formation.
- Compare and contrast different binary chemical compounds based on their composition and properties.
- Form models to represent chemical compounds such as water, carbon(IV) oxide, iron(II) sulfide and magnesium oxide.

### Unit in a nutshell

- Elements are substances that cannot be broken down to simpler substances by any physical or chemical method and are made up of atoms of the exact same kind.
- A molecule consists of two or more atoms that are bonded together to form a chemical compound and whose physical state is determined by the forces existing between the units.
- An ion is an atom or group of atoms that has either a positive or a negative electrical charge.
- Compounds form new substances with their own properties that are different from the properties of the elements they contain.
- Chemical symbols are combined in a formula to describe the structure of the compound.
- Generally, binary compounds can be classified into two main groups, based on the type of elements that constitute them, namely binary molecular (covalent) compounds and binary ionic compounds

**ACTIVITY 1.2.1****Writing chemical formulae**

LB page 9

(Pairs)

CP5.6

**Guidelines**

- The learners should identify and write down the atoms making up each compound and their chemical formula.

**Answers**

- |                           |                     |                         |
|---------------------------|---------------------|-------------------------|
| 1. a) sulfur, oxygen      | b) sodium, chlorine | c) nitrogen, oxygen     |
| d) hydrogen, oxygen       | e) oxygen           | f) carbon, oxygen       |
| 2. a) $\text{SO}_2$       | b) NaCl             | c) $\text{NO}_2$        |
| d) $\text{H}_2\text{O}_2$ | e) $\text{O}_3$     | f) $\text{C}_2\text{O}$ |

**PRACTICAL ACTIVITY 1.2.1****Making a model of a binary chemical compound**

LB page 10

(Groups)

CP5.6, CP6.6, CC9.6, CP5.4, CP6.4, CI5.4

**Materials**

The learners will need beads, playdough, clay or any other suitable materials to form molecular models. They can use sticks or toothpicks for the bonds.



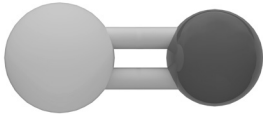
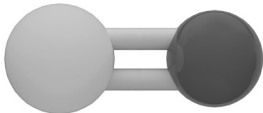
**Guidelines**

- This should be a fun activity for the learners and will help them to repeat and consolidate their understanding of chemical compounds.
- The learners should make models of any two of the following compounds: water, carbon(IV) oxide (carbon dioxide), iron(II) sulfide and magnesium oxide. Assign two compounds to each group to prevent everybody from making the same models. It would be ideal if the learners could work in groups of four, then two learners in each group can work on one of the models, and two can work on the other.
- Point out to the learners that carbon(IV) oxide is commonly known as carbon dioxide.
- If the materials are not available to make the models, allow the learners to draw the molecular structure of the compounds.
- Guide the learners in first finding out the chemical formulae of the compounds and correct them where needed.



## Answers

The table below shows the compounds, their structures and their formulae. The learners' models should resemble the structures shown here.

Compound	Model	Formula
Water		H <sub>2</sub> O
Carbon(IV) oxide		CO <sub>2</sub>
Iron(II) sulfide		FeS
Magnesium oxide		MgO

## Assessment

Use the rubric for models on page 194 of this guide to assess the learners' models.

## Extension

Explain to the learners that iron(II) sulfide does not occur as single molecules. The molecules are packed in a crystal lattice, so the basic unit of the lattice will be FeS or FeS<sub>2</sub>. Encourage the learners to make a number of FeS units and try and fit them together in a lattice pattern.

The websites at the two links below give useful basic information about iron(II) sulfide.

<https://www.chemistrylearner.com/iron-ii-sulfide.html>

<https://www.youtube.com/watch?v=fkqgx1CPKxs>

### ACTIVITY 1.2.2

### Comparing molecular and ionic compounds

LB page 11

(Individual)

CP5.6, CP6.6, CP6.4, CI5.4

## Answers

1.

Compounds with two non-metal elements	Compounds with a metal and a non-metal element
Ammonia	Sodium chloride
Iodine monochloride	Potassium iodide
Sulfur hexafluoride	Zinc chloride
Water	Aluminium carbide
Butane	Caesium bromide
Sulfur dioxide	Aluminium nitride
Nitrous oxide	Calcium iodide
Carbon monoxide	Aluminium phosphide
Carbon disulfide	Barium nitride
Sulfur trifluoride	Aluminium oxide
Nitrogen triiodide	
Tetrasulfur dichloride	
Methane	

- Compounds with two non-metal elements are all binary molecular compounds. Compounds with a metal and a non-metal element are all binary ionic compounds.
- Binary molecular compounds are formed by two non-metal elements. Ionic compounds are formed by the combination of a metal ion and a non-metal ion.

## Unit 1.3 Characteristics of acids, bases and salts

### Content standard

- B9.1.1.1: Show an understanding of formation of binary chemical compounds and their uses (acids, bases and salts).

### Indicator

- B9.1.1.1.3: Describe the characteristics of common acids, bases and salts.

## Exemplars

- Identify acids, bases and salts by their characteristics.
- Create a model of a pH scale and use it to determine the strength of common acids and alkali solutions using indicators.

## Unit in a nutshell

- An acid is a compound that contains a lot of hydrogen atoms and can donate hydrogen ions when combined with another substance, such as water.
- A base is an ionic compound that, when combined with another substance, such as water, can gain hydrogen ions, forming a basic solution.
- Salts are formed by the interaction between acids and bases, called acid–base reactions or neutralisation.
- An indicator is an organic substance that changes colour when exposed to acids and bases.
- It measures how acidic or basic a substance is, based on the concentration of hydrogen ions in a substance. The scale ranges from 0 to 14.

### EXPERIMENT 1.3.1

#### Using litmus paper to test substances for alkalinity or acidity

LB page 15

*CP5.8, CI5.4, CI6.5*

#### Materials and apparatus

Red and blue litmus paper (three pieces of each per group); chemicals; a small amount of common everyday substances such as: tap water, toothpaste, shampoo, dish soap, vinegar, tea, coffee and lemon juice; glass containers for testing

## Guidelines

- Ask the learners to each bring in a substance to be tested.
- When assigning the substances to be brought in, the learners should be warned that there are many hazardous chemicals in the home. Avoid chemicals such as bleach and drain cleaner.
- Provide enough glass containers for testing.
- Refer the learners to the 'Remember' notes on page 14 of the Learner's Book to remind them of the characteristics of litmus paper.
- Read the instructions with the class before the learners start the experiment and make sure that they understand what to do.
- Walk through the class while the learners work and give guidance where needed.

### ACTIVITY 1.3.1

#### Thinking about the pH scale

LB page 16

(Individual)

*CP5.8, CI5.4, CI6.5*

## Guidelines

- This is a written activity.
- Guide and help the learners where necessary.

## Answers

1. The blue litmus paper will turn red as the lemon juice is an acid.
2. An alkaline
3. a) 7  
b) It is neutral.

- A chemical compound consists of atoms of two or more elements that are bonded together in a fixed ratio.
- two
- a) Mg                                  b) Cl                                  c) Hg
- a) bicarbonate of soda  
b) ethanol  
c) carbon dioxide
- Covalent: ethane, ethanol, hydrogen chloride, sulfur dioxide, chlorine dioxide, nitrogen dioxide  
Ionic: sodium hydroxide, potassium chloride, calcium iodide
- Hydrogen – 2 atoms; sulfur – 1 atom; oxygen – 4 atoms

- 8.** An acid is a compound that contains a lot of hydrogen atoms and can donate hydrogen ions when combined with another substance, such as water.
- 9.** Salts are formed by the interaction between acids and bases, called acid–base reactions or neutralisation.
- 10.** It will turn red, as vinegar is an acid.
- 11.** It will turn red. The tomato juice is an acid.
- 12.** **a)** green                                  **b)** 7
- 13.** Any two:  
People who keep tropical fish need to test the water in the tank regularly to make sure that the water in the tank does not become too alkaline.

Accept other suitable reasons.

## Check ...

Learners can:	Yes	No
1. Identify by name binary chemical compounds and discuss their uses.		
2. Identify and name chemical compounds from a collection of materials commonly found at home, school and in the community.		
3. Write the chemical symbols of the elements identified in the chemical compounds.		
4. Discuss the formation of binary chemical compounds.		
5. Distinguish between elements, molecules, ions and compounds.		
6. Write molecular formulae of binary compounds and describe their formation.		
7. Compare and contrast different binary chemical compounds based on their composition and properties.		
8. Form models to represent chemical compounds.		
9. Describe the characteristics of common acids, bases and salts.		
10. Identify acids, bases and salts by their characteristics.		
11. Create a model of a pH scale and use it to determine the strength of common acids and alkali solutions using indicators.		

## Unit 2.1 Types of atomic bonding

### Content standard

- B9.1.1.2: Demonstrate knowledge of atomic bonding in the formation of chemical compounds.

### Indicator

- B9.1.1.2.1: Recognise that chemical bonds result from the attraction between atoms in a compound.

### Exemplars

- Identify types of inter-atomic bonds.
- Describe the formation of inter-atomic bonds.
- Identify examples of substances that exhibit ionic, covalent and metallic bonding.

### Unit in a nutshell

- A chemical bond is the physical process that causes atoms and molecules to be attracted to each other and held together as more stable chemical compounds.
- Atoms are more reactive, and therefore more likely to bond, when their valence orbitals are not full. Atoms are more stable when their valence orbitals contain the maximum number of electrons.
- The valency is the number of electrons in the valence orbital of an atom that are able to be used to form bonds with other atoms.
- When atoms bond, electrons are either shared or exchanged.
- An ionic bond occurs when an exchange of electrons takes place and the atoms are held together by the electrostatic force of attraction between the resulting oppositely charged ions.
- Ionic compounds have high melting and boiling points and are brittle.
- Covalent bonding occurs between the atoms of non-metals and involves a sharing of electrons to fill the valence orbitals in the atoms.
- A double or triple bond occurs when there are two or three electron pairs shared between two atoms.
- Covalent compounds have lower melting and boiling points than ionic compounds.
- Covalent compounds are also generally flexible, are generally not soluble in water and do not conduct electricity.
- A metallic bond is the electrostatic attraction between the positively charged nuclei of metal atoms and the non-localised electrons in the metal.
- Metals are able to conduct both heat and electricity, they are malleable (flexible) and ductile (stretchable) and they have a high melting point and density.

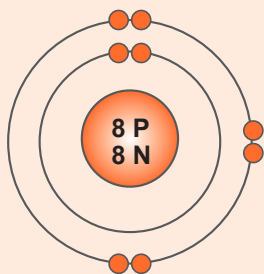
**ACTIVITY 2.1.1****Drawing a model of an atom using the Periodic Table**

LB page 21

(Individual)  
DL5.3, PL5.1, DL5.5

**Guidelines**

- This is a practical activity. The learners should follow the step-by-step instructions to draw a model of an oxygen atom.

**Answer****Assessment**

Use the rubric for drawings on page 193 of this guide to assess the learners' drawings.

**ACTIVITY 2.1.2****Drawing a model of an ionic bond**

LB page 24

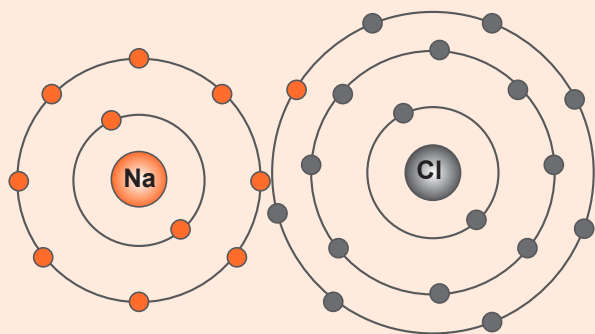
(Pairs)  
CC8.1, CC9.2, DL5.3, PL5.1

**Guidelines**

- The learners should refer to the Periodic Table to create a model of salt (NaCl).
- Assist the learners who need help with finding and using the information in the Periodic Table for sodium and chlorine.
- If necessary, remind the learners that the octet state is the most stable state.
- You can also point out that sodium has only one electron in its valence orbital.
- Also show the learners that the chlorine atom needs only one electron to fill its valence orbital.
- When the learners have completed their drawings, ask a few to copy their drawings to the board. Ask them to explain why they drew it the way they did.



## Answer



### INTERNET INTERACT

The video at the link below gives clear information about ionic binds, using NaCl as example. If there is time and if you have access to the internet, play the video for the class to watch.

<https://www.youtube.com/watch?v=IQ4JOBZRAKQ>

### ACTIVITY 2.1.3

#### Describing the formation of a covalent bond of ammonia

LB page 26

(Pairs)

CC8.1, CC9.2, DL5.3, PL5.1, PL6.8, DL5.5

### Guidelines

- The learners should work out how nitrogen and hydrogen atoms bond to form a molecule of ammonia ( $\text{NH}_3$ ).
- They should also draw a model to describe this ionic bond.
- The steps are outlined in the activity.
- Encourage the learners to do an internet search to find more information about covalent bonds.
- Assist and guide any learners who are having difficulty through the steps needed to complete the activity.

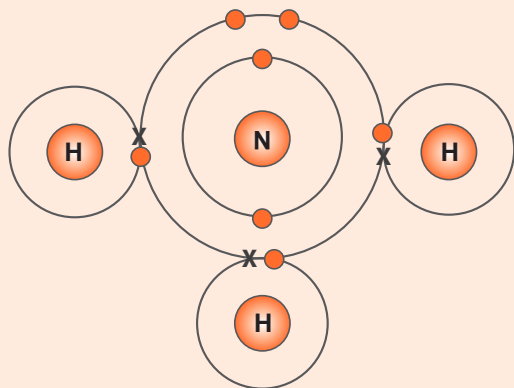


### INTERNET INTERACT

If you have internet access in class, you can play the following video for the class. It explains how to draw the model of ammonia.

<https://www.youtube.com/watch?v=y1agNciN9uE>

## Answer



## TALK ABOUT

LB page 27

There are countless objects that are made of metal, so the learners' answers will vary. Guide the discussion and help the learners to understand the link between the metal used to make an object and its function. For example:

- The wires in an electric cable are made of copper. Copper is a good conductor, so electricity can flow through the cable.
- Steel is very strong, so it is useful in construction and to make tools such as hammers.
- Gold is malleable, so it is good for making jewellery.

## ACTIVITY 2.1.4

### Drawing models of chemical bonds

LB page 27

(Individual)

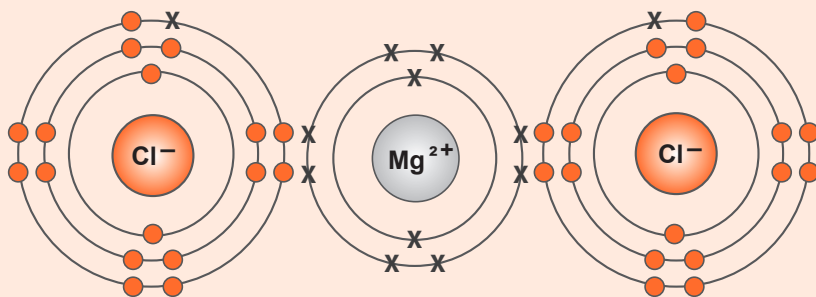
PL5.1, DL5.5

## Guidelines

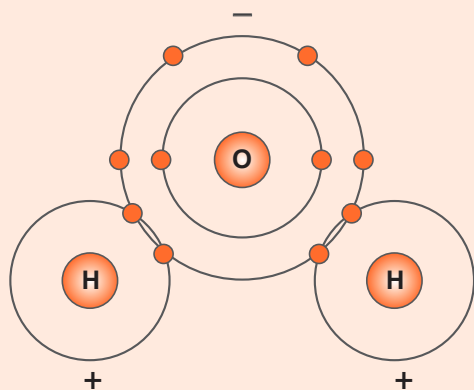
- The learners should create models and name the bonds.
- Assist any learners who are still struggling.

## Answer

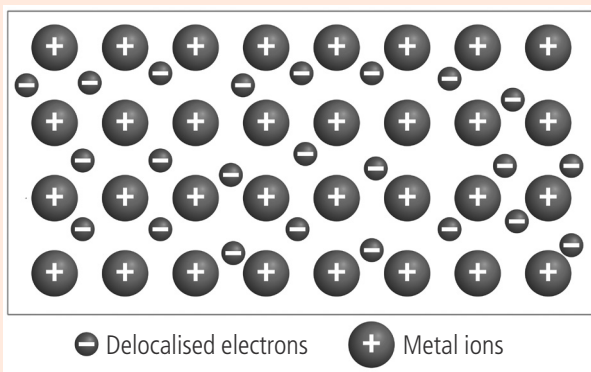
1. a) magnesium chloride ( $\text{MgCl}_2$ ) – ionic bond



b) water ( $\text{H}_2\text{O}$ ) – covalent bond



2.



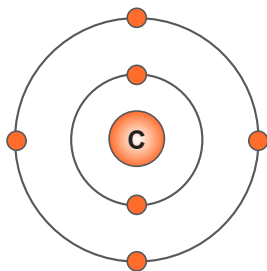
## Assessment

Use the rubric for drawings on page 193 of this guide to assess the learners' drawings.

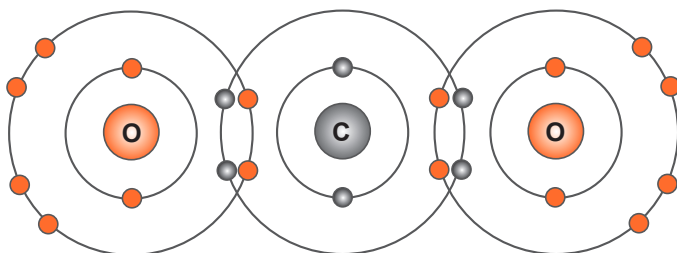
Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1. B ionic bonding
2. D 8
3. A chemical bond is the physical process that causes atoms and molecules to be attracted to each other and held together as more stable chemical compounds.
4. To find the number of neutrons in the nucleus, subtract the number of protons from the atomic number.
5. Any three:  
They conduct electricity well.  
They conduct heat well.  
Metals are both malleable and ductile.  
Aside from mercury, they are solids at ordinary temperatures.

6.



7.



### Check ...

Learners can:	Yes	No
1. Identify types of inter-atomic bonds.		
2. Describe the formation of inter-atomic bonds.		
3. Identify examples of substances that exhibit ionic, covalent and metallic bonding.		

# Topic 2: Living cells

## Module 3

## Specialised cells

### Unit 3.1 Specialised cells

#### Content standard

- B9.1.2.1: Demonstrate knowledge of specialist cells of dicotyledonous plants and humans, their formation and functions for the existence of the plants and humans.

#### Indicator

- B9.1.2.1.1: Discuss the concepts of specialised cells and how they are formed in dicotyledonous plants and humans.

#### Exemplars

- Brainstorm to bring out the meaning of specialised cells.
- Discuss how specialised cells are formed in dicotyledonous plants and humans.

#### Unit in a nutshell

- A specialised cell is a cell that is modified to perform a specific (particular) function in the body of an organism.
- There are two types of cell division, namely meiosis and mitosis.
- Plants have specific regions, called meristems, in which cell division takes places.
- The cells produced by the meristems are unspecialised and can develop into any type of cell.
- Differentiation is influenced by the location of the cell (environment), genes and hormones.
- The embryo of a developing animal contains stem cells that can differentiate into any cell type. The process of cell differentiation and specialisation is controlled and determined by each organism's DNA.

#### ACTIVITY 3.1.1

#### Discussing cells

LB page 31

(Groups)  
CC9.1, CP6.4

#### Guidelines

- The aim of this activity is that the learners can consolidate their knowledge of cells from previous years.
- For question 3, the learners have to use their own knowledge and insight to brainstorm the meaning of specialised cells. Guide the learners to formulate a good definition and write it on the board. Refer to this when you discuss specialised cells later in the lesson or in the next lesson (see Learner's Book page 33) and ask the learners if the definition they formulated is accurate.

## Answers

1. Any two: bacteria, protists, yeast
2. It is an organism that is made up of many cells. Examples: any plant or animal.
3. Specialised cells are cells that are modified to perform a specific function in the body of an organism. Specialised cells become adapted to perform these specific functions by modifying either their size, shape or structure.

### ACTIVITY 3.1.2

### Researching and discussing

LB page 33

(Groups)

CC9.1, CP6.4

## Guidelines

- Encourage the learners to find more information about cell division than what is included in the Learner's Book.
- Allow for some discussion time for the learners to consolidate their research and knowledge.

## Answers

The learners' answers will vary, but they should include the following points:

- Cells divide many times to form a fully developed organism.
- There are two types of cell division, namely meiosis and mitosis.
- Meiosis is a type of cell division in which the chromosome number in each cell is halved. This type of cell division is limited to sex cells (sperm cells and ova). The chromosome number is halved so that when a sperm cell and ovum join, the cell that is produced will have the correct number of chromosomes.
- Mitosis is a type of cell division where each cell divides to form two daughter cells that are exactly the same as the original cell. This type of cell division provides new body cells that are needed for growth or to replace old or damaged cells.



### INTERNET INTERACT

Watch the video 'What is a chromosome?' with the class and explain anything they do not understand.

<https://www.youtube.com/watch?v=lePMXxQ-KWY>

### TALK ABOUT

LB page 34

Watch the video at the link below with the class and have a class discussion about the possibilities offered by using stem cells in medicine. Bear in mind that this may be a controversial topic for some. Point out to learners that they should respect each other's opinions. <https://www.youtube.com/watch?v=evH0I7Coc54>

Encourage the learners to do their own research online to learn more about this topic.

### ACTIVITY 3.1.3

### Answering questions about cell specialisation

LB page 35

(Individual)  
CC9.1, CP6.4

### Guidelines

- Make sure that the learners understand the concept of cell specialisation. Explain that multicellular organisms have many cells that are specialised to perform certain functions, and that their structure is adapted to the specific function.
- Give an opportunity for the learners to ask questions about any aspect of the work that they do not understand.
- If the learners have access to the internet, encourage them to do their own research to find out more about cell specialisation.
- The learners can do the activity for homework. During the next lesson, go through the answers in class and let the learners mark their own work and correct any wrong or incomplete answers.

### Answers

1. A specialised cell is a cell that has developed (become specialised) to carry out particular functions.
2. An apical meristem is found at growing points of roots and tips of shoots. It is responsible for primary growth (increased length).  
A lateral meristem is found in the cambium in stems and roots, and is responsible for secondary growth (increased diameter).
3. Stem cells are found in the embryo of a developing animal. The stem cells are able to differentiate into any cell. They are, in other words, immature cells.

### TALK ABOUT

LB page 35

Explain to the learners that in most cases, a cell cannot undergo mitosis once it has become specialised. Stem cells, however, can undergo mitosis and divide. They are therefore essential to replace specialised cells that have been destroyed or damaged.

If possible, watch the two videos below on your own before the lesson. It will give you a good background to help explain the concepts to the class. If time allows, you can play the videos for the class.

- A stem cell story:  
[https://www.youtube.com/watch?v=2-3J6JGN-\\_Y&t=884s](https://www.youtube.com/watch?v=2-3J6JGN-_Y&t=884s)
- GCSE Biology – Cell Differentiation, Specialisation & Stem Cells #3:  
[https://www.youtube.com/watch?v=X0GMp8oM\\_2E](https://www.youtube.com/watch?v=X0GMp8oM_2E)

## Unit 3.2 Specialised cells in dicotyledonous plants

### Content standard

- B9.1.2.1: Demonstrate knowledge of specialist cells of dicotyledonous plants and humans, their formation and functions for the existence of the plants and humans.

### Indicator

- B9.1.2.1.2: Examine the functions of specialised cells in dicotyledonous plants such as epidermal, guard cells, cambium, xylem in relation to the existence of the plants.

### Exemplars

- Observe specialised dicotyledonous plant cells such as *epidermal*, *guard cells*, *cambium*, *xylem* from videos and charts and identify them by their names and shapes.
- Search from books and the internet for information on the functions of the specialised cells of dicotyledonous plants and how they relate to the existence of the plants.

### Unit in a nutshell

- The epidermis is made up of pavement cells, stomatal guard cells and trichomes.
- Pavement cells form a sturdy layer on the surface of a leaf that protects the leaf, prevents excess water loss, maintains the internal temperature of the leaf, keeps the inner layers of cells in position, and keeps the stomata apart.
- Guard cells control the opening and closing of stomata.
- Trichomes are growths that develop from the epidermal cell on the leaves and stems of some plants.
- Cambium is a meristem in the stems and roots of plants. It provides partially undifferentiated cells for secondary growth.
- The vascular cambium is the main meristem for secondary growth.
- Xylem carries water and mineral salts from the root to the stem and leaves.
- Phloem tissue transports organic nutrients from the leaves to the rest of plant.

#### EXPERIMENT 3.2.1

#### Observing stomata on a leaf

LB page 38

(Pairs)

CP5.1

#### Materials and apparatus

Leaf, clear nail varnish, clear sticky tape, microscope glass slide, microscope cover slip, microscope

### Guidelines

- Read the instructions in the Learner's Book with the class before they start with the experiment. Make sure that they understand what they have to do.
- If you do not have nail varnish available, you could use superglue instead.
- Walk through the class while the learners are working and give guidance where necessary.



## Answers

The learners record their observations. You can ask a few learners to share their observations with the class.

### ACTIVITY 3.2.1

### Identifying plant cells

LB page 40

(Pairs)

DL5.3, CP5.1

## Guidelines

- Ask the learners to name the plant cells that you have discussed so far in this module. Write the list on the board.
- To consolidate their learning, ask the learners to say where each type of cell is found and what the function of each type of cell is. Tell the learners that they should keep that information in mind when they look at the micrograph in Activity 3.2.1.
- Let the learners work in pairs and decide what type of cells are shown on the micrograph. Encourage them to give reasons for their answers.

## Answers

1. A: epidermis; B: guard cells (part of stoma); C: trichome
2. Epidermis: (any two) It protects the plant from injury. It helps to prevent harmful micro-organisms from entering the plant tissue. It prevents loss of water. It helps to maintain the water balance in the plant. It helps to store water.  
Guard cells: The guard cells control the opening and closing of stomata. They control the exchange of gases between the internal part of the leaf and the atmosphere surrounding the leaf.  
Trichome: (any two) It prevents water loss by transpiration. It protects the plant against harsh sunlight. It helps to regulate the temperature in the leaf. It protects the plant from being eaten by animals. It secretes substances that attract insects that help with pollination. It secretes substances that act as insect repellent.

### ACTIVITY 3.2.2

### Drawing a stem

LB page 41

(Individual)

DL5.3, CP5.1

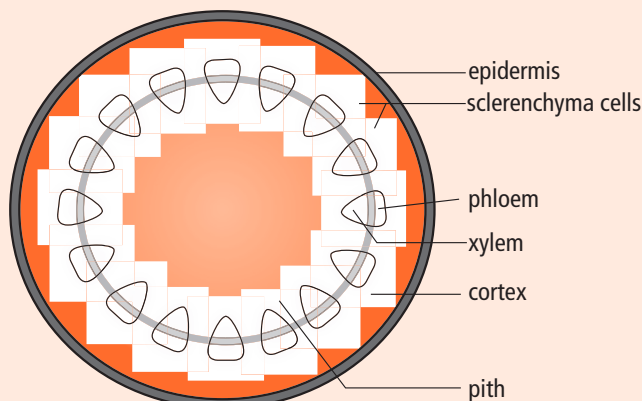
## Guidelines

- Summarise the differences between a herbaceous and a woody stem for the class. You can refer to Figure 3.2.11 and Figure 3.2.12 on page 40 of the Learner's Book.
- Write the assessment criteria for drawings (see the rubric on page 193 of this guide) on the board. Read the criteria with the class and advise them to refer to the list when they make their drawing. (Note: Point 5 in the rubric on page 193 is not relevant to this activity.)

- Ask the learners to work on their own and complete Activity 3.2.2. If there isn't time to do it in class, you can give it as homework. (If the learners will do the drawing as homework, ask them to copy the assessment criteria into their workbook for reference.)

## Answers

- It is a herbaceous stem. It contains vascular bundles that are arranged to form a ring inside the stem.
- 



### ACTIVITY 3.2.3

### Comparing xylem and phloem

LB page 44

(Individual)  
CC9.1, CP6.4

## Guidelines

- Make sure that the learners understand the difference between xylem and phloem. Give them an opportunity to ask questions. Give further attention to any sections of the work with which the learners may be struggling.
- Ask the learners to complete Activity 3.2.3.

## Answers

1. Characteristic	Xylem	Phloem
Function	Carries water and mineral salts from the root to the stem and leaves	Carries organic nutrients produced during photosynthesis (mainly as sucrose) from the leaves to the rest of plant
Position in vascular bundle	In the centre of the vascular bundle	In the outer side of vascular bundle
Condition of vessels (living/dead)	Mostly dead, parenchyma is the only living part	Living
Structure	Consists of four elements: <ul style="list-style-type: none"> <li>vessels</li> <li>tracheids</li> <li>parenchyma cells</li> <li>fibres</li> </ul>	<ul style="list-style-type: none"> <li>Consists mainly of two types of cells, namely sieve-tube cells and companion cells</li> <li>Also contains sclerenchyma cells, parenchymal cells and fibre</li> </ul>
Direction of movement	Only upwards	Upwards and downwards

2. Answers will vary, but should demonstrate that the learners understand the following:
- Xylem is found throughout the plant, and carries water and mineral salts from the root to the stem and leaves. The movement is only in one direction (upwards).
  - Xylem consists of vessels, tracheids, parenchyma cells and fibres.
  - Tracheids have thick secondary cell walls and are tapered at the ends. Tracheids do not have end openings like the vessels. The ends of tracheids overlap one another. Small openings called pits allow water to pass horizontally from cell to cell.
  - The xylem parenchyma cells are the only living part of xylem. The parenchyma cells have nuclei and protoplast. They also have large vacuoles. The parenchyma cells help with the transportation of water over small distances. They also store food in the form of starch and fats.
  - The xylem fibres are strong and elastic. They protect the xylem tissue and provide mechanical support.

## Unit 3.3 Specialised cells in animals

### Content standard

- B9.1.2.1: Demonstrate knowledge of specialist cells of dicotyledonous plants and humans, their formation and functions for the existence of the plants and humans.

### Indicator

- B9.1.2.1.2: Examine the functions of specialised animal cells such as nerve cells, blood cells, muscle cells and sperm cells in relation to the existence of humans.

### Exemplars

- Observe specialised animal cells such as nerve cells, blood cells, muscle cells and sperm cells from pictures, videos and charts and identify them by their names and make models to represent their shapes.
- Search from books, journals and internet for information on specialised cells in exemplar 1 and how they relate to the existence of humans.

### Unit in a nutshell

- The embryo of a developing animal contains stem cells that can develop into any type of cell.
- There are three types of blood cells, namely red blood cells, white blood cells and platelets.
- Red blood cells carry oxygen from the lungs to the rest of the body.
- White blood cells protect the body against infection and invasive substances or organisms.
- Platelets cause blood to clot.
- There are three types of muscle cells, namely skeletal muscle, smooth muscle and cardiac muscle.
- Skeletal muscles are voluntary muscles. They are responsible for movement of the skeleton.
- Smooth muscles are involuntary muscles. They are found in the walls of hollow organs.
- Cardiac muscles are involuntary muscles and are found only in the heart.

- Sperm cells are the male gametes. Their function is to transfer genes from the male animal to fertilise the female gamete during sexual reproduction.
- Ova are the female gametes. They fuse with sperm cells to create a zygote, that develops into a new individual.

### ACTIVITY 3.3.1

### Examining animal cells

LB page 45

(Pairs)

DL5.3, CP5.1

### Guidelines

- If you have microscopes and microscope slides available, remind the learners how to use a microscope correctly. Help learners who struggle to focus the microscope correctly.
- If you don't have microscopes available, guide the learners to search online for micrographs. You could also show them photos in books.
- Walk through the class while the learners are working and give guidance where needed. If any learners struggle to identify a cell, ask them to tell you what they remember about the different cells. Prompt them to identify characteristics of the cell in the micrograph until they reach the correct answers.

### Answers

This is a practical activity and there are no specific answers.



### INTERNET INTERACT

There are many videos online that you can watch with the class. The video at the link below gives an overview of specialised animal cells, and will help the learners to identify cells in micrographs.

<https://www.youtube.com/watch?v=2sB735u8Y5U>

### ACTIVITY 3.3.2

### Class quiz

LB page 48

(Class)

CP5.1, DL5.3

### Guidelines

- Divide the class into two groups, one for elements and one for symbols.
- Guide the learners in the quiz, acting as the adjudicator.
- The learners who ask the questions can refer to the Learner's Book to formulate the questions and to check the answers.

### Answers

Answers will vary according to the quiz questions. Use the Learner's Book to check answers.

(Groups)

CP5.1, DL5.3

## Guidelines

- This activity gives the learners the opportunity to consolidate their knowledge of blood cells, and to think about how the form and function of blood cells are related.
- If you have internet access, you can encourage the learners to find information online. You can also bring books or copies of relevant articles to class so that the learners can find more information. The learners may also refer to the Learner's Book.
- Walk through the class while the learners are having their discussion and give guidance where needed.
- If you notice that learners are struggling to understand any part of the work, make time to explain the information again to the class.

## Answers

1. The learners can refer to the text in the Learner's Book to make sure that they have the correct information about the function of blood cells. For the discussion about the relationship between the physical characteristics of cells and their function, they can, for example mention the following:
  - Red blood cells: Their main function is to carry oxygen from the lungs to the rest of the body. The shape of red blood cells enlarges their capacity for carrying oxygen. They are small and flexible, so they can fit through narrow blood vessels. They have a thin outer membrane, which allows oxygen to diffuse easily through the cell membrane. They do not have a nucleus, as they do not need it to fulfil their function of transporting oxygen through the body. The absence of a nucleus means that there is more space in the cell to accommodate oxygen. They contain a red pigment called haemoglobin, which gives blood its characteristic red colour. Haemoglobin easily combines with oxygen to form oxyhaemoglobin. This makes it easy for the blood to transport oxygen to the various tissues in the body.
  - White blood cells: Their main function is to protect the body against infection. White blood cells are bigger and have a nucleus. The cell organelles are necessary to produce energy, which is necessary to fight infections and destroy pathogens. White blood cells are more complex, and must be able to produce and release certain chemical substances. They do not contain haemoglobin, which leaves more space in the cell for essential components.
  - Platelets: Their main function is to cause blood to clot. In their inactive state, they are shaped like small discs or plates. When they get a signal that a blood vessel has been damaged, the platelets travel to the injured site and change into their active form. They grow sticky protrusions that help them stick to one another, and form a clot (plug) around the wound to stop the bleeding.
2. There are many types of blood disorders. The most common ones for each type of blood cell are listed below, but the learners can give any other valid examples.
  - Red blood cells: anaemia
  - White blood cells: various cancers, for example lymphoma, leukaemia and myeloma
  - Platelets: haemophilia, certain types of purpura, blood clots

**ACTIVITY 3.3.4****Identifying muscle tissue**

LB page 52

(Groups)  
CP5.1, DL5.3

**Guidelines**

- Summarise the lesson by giving a brief description of each type of muscle cell and their functions. Refer to the images in the Learner's Book or other images of muscle cells that you may have and check that the learners can identify the different types.
- For the report, help the learners to access information.
- Encourage the learners to use drawings or pictures to illustrate their reports.
- Write down the assessment rubric for reports on the board so that the learners know how their reports will be assessed.

**Answers**

- a)** Cardiac muscle      **b)** Smooth muscle      **c)** Skeletal muscle
- Answers will vary.

**Assessment**

Use the rubric for reports on page 194 of this guide to help you assess the learners' reports.

**ACTIVITY 3.3.5****Matching features to cells**

LB page 54

(Individual)  
CP5.1

**Guidelines**

- If time allows, the learners can do this activity in class. Alternatively, ask them to do it as homework.
- When the learners have completed the task, ask them to form pairs and swap their books. In their pairs, the learners mark each other's work and help each other to make corrections, if necessary.
- Then go through the answers with the class.

**Answers**

1.	Column A	Column B
	<b>a)</b> Nerve cells	<b>F.</b> responsible for sending and receiving signals from your central nervous system (brain and spinal cord)
	<b>b)</b> White blood cells	<b>E.</b> protect the body against infection
	<b>c)</b> Smooth muscles	<b>D.</b> found in the walls of hollow organs
	<b>d)</b> Sperm cells	<b>G.</b> contain only half the number of chromosomes
	<b>e)</b> Red blood cells	<b>B.</b> have no nucleus
	<b>f)</b> Platelets	<b>A.</b> cause blood to clot
	<b>g)</b> Dendrites	<b>C.</b> fibrous roots that branch out from the cell body

2. a) cardiac
- b) skeletal
- c) smooth

### PRACTICAL ACTIVITY 3.3.1 Making models of cells

LB page 55

(Groups)  
CP5.1, DL5.3

#### Materials and apparatus

Any of the following, as needed: clay, play dough, papier-mâché, string, paper, cardboard, scissors, felt-tip pens

#### Guidelines

- This should be a fun activity to help the learners to consolidate their understanding of types of cells.
- Ask the learners in advance to collect materials that they can use to make their models. This could include recycled materials such as clear plastic bags, plastic bottles, string, cardboard and paper. They could also make papier-mâché or play dough.

##### To make papier-mâché

Tear strips of newspaper and mix the strips of paper in a paste made of water and flour (one part flour with one part water). Blend the paper and flour mixture together until it forms a smooth paste that is easy to mould.

##### To make play dough

Mix 1 cup flour, ½ cup salt, 1 tablespoon vegetable oil and 1 cup water together till you have a smooth dough. You can also add a few drops of food colouring to get different colours.

- Divide the class into groups and assign a type of cell, or set of cells, to each group. (This will depend on the number of learners in each group, and the amount of time available.) The complete range of cells that should be covered is:
  - nerve cells: multipolar, unipolar, bipolar, pyramidal
  - blood cells: red, white, platelet
  - muscle cells: skeletal muscle, smooth muscle, cardiac muscle
  - sex cells: ovum, sperm.
- Ask the learners to refer to the illustrations of the different types of cells in the Learner's Book to make their models.
- Encourage the learners to be creative and resourceful.
- Let the groups display their completed models in the classroom.
- Give the groups time to move around and identify the other groups' models.

#### Answers

This is a practical activity and there are no specific answers.

(Groups)

CP5.1, CC 9.1

### Answers

1. It is a compound that is made up of only two different elements.
2. Atomic bonding is how atoms connect to form molecules and compounds. There are three main types of atomic bonds: ionic, covalent and metallic.
3. A specialised cell is a cell that is modified to perform a specific function in the body of an organism. It becomes adapted to perform these specific functions by modifying either its size, shape or structure.
4. Meiosis and mitosis

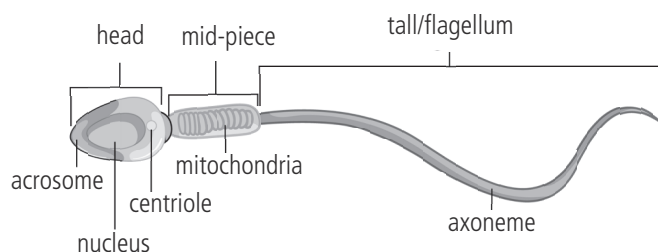
### Assessment

Use the rubric for models (see page 194 of this guide) to assess and award marks for the learners' models.



Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1. a) Cell division takes place in meristems.  
b) Stem cells in embryo of a developing animal differentiate into any cell type.
2. Meiosis is a type of cell division in which the chromosome number in each cell is halved. This type of cell division is limited to sex cells (sperm cells and ova). The chromosome number is halved so that when a sperm cell and ovum join, the cell that is produced will have the correct number of chromosomes.  
Mitosis is a type of cell division where each cell divides to form two daughter cells that are exactly the same as the original cell. This type of cell division provides new body cells that are needed for growth or to replace old or damaged cells.
3. The location of the cell (environment), genes, hormones
4. Cambium: provides partially undifferentiated cells for plant growth  
Xylem: conducts water and dissolved nutrients upwards from the root  
Phloem: conducts sugars and other metabolic products downwards from the leaves
5. a) True  
b) False. Interneurons send messages from one neuron to another.  
c) True
6. a) Transfers genes from the male animal to fertilise the female gamete during sexual reproduction  
b) It is the female reproductive cell.  
c) Sends and receives signals from the central nervous system  
d) Carries oxygen from the lungs to the rest of the body  
e) Protects the body against infection and invasive substances or organisms  
f) Causes blood to clot
7. Draw a labelled diagram of a sperm cell.



## Check ...

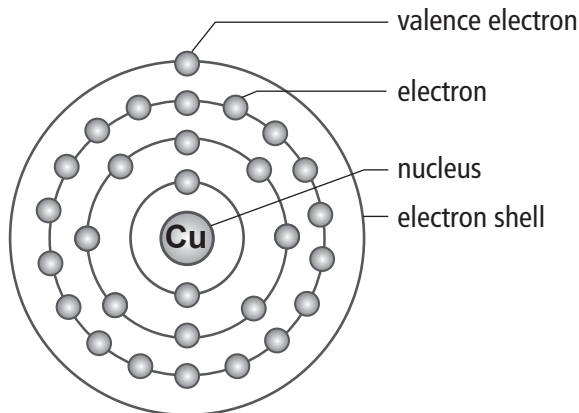
Learners can:	Yes	No
1. Demonstrate knowledge of specialised cells and how they are formed in dicotyledonous plants and humans.		
2. Explain the meaning of specialised cells by brainstorming ideas.		
3. Discuss how specialised cells are formed in dicotyledonous plants and humans.		
4. Describe/explain the functions of specialised cells in dicotyledonous plants, such as epidermal, guard cells, cambium and xylem.		
5. State the functions of specialised animal cells such as nerve cells, blood cells, muscle cells and sex cells.		

**Activity 1: Multiple choice**

1. C atoms
2. C  $\text{H}_2\text{O}$
3. A two
4. D valence orbital
5. A cation
6. C Covalent
7. A metal
8. C at the tips of roots
9. D axon
10. A walls of hollow organs

**Activity 2: Short questions**

1. It saves time and space to write only one or two letters instead of a whole word.  
It makes chemical formulae shorter and easier to read.  
The same symbols are used throughout the world so anybody can understand them, irrespective of which language they speak.
2. Salts are made from metallic and non-metallic ions.  
They have a crystalline structure.  
They dissolve in water.  
Strong salts, made from strong acids and bases, have no smell; weak salts may smell sweet, sour, salty or bitter.
3. a) It turns red.  
b) It turns blue.  
c) It turns blue-red.
4. The pH scale is based on the values obtained with a universal indicator. It measures how acidic or basic (alkaline) a substance is, based on the concentration of hydrogen ions in a substance. The scale ranges from 0 to 14.
5. Chemical bonding is the physical process that causes atoms and molecules to be attracted to each other and held together as more stable chemical compounds.
- 6.



7. An ionic bond is formed by the electrostatic attraction between oppositely charged ions in a chemical compound. This bond forms when the outermost (valence) electrons of one atom are transferred permanently to the other atom. The atom that gains electrons becomes a negatively charged ion (anion), while the one that loses them becomes a positively charged ion (cation). Ionic bond formation is favoured by atoms that easily lose or gain electrons. This means that metals on the far left of the Periodic Table and non-metals on the far right form ionic bonds.
8. Ionic compounds do not contain molecules.  
They conduct electricity when melted or dissolved in water.  
They are generally solids and do not vaporise easily.  
They will not usually dissolve in organic solvents.
9. the location of the cell (environment), genes, hormones
10. Phloem tissue is responsible for transporting organic nutrients produced during photosynthesis (mainly as sucrose) from the leaves to the rest of plant. Phloem can transport substances upwards and downwards.
11. Red blood cells: carry oxygen from the lungs to the rest of the body  
White blood cells: protect the body against infection and invasive substances or organisms  
Platelets: cause blood to clot

### Activity 3: Essay

Guide the students to choose a topic and write an essay.

Use the rubric for essays on page 195 of this Teacher's Guide to help you assess the learners' essays.

## Learning outcomes

Content standard	Indicators and exemplars	Core competencies
<b>Topic 1: Earth science</b>		
<b>B9.2.1.1</b> Demonstrate an understanding of the nitrogen cycle as a repeated pattern of change in nature, and how it relates to the environment.	<p><b>B9.2.1.1.1</b> Explain the process of the nitrogen cycle as a repeated pattern in nature.</p> <ol style="list-style-type: none"> <li>1. Identify the nitrogen cycle from the internet, charts or pictures.</li> <li>2. Explain the nitrogen cycle, depicting processes such as: <ul style="list-style-type: none"> <li>– nitrogen fixation</li> <li>– nitrification (converting ammonia into nitrates)</li> <li>– assimilation (plants and animals using nitrogen)</li> <li>– ammonification (adding organic nitrogen compounds to ammonia or ammonia formation)</li> <li>– denitrification.</li> </ul> </li> <li>3. Explain the relationship between the nitrogen cycle and the environment.</li> <li>4. Explain why the nitrogen cycle is a repeated pattern in nature.</li> </ol>	DL5.4, CP5.6, CG5.3, CC7.3
	<p><b>B9.2.1.1.2</b> Describe the importance of the nitrogen cycle to the environment.</p> <ol style="list-style-type: none"> <li>1. Describe the importance of nitrogen to the environment.</li> <li>2. Carry out a project to show how certain plants such as leguminous crops can replenish nitrogen in the soil.</li> <li>3. Predict what will happen if the nitrogen cycle is interrupted by actions such as leaching, bush burning, and destruction of leguminous plants.</li> </ol>	CI5.3, CC8.1, CI6.4
<b>Topic 2: Life cycle of organisms</b>		
<b>B9.2.2.1</b> Demonstrate an understanding of the life cycle of grasshoppers and assess how their activities affect humans.	<p><b>B9.2.2.1.1</b> Describe the life cycle of the grasshopper as a form of incomplete metamorphosis.</p> <ol style="list-style-type: none"> <li>1. Draw the stages of the life cycle of a grasshopper from egg through nymph to adult.</li> <li>2. Identify the behaviour of each stage of the life cycle of a grasshopper.</li> <li>3. Explain why the life cycle of the grasshopper is described as incomplete metamorphosis as compared to complete metamorphosis in the housefly and mosquito in B7.2.2.1.1 and B8.2.2.1.1 respectively.</li> </ol>	CI6.3, DL6.3, CC8.1, CC8.2, CP9.2

Content standard	Indicators and exemplars	Core competencies
	<p><b>B9.2.2.1.2</b> Examine how the activities of the grasshopper affect humans.</p> <ol style="list-style-type: none"> <li>1. Outline the activities of the grasshopper in everyday life (e.g. feeding on grasses and weeds).</li> <li>2. Carry out a search for information on activities of the grasshopper that are harmful or beneficial to humans.</li> <li>3. Generate activities to promote or reduce the effect of the activities of grasshoppers on humans.</li> </ol>	CC7.3, CC8.2, DL5.6, DL6.6, CP6.7
<b>Topic 3: Crop production</b>		
<b>B9.2.3.1</b> Show an understanding of differences in maturities of different crops grown in different soils and different seedbeds.	<p><b>B9.2.3.1.1</b> Observe and describe differences in maturation of crops grown in different soils and on different seedbeds.</p> <ol style="list-style-type: none"> <li>1. Observe and record the maturity stages of different crops grown in different soils and seedbeds.</li> <li>2. Discuss the differences in maturity stages among the different crops on the different soils and seedbeds.</li> <li>3. Compare and contrast the maturity stages of crops and seedlings in the community/ school garden with others grown elsewhere.</li> </ol>	DL5.5, CC7.3, CC8.2, CC8.3
<b>B9.2.3.2</b> Demonstrate knowledge and understanding of uses of different crops at different maturity stages.	<p><b>B9.2.3.2.1</b> Observe and record the uses of different crops at different maturity stages.</p> <ol style="list-style-type: none"> <li>1. Discuss and write the uses of each maturity stage of each crop identified.</li> <li>2. Categorise crops by their different maturity stages and uses.</li> </ol>	CC8.2, DL5.5, CP5.1
<b>B9.2.3.2</b> Demonstrate and evaluate the importance of knowledge and understanding of uses of different crops at different maturity stages.	<p><b>B9.2.3.2.2</b> Evaluate the importance of knowledge of the maturity stages of different crops to human beings.</p> <ol style="list-style-type: none"> <li>1. Explain the specific use(s) of each maturity stage of different crops to humans, other crops, animals, and the environment.</li> <li>2. Explain how the knowledge of the maturity stages of different crops helps a farmer in crop selection, time of harvest, and others.</li> <li>3. Compare different stages of maturity of crops identified in the community with those used in other places.</li> </ol>	CC7.3, CP5.3, CP6.4, DL5.3
<b>Topic 4: Animal production</b>		
<b>B9.2.4.1</b> Demonstrate understanding of the preparation of feed for domestic and commercial animals	<p><b>B9.2.4.1.1</b> List the ingredients and the method of preparation of different feed for different domestic and commercial animals.</p> <ol style="list-style-type: none"> <li>1. Demonstrate how farmers prepare feed for different domestic and commercial animals with ingredients.</li> <li>2. Write down the process of preparing feed for different domestic and commercial animals with the ingredients.</li> </ol>	CP5.6, PL6.2, DL6.6

Content standard	Indicators and exemplars	Core competencies
	<ol style="list-style-type: none"> <li>3. Compile a table, matching feed, ingredients and method of preparation.</li> <li>4. Formulate and prepare feed for domestic and commercial animals.</li> </ol>	
<b>B9.2.4.2</b> Demonstrate skills and knowledge of feeding domestic and commercial animals.	<p><b>B9.2.4.2.1</b> Describe and select appropriate feed for different domestic and commercial animals.</p> <ol style="list-style-type: none"> <li>1. Compile a list of feed commonly consumed by the different domestic and commercial animals in the environment.</li> <li>2. Compare and contrast the characteristics of different kinds of feed commonly consumed by categories of domestic and commercial animals (ruminants, monogastrics, and poultry).</li> <li>3. Record feed used to feed domestic and commercial animals on farms over a period of time.</li> <li>4. Identify named samples of feed for three categories of domestic and commercial animals (ruminants, monogastrics, and poultry).</li> </ol>	CC8.2, DL5.3, CP5.1, PL5.2
	<p><b>B9.2.4.2.2</b> Differentiate between different types of feed for different stages of domestic and commercial animals.</p> <ol style="list-style-type: none"> <li>1. Categorise different types of animals according to their stages of growth (young, growing and matured stages).</li> <li>2. List the types of feed used for the various stages of growth in their domestic and commercial ruminants, monogastrics and poultry.</li> <li>3. Compare and construct the major functions of feed in each growth stage of different animals.</li> <li>4. Discuss types of feed used to feed different domestic and commercial animals at different stages of growth.</li> </ol>	CP5.5, CC9.2, PL5.1, CC9.4
	<p><b>B9.2.4.2.3</b> Perform the feeding of domestic and commercial animals.</p> <ol style="list-style-type: none"> <li>1. Demonstrate how to feed domestic and commercial animals at different stages of growth and production, with appropriate feed in the school farm or a farm in the community.</li> </ol>	CC8.5, CP5.6

# Topic 1: Earth science

## Module 4

## The nitrogen cycle

### Unit 4.1 Stages of the nitrogen cycle

#### Content standard

- B9.2.1.1: Demonstrate an understanding of the nitrogen cycle as a repeated pattern of change in nature, and how it relates to the environment.

#### Indicator

- B9.2.1.1.1: Explain the process of the nitrogen cycle as a repeated pattern in nature.

#### Exemplars

- Identify the nitrogen cycle from the internet, charts or pictures.
- Explain the nitrogen cycle, depicting processes such as:
  - nitrogen fixation
  - nitrification (converting ammonia into nitrates)
  - assimilation (plants and animals using nitrogen)
  - ammonification (adding organic nitrogen compounds to ammonia or ammonia formation)
  - denitrification.
- Explain the relationship between the nitrogen cycle and the environment.
- Explain why the nitrogen cycle is a repeated pattern in nature.

#### Unit in a nutshell

- All living organisms need a source of nitrogen for the synthesis of amino acids, nucleotides and other compounds.
- Nitrogen is abundant in the atmosphere, but in a form that is inaccessible to most organisms.
- Nitrogen moves through the Earth system in a repeating cycle known as the nitrogen cycle.
- There are five main stages in the nitrogen cycle. They are:
  - nitrogen fixation
  - nitrification (converting ammonia into nitrates)
  - assimilation (plants and animals using nitrogen)
  - ammonification (adding organic nitrogen compounds to ammonia or ammonia formation)
  - denitrification.
- During the process of nitrogen fixation, atmospheric nitrogen ( $N_2$ ) is converted into a usable form, namely nitrates ( $NO_3^-$ ).
- There are three ways in which nitrogen fixation can take place, namely atmospheric fixation, biological fixation and non-biological or artificial fixation.
- In legumes, biological nitrogen fixation takes place inside root nodules.
- Animals assimilate nitrogen by consuming these plants or other animals that contain nitrogen. Humans consume proteins from these plants and animals and then the nitrogen assimilates into our system.



- During the final stages of the nitrogen cycle, bacteria and fungi help decompose organic matter, where the nitrogenous compounds get dissolved into the soil. The nitrogen is again used by the plants.
- Some bacteria then convert these nitrogenous compounds in the soil and turn them into nitrogen gas. The nitrogen gas goes back into the atmosphere.
- Nitrogen can be lost from the system through denitrification by denitrifying bacteria, conversion of  $\text{NH}_4^+$  (urea) to ammonia gas ( $\text{NH}_3$ ) under warm, dry conditions, leaching of  $\text{NO}_3^-$  (nitrates) into water bodies, erosion and combustion (fires).

### ACTIVITY 4.1.1

### Finding online charts and diagrams of the nitrogen cycle

LB page 63

(Individual)

DL5.4, CP5.6, CC7.3

### Guidelines

- The learners can do this activity on their own. They could also do it as a homework.
- The learners should use the internet or books to find charts and diagrams of the nitrogen cycle.
- Guide them in finding and selecting suitable diagrams that are not too simplified or advanced but that show the five main processes as well as some of the organisms involved in the cycle.

### Answers

Guide the learners to find suitable and reliable sources of information. They should be able to see from the information they gather that there are five main stages in the nitrogen cycle, namely nitrogen fixation, nitrification, assimilation, ammonification and denitrification.

The lists the learners make and their discussions will depend on the information they have gathered. Point out that they will learn more about the nitrogen cycle on the pages that follow, and that they will be able to see if their opinions were valid.

### ACTIVITY 4.1.2

### Drawing a labelled diagram of the nitrogen cycle

LB page 68

(Individual)

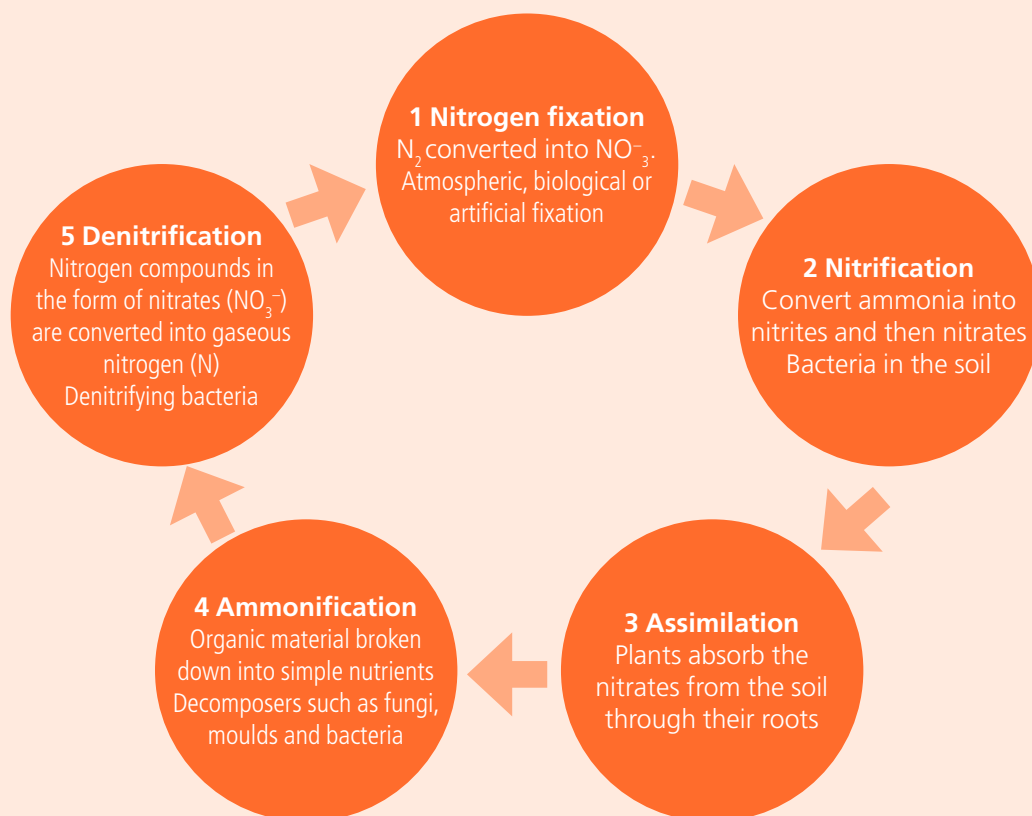
DL5.4, CP5.6, CC7.3

### Guidelines

- The learners work individually.
- They should draw a labelled diagram of the nitrogen cycle. They should use the labels to add the following information:
  - name of stage
  - basic function
  - organism(s) or event(s) that cause or perform the function.

## Answers

The learners can choose how to draw the diagram. They could add drawings, or just use simple shapes and text. They may also choose between using chemical symbols or normal text. Although the diagram will vary, the basic information in the diagram below should be included.



## Assessment

Use the rubric for drawings (see page 193 of this guide) to assess and award marks for the learners' diagrams.

### ACTIVITY 4.1.3

### Discussing the nitrogen cycle as a repeated cycle

LB page 71

(Groups)

DL5.4, CP5.6, CG5.3, CC7.3

## Guidelines

- This is a revision exercise where the learners should sum up what they have learned about the nitrogen cycle in this unit.
- They should discuss and explain why they think the nitrogen cycle is a repeated cycle. Guide the learners to understand that each step in the process sets up the conditions for the next step to occur. This is why it is called a cycle. Also guide them to understand that this cycle is repeated continually in nature.

- The learners can use a simplified version of the diagram they drew in Activity 4.1.2, maybe just with the basic stages and arrows to show the order in which the stages occur.

### Answers

There are no specific answers for this activity.

## Unit 4.2 The importance of the nitrogen cycle

### Content standard

- B9.2.1.1: Demonstrate an understanding of the nitrogen cycle as a repeated pattern of change in nature, and how it relates to the environment.

### Indicator

- B9.2.1.1.2: Describe the importance of the nitrogen cycle to the environment.

### Exemplars

- Describe the importance of nitrogen to the environment.
- Carry out a project to show how certain plants such as leguminous crops can replenish nitrogen in the soil.
- Predict what will happen if the nitrogen cycle is interrupted by actions such as leaching, bush burning, and destruction of leguminous plants.

### Unit in a nutshell

- If the balance of nitrogen is disrupted, it can affect the growth and health of plants and animals.
- Certain plants such as leguminous crops can replenish nitrogen in the soil.
- Human activities, such as application of nitrogen fertilisers, bush burning and the destruction of leguminous plants can cause an imbalance of nitrogen in the ecosystem.

#### EXPERIMENT 4.2.1

#### Showing that leguminous plants can replenish soil nitrogen

LB page 72

(Groups)

CP5.6, CG5.3, CC7.3

### Guidelines

- This is a group practical experiment that will take a number of weeks to complete.
- Note that this experiment requires advance preparation. Identify a suitable part of the school grounds, or an area close to the school, where the learners can grow their plants.
- Divide the class into two groups – one to carry out the experiment, and one to carry out the experimental control. Explain to the learners why a control group is necessary (see the internet Interact feature after the Answers section).
- Make sure that each group assigns a leader and a note-taker to facilitate group discussions.

- Guide the learners in discussion to ensure that each group knows exactly what it should do to achieve the goals of the experiment and plans their steps properly.
- Review the materials and apparatus list and ensure that the learners have the resources available to carry out the experiment.
- Ensure that you have first-aid resources on hand for each step of the experiment, particularly those steps that use tools.
- Supervise the progress of the experiment, ensuring that the learners take appropriate safety measures when using tools.
- For the first part of the experiment, where the control group has nothing to do, they can help the experimental group.
- As the experiment will take time to complete, revise the aims of the experiment with the learners before undertaking each step. Remind them of the steps completed so far and what still needs to be done.
- Once the experiment has been completed, the learners will have to compare the results from each group and discuss the outcomes.

### Answers

There are no specific answers to this experiment. The learners' responses will depend on what they observe. Use the information in the Learner's Book as a guideline.



### INTERNET INTERACT

The videos at the links below explain the importance of a control group in an experiment, and what independent and dependent variables are.

<https://www.youtube.com/watch?v=D3ZB2RTyIR4>

<https://www.youtube.com/watch?v=aLesk8fujH8>

### ACTIVITY 4.2.1

### Predicting the effect of human activities on the nitrogen cycle

LB page 74

(Groups)

CI5.3, CC8.1, CI6.4

### Guidelines

- The learners should use the knowledge of the nitrogen cycle that they learned in Unit 4.1 to discuss the effect that the following human activities will have on the nitrogen cycle: leaching, bush burning, the destruction of leguminous plants.
- Guide the learners' discussion to define what each of the three terms means, what they think the possible outcomes on the nitrogen cycle will be, and why they think these things will happen.

### Answers

There are no specific answers for this discussion activity. Refer to the Learner's Book for guidelines.

**ACTIVITY 4.2.2****Researching human activities that affect nitrogen balance in the environment**

LB page 76

(Pairs)

*DL5.4, CP5.6, CG5.3, CC7.3***Guidelines**

- The learners work in pairs to research and make a list of human activities in their area that might be affecting the nitrogen balance in the local environment.
- Guide them in identifying what these activities are, such as farming and land clearing, or any other activities that result in interruptions to the balance of nitrogen.
- Using what they already know about the nitrogen cycle they should list the possible outcomes of these activities.
- They should then suggest solutions that can help to prevent or minimise the disruption of the nitrogen cycle, such as better farming practices, education of farmers on the correct amounts of fertiliser to use, and so on.

**Answers**

Answers will vary, depending on the activities the learners identify.

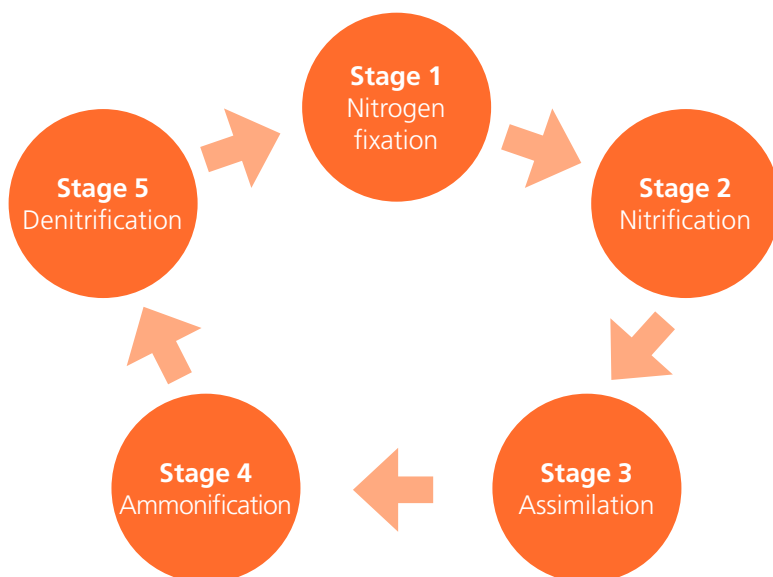
**EXTENSION ACTIVITY**

LB page 76

- Encourage the learners to prepare an oral presentation, in which they can share the information they obtained during their research with the class.
- Guide the learners when they prepare their presentations. Point out that the presentation should be well structured, with an introduction, middle (body) and a conclusion. It should be easy to follow and delivered in an engaging way.
- The learners may use photos, diagrams and/or drawings to supplement their presentation.

Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1. B atmosphere
2. A nitrites
3. A *Rhizobium*
4. Nitrogen is one of the basic nutrients that is necessary for the survival of all living organisms. It is an essential component of many biomolecules such as proteins, DNA and chlorophyll.
- 5.



6.  $N_2 \rightarrow 2N^+$ ;  $N + O_2 \rightarrow NO + O \rightarrow NO_x$
7.
  - a) Nitrogen fixation is the first step of the nitrogen cycle. During the process of nitrogen fixation, atmospheric nitrogen ( $N_2$ ) is converted into a usable form, namely nitrates ( $NO_3^-$ ).
  - b) Ammonification is the fourth stage of the nitrogen cycle, during which organic material decays.
  - c) Nitrification is the process during which ammonia is converted into nitrates.
  - d) Assimilation is the third stage of the nitrogen cycle, during which plants absorb the nitrates from the soil.
  - e) Denitrification is the final stage of the nitrogen cycle, during which nitrates are converted into gaseous nitrogen.
8. The Haber-Bosch process is an artificial nitrogen fixation process in industry and is also the process by which artificial nitrogen fertilisers are synthesised.
9. Legumes can form a symbiotic association with nitrogen-fixing bacteria. The plant creates nodules in their roots where the bacteria are found and the bacteria play a vital role in this conversion and fixation of nitrogen for the plant's use. So, legumes play an important part in the nitrogen cycle.
10. When too much nitrogen enters a body of water, it leads to a build-up of excessive nutrients called eutrophication. The large amounts of nitrogen in the water cause algae to grow excessively. The large mass of algae then takes up so much oxygen that there is not enough to keep fish and other water organisms alive and healthy. These large growths of algae are called

algal blooms. The algal bloom can cover large parts of the water surface, thereby blocking sunlight from reaching the water below. Some algal blooms produce toxins that are harmful to humans and other animals.

**11. Any one:**

Bad agricultural practices: excess nitrogen can leach out of the soil and enter streams and rivers

Bush burning: releases nitrogen into the atmosphere instead of into the soil by decomposition.  
The destruction of leguminous plants: lose a valuable source of nitrogen and decrease the quality of the soil.

**12. Divide a land space into two equal plots.**

Plant legume seeds in one plot at recommended spacing. Do not plant anything in the other plot.

Wait for the legume plants to bear nodules then replough the land.

Plant maize seeds on both plots at the recommended spacing. Watch the maize plants grow and observe the condition of the plants.

Record the plant colour and height, leaf size and plant dry matter.

Compare the condition of the plants on the land that was planted with legumes to those on the control plot.

## Check ...

Learners can:	Yes	No
1. Identify the nitrogen cycle from the internet, charts or pictures.		
2. Explain the nitrogen cycle depicting processes of nitrogen fixation, nitrification, assimilation, ammonification and denitrification.		
3. Explain the relationship between the nitrogen cycle and the environment.		
4. Explain why the nitrogen cycle is a repeated pattern in nature.		
5. Describe the importance of the nitrogen cycle to the environment.		
6. Carry out a project to show how certain plants such as leguminous crops can replenish nitrogen in the soil.		
7. Predict what will happen if the nitrogen cycle is interrupted by actions such as leaching, bush burning, and destruction of leguminous plants.		

# Topic 2: Life cycle of organisms

## Module 5

## The grasshopper

### Unit 5.1 The life cycle of the grasshopper

#### Content standard

- B9.2.2.1: Demonstrate an understanding of the life cycle of grasshoppers and assess how their activities affect humans.

#### Indicator

- B9.2.2.1.1: Describe the life cycle of the grasshopper as a form of incomplete metamorphosis.

#### Exemplars

- Draw the stages of the life cycle of a grasshopper from egg through nymph to adult.
- Identify the behaviour of each stage of the life cycle of a grasshopper.
- Explain why the life cycle of the grasshopper is described as incomplete metamorphosis as compared to complete metamorphosis in the housefly and mosquito in B7.2.2.1.1 and B8.2.2.1.1 respectively.

#### Unit in a nutshell

- Grasshoppers undergo incomplete metamorphosis.
- The life cycle of a grasshopper has three stages: egg, nymph and adult.
- When the nymphs hatch, they look just like the adults but do not have wings and reproductive organs.
- Nymphs moult four to six times before they reach adulthood.
- Adult grasshoppers can undergo a chemical change in their body and turn into locusts, which form swarms.

#### ACTIVITY 5.1.1

#### Finding out more about the grasshopper's life cycle

LB page 83

(Groups)

CI6.3, DL6.3, CC8.1, CC8.2, CP9.2

#### Guidelines

- The learners should work in groups to research details of each of the three stages of a grasshopper's life cycle and create posters for each stage.
- Divide the class into three groups or, for larger classes, multiple sets of three groups.
- Assign a life stage of the grasshopper to each group.
- Assist the groups where necessary to ensure they gather the correct information.



## Answers

Information and presentation will vary from group to group. Each poster should have the relevant information for the relevant stage of the life cycle as well as pictures.

## Assessment

Use the rubric for posters (see page 194 of this guide) to assess and award marks for the learners' posters.

### ACTIVITY 5.1.2

### Comparing and discussing life cycles

LB page 85

(Groups)

CC8.1, CC8.2, CP9.2

## Guidelines

- The learners work in groups, first reviewing what they learned in Basic 7 and Basic 8 about the life cycle of the housefly and the mosquito, then answer the questions about the life cycle of a butterfly.
- Guide the revision discussion, ensuring that the learners recall the details about these life cycles.
- Also refer the learners to the earlier Learner's Book content on life cycles and metamorphosis at the beginning of this unit.



### INTERNET INTERACT

The video below shows a grasshopper laying eggs.

<https://www.youtube.com/watch?v=QIWVf8jVOYo>

The video below shows excellent close-up footage of the giant red-winged grasshopper.

<https://www.youtube.com/watch?v=J1jHzl0LHII>

## Answers

2.
  - a) Egg, larva, pupa and adult
  - b) Complete metamorphosis as it has four stages
  - c) With the butterfly, the young caterpillar looks nothing like the adult and it goes through a complete metamorphosis of four stages (egg, caterpillar, pupa and adult) in the process to becoming adult. The grasshopper undergoes incomplete metamorphosis with three stages (egg, nymph, adult) and the nymph is similar in appearance to the adult grasshopper.

## Unit 5.2 The effect of grasshoppers on humans

### Content standard

- B9.2.2.1: Demonstrate an understanding of the life cycle of grasshoppers and assess how their activities affect humans.

## Indicator

- B9.2.2.1.2: Examine how the activities of the grasshopper affect humans.

## Exemplars

- Outline the activities of the grasshopper in everyday life (e.g. feeding on grasses and weeds).
- Carry out a search for information on activities of the grasshopper that are harmful or beneficial to humans.
- Generate activities to promote or reduce the effect of the activities of grasshoppers on humans.

## Unit in a nutshell

- A few grasshoppers in a garden or field are not a threat.
- Effective farming practices can help to offset the negative effect of grasshoppers.
- Swarms of locusts can destroy crops by eating all the plants.
- Locust infestations can lead to a food shortage and great financial loss.
- Swarms of locusts can be reduced by spraying pesticides.
- Grasshoppers are a source of nutritious food for humans.
- Grasshoppers have beneficial effects on the environment.

### ACTIVITY 5.2.1

### Discussing the case study

LB page 88

(Pairs)

CC7.3, CC8.2, DL5.6, DL6.6, CP6.7

## Guidelines

- Ask the learners if they have ever encountered a locust plague. Ask the learners to share any personal experiences or related information with the class.
- Read through the case study on pages 87 to 88 of the Learner's Book with the class.
- The learners work in pairs to discuss the case study and answer the questions.

## Answers

1. Unusually high rainfall in 2018 and 2019 caused the increase in the number of grasshoppers. The good rainfall will have increased the amount of vegetation, enabling many more grasshoppers to hatch and survive.
2. The swarms consisted of locusts rather than grasshoppers, as the increase in the grasshopper population caused them to enter the gregarious phase where they became locusts. Grasshoppers do not swarm, but locusts do.
3. Aeroplanes were used to spray pesticides. This would have been the most successful method to control the locusts if there were more planes to spray and a large enough supply of pesticides.
4. It is important to predict the movement of locust swarms and egg-laying sites of grasshoppers to be able to take preventative measures against new swarms forming.
5. food insecurity and financial loss

(Groups)

CC7.3, CC8.2, DL5.6, DL6.6, CP6.7

## Guidelines

- The learners work in groups to discuss the effects of grasshoppers.
- Divide the learners into groups and guide their discussions.
- They should research, discuss and make lists of the benefits and harmful effects of grasshoppers on humans.
- Finally, they should create a mind map of the information they have gathered and present this information to the rest of the class.

## Answers

Answers will vary. You can use the sample answer below as a guideline.

**1.** Benefits can include:

- They are good for the environment.
- They are a good source of food.
- They feed on poisonous weeds that can harm livestock.
- They improve soil fertility.
- They eat weeds.
- They prevent overgrowth of plants.

**2.** Harmful effects can include:

- Damage to crops.
- As locusts they can destroy entire crops quickly and can cost huge amounts of money to control with pesticides and spraying.

Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1. Incomplete metamorphosis is when the new individual that hatches looks similar to the adult. There are three stages in the development, namely egg, nymph and adult. Complete metamorphosis occurs when the insect undergoes a complete physical change before it becomes an adult. The process has four stages: embryo, larva, pupa and imago.
2.
  - a) False. When a grasshopper hatches, it is called a nymph.
  - b) False. An adult grasshopper is only ready to reproduce after one to three weeks.
  - c) True.
  - d) False. Grasshoppers are cold-blooded.
3.
  - a) The life cycle of a grasshopper has three stages: egg, nymph and adult.
  - b) Answers will vary, but should include the main points given below.

The egg is the first stage of a grasshopper's life cycle. Each batch of eggs typically contains 15–150 eggs, and the grasshopper can lay up to 25 batches. The eggs are in the shape of grains of rice and can be white, yellow or shades of brown, depending on the species. The time it takes for the eggs to hatch varies by species. In some species, the eggs will hatch after three to four weeks. In other species, the eggs will stay underground throughout the winter and only hatch in the spring, when the weather is warmer and there is more food available.

When the eggs hatch, the young grasshoppers, called nymphs, enter the second stage of their life cycle. The nymphs look just like the adult grasshopper, but have no wings or reproductive organs. Immediately after hatching, the nymphs start to feed on the soft, juicy parts of plants.

The adult is the third stage of the life cycle of a grasshopper. When the nymph moults for the last time, it emerges as an adult and is known as a fledgling. The fledgling has fully developed wings but the reproductive organs are still developing. The reproductive organs mature after the fledgling emerges and the adult grasshopper also gains weight. After one to three weeks, depending on the species, the grasshopper reaches full maturity. At maturity, grasshoppers can mate and the female can lay her first batch of eggs. Once the female starts laying eggs, she continues to lay eggs every three to four days until she dies. The adult stage lasts 30–50 days, until the grasshopper dies.
4. Grasshoppers have an exoskeleton that cannot stretch or expand. As the nymph develops, it outgrows its exoskeleton. As a result, the nymph has to shed the old exoskeleton so that a new, bigger exoskeleton can form. This process is known as moulting.
5. Any three:
  - They are good for the environment.
  - They are a good source of food.
  - They feed on poisonous weeds that can harm livestock.
  - They improve soil fertility.
  - They eat weeds in agricultural fields and gardens.
  - They prevent overgrowth of plants.

6. When grasshoppers change into locusts, they become social and tend to swarm. Swarms of locusts can destroy crops by eating all the plants. Locust infestations can lead to a food shortage and great financial loss.

### Check ...

Learners can:	Yes	No
1. Describe the life cycle of the grasshopper as a form of incomplete metamorphosis.		
2. Draw the stages of the life cycle of the grasshopper.		
3. Identify the behaviour of each stage of the life cycle of a grasshopper.		
4. Explain why the life cycle of the grasshopper is described as incomplete metamorphosis as compared to complete metamorphosis in the housefly and mosquito.		
5. Explain how the activities of the grasshopper affect humans.		
6. Describe the activities of the grasshopper in everyday life.		
7. Explain how grasshoppers are harmful or beneficial to people.		
8. Suggest solutions to reduce the harmful effects of grasshoppers on humans.		

# Topic 3: Crop production

## Module 6

## Maturity stages of crops

### Unit 6.1 Crop maturation

#### Content standard

- B9.2.3.1: Show an understanding of differences in maturities of different crops grown in different soils and different seedbeds.

#### Indicator

- B9.2.3.1.1: Observe and describe differences in maturation of crops grown in different soils and on different seedbeds.

#### Exemplars

- Observe and record the maturity stages of different crops grown in different soils and seedbeds.
- Discuss the differences in maturity stages among the different crops on the different soils and seed beds.
- Compare and contrast the maturity stages of crops and seedlings in the community/school garden with others grown elsewhere.

#### Unit in a nutshell

- A plant goes through various growth stages, or maturity stages.
- At every stage of the crop's development, the nutritional requirement of the crop changes.
- Farmers should know the type of soil on their farm and treat the soil for optimal production.
- A seedbed is a bed or field where seeds are sown.
- In a good seedbed, the soil is prepared in a way that will make it as easy as possible for seedlings to grow and to get all the nutrients they need.
- Different crops have different requirements in terms of the type of soil, temperature and amount of water.

#### ACTIVITY 6.1.1

#### Talking about soil types

LB page 93

(Pairs)

DL5.5, CC7.3, CC8.2, CC8.3

#### Guidelines

- The learners work in pairs to identify the different types of soil based on the details given in the questions.
- Give them enough time to consider the answers and to help one another to understand the reasons for the answers.

- Once they have identified the soil type, they should also explain how the specific type of soil will affect plant growth.
- They should write the answers in their workbooks.

### Answers

1. Chalky soil as it is full of stones. Seeds will struggle to sprout due to the stones and the high alkalinity.
2. Clay soil as water cannot drain away. Plants get too much water and roots may rot.
3. Sandy soil. As it does not hold water well, plants may not get enough water and growth will be stunted.

#### ACTIVITY 6.1.2

#### Discussing seedbeds

LB page 95

(Groups)

DL5.5, CC7.3, CC8.2, CC8.3

### Guidelines

- The learners work in groups to discuss and answer the questions.
- They should write down the answers to the questions.
- Once completed, they can exchange their answers with another group to compare.

### Answers

1. No. Raised beds do not retain water as well as flat or sunken beds, so will not work as well in an area where water is scarce and the daily temperatures are high.
2. Remove all stones and plant debris from the surface.  
Dig or plough the soil to loosen stones and debris and aerate the soil.  
Break up the soil and remove any other stones and debris.  
Improve the soil structure by digging in organic matter.  
Improve the nutrient content of the soil by adding fertilisers.  
Rake the soil again to level it.

#### ACTIVITY 6.1.3

#### Comparing maturity stages of crops grown in different seedbeds

LB page 96

(Groups)

DL5.5, CC7.3, CC8.2, CC8.3

### Guidelines

- The learners work in groups to look at the examples given and answer the questions.
- They should write the answers in their workbooks.

## Answers

1. B Correct soil and pH for the crop.
2. a) They would not germinate well due to the high alkalinity of the soil.  
b) They might take longer to reach the maturity stages or not be as healthy.
3. The roots could rot due to the clay soil holding too much water.

## PROJECT

### Preparing seedbeds and comparing growth stages of crops

LB page 96

(Groups)

DL5.5, CC7.3, CC8.2, CC8.3

## Guidelines

- The learners work in groups to do this practical project.
- If your school does not have a vegetable garden, ask permission to use an area of the school ground for this project. Alternatively, find a place close to the school where the learners will be allowed to plant crops. Parents or other members of the community may be willing to let the learners make the seedbeds on their property. (If that is the case, remember to share the yield of the crops with the property owner.)
- Make sure that you have enough tools and resources for the number of groups.
- The learners should follow the instructions in the Learner's Book for preparing seedbeds, and then grow the various crops.
- Each group should assign learners to ensure that each crop is watered according to instructions.
- Each group should assess the progress of all their crops regularly and assign one learner to carefully record the progress.
- Each group should follow the instructions to compare results between the beds and write down their conclusions.
- Have a class discussion during which the groups compare their observations.



## INTERNET INTERACT

Encourage the learners to do an online search to find out more about crop farming and how to grow specific crops. The video at the link below discusses onion farming in Ghana.

<https://www.youtube.com/watch?v=AfZCqsEfICM>

## Unit 6.2 Uses of stages of maturity

### Content standard

- B9.2.3.2: Demonstrate knowledge and understanding of uses of different crops at different maturity stages.

### Indicator

- B9.2.3.2.1: Observe and record the uses of different crops at different maturity stages.



## Exemplars

- Discuss and write the uses of each maturity stage of each crop identified.
- Categorise crops by their different maturity stages and uses.

## Unit in a nutshell

- Most fruit and vegetable crops are ready for use when the fruits are ripe or, in the case of vegetables such as potatoes, before the edible parts begin to sprout.
- Some fruit and vegetables can be used at other stages of maturity – in some cases as food for humans, but also for a variety of other uses.
- Tomatoes can be harvested during the fruiting and fruit ripening stages of the plant's life, when the fruit ranges from the green stage to the fully ripened stage.
- The banana growth cycle has three main stages, and the plant can be used at each stage of maturity.
- Parts of the onion plant can be used at different stages of maturity.
- Crops can be classified based on maturity stages and uses.

### ACTIVITY 6.2.1

#### Talking about uses of tomatoes

LB page 98

(Groups)

CC8.2, DL5.5, CP5.1

## Guidelines

- The learners work in groups to discuss how tomatoes are used in their homes.
- Guide discussion to include any home usage of different stages of maturity.

### ACTIVITY 6.2.2

#### Thinking about maturity stages of banana plants

LB page 100

(Individual)

CC8.2, DL5.5, CP5.1

## Guidelines

- The learners work on their own to complete this activity.
- They should answer the questions given in their workbook.
- When finished, they can exchange their workbook with another student for evaluation.

### Answers

1. Asexual vegetative reproduction
2. Vegetative development, flowering, fruiting
3. Any two: Vegetative development: Suckers as planting materials.  
Flowering: The bract is edible.  
Fruiting: The fruit is edible.

**ACTIVITY 6.2.3****Classifying crops**

LB page 102

(Groups)

CC8.2, DL5.5, CP5.1

**Guidelines**

- If necessary, revise the maturity stages of plants with the class before the learners do this activity.
- Explain to the learners that although the maturity stages of some plants may be subdivided or grouped together, the main stages are the same for all plants.
- Make sure that the learners understand what they should do in this activity. Give guidance where needed.

**Answers**

Stage	Uses of crops		
	Tomato	Banana	Onion
Germination and sprouting	–	–	Edible sprout
Vegetative	–	Planting material	Edible tops, edible bulbs
Flowering	–	Edible bract	Edible flowers
Fruiting	Edible fruit	Edible fruit	Edible/medicinal seeds
Maturity (seed forming)	Edible fruit	Edible fruit	Edible fruit

**ACTIVITY 6.2.4****Researching the uses of crops at different maturity stages**

LB page 102

(Groups)

CC8.2, DL5.5, CP5.1

**Guidelines**

- Explain to the learners that this activity will require some research. The learners can use the library or the internet, or they can talk to farmers and other knowledgeable people in the community.
- Learners use their own research and existing knowledge to complete the table.
- Accept any valid answers.
- For the report, guide the learners to understand that they should think about crops that will give the farmer a good income throughout the combined life span of the three crops. They should also think about the practical aspects, for example to spread harvesting out over a longer period instead of having to do everything at the same time.

**Assessment**

Use the rubric for reports on page 194 of this guide to assess the learners' reports.

## Unit 6.3 Evaluate knowledge of maturity stages

### Content standard

- B9.2.3.2: Demonstrate and evaluate the importance of knowledge and understanding of uses of different crops at different maturity stages.

### Indicator

- B9.2.3.2.2: Evaluate the importance of knowledge of the maturity stages of different crops to human beings.

### Exemplars

- Explain the specific use(s) of each maturity stage of different crops to humans, other crops, animals, and the environment.
- Explain how the knowledge of the maturity stages of different crops helps a farmer in crop selection, time of harvest, and others.
- Compare different stages of maturity of crops identified in the community with those used in other places.

### Unit in a nutshell

- Crops are useful at each stage of their growth to humans, animals, the environment and even to other crops.
- It is very important for farmers to know and understand the maturity stages of crops so that they can harvest the produce at the right stage.
- Knowledge of maturity stages helps farmers to manage their farms.
- Physiological maturity is when the crop has reached its maximum growth and development.
- Horticultural (or commercial) maturity is when the crop has developed to the point where it can be harvested so that it will be in the best possible condition for its intended use.

#### ACTIVITY 6.3.1

#### Using crops in your community

LB page 104

(Groups)

CC7.3, CP5.3, CP6.4, DL5.3

### Guidelines

- The learners work in groups.
- Each group should discuss how crops are used in the community.
- They create a spider diagram for each crop they discuss, listing the specific use, the maturity stage, and whether the use is for humans, other crops, animals or the environment.
- Groups do a presentation of their findings to the class, using the spider diagrams to support the presentation.

**ACTIVITY 6.3.2****Researching stages of maturity of crops  
in your community and elsewhere**

LB page 107

(Groups)

*CC7.3, CP5.3, CP6.4, DL5.3***Guidelines**

- The learners work in groups to do community research.
- Each group should gather information from the community as instructed in the Learner's Book.
- They may use the internet to research and compare their findings with other areas and countries.
- They should combine the information and create a logic tree similar to the example provided to explain the possible reasons for any differences between the local findings and other areas.
- Each group should share its findings with the class in a class discussion.

Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1. seed germination  
sprout  
seedling  
leafy growth  
flowering  
fruit formation  
ripe fruit and seed dispersal
2. Clay: (any one characteristic) dense, particles stick together; does not drain well; can become very wet and cold in rainy seasons; quickly dries in warm seasons; colour can vary from red to grey.  
Sand: (any one characteristic) has a gritty, light, loose texture and does not retain water; warms up quickly; has a pale yellow or white appearance.  
Loam: (any one characteristic) is a combination of silt, sand and clay; is rich in humus and nutrients and drains well; is ideal for most types of crops; has a dark brown colour.
3. It is alkaline and has a low nutrient content.
4. Improve the soil structure by digging in organic matter such as manure, compost or peat.
5. Reddish pink: Almost the whole tomato is light red or reddish pink, and the tomato begins to soften.
6. Vegetative development (six months), flowering stage (three months) and fruiting stage (three months)
7. Onion sprouts can be used in salads and to add flavour to other dishes. The green tops of young onions can be used in salads.
8. Physiological maturity is when the crop has reached its maximum growth and development, such as fully ripe fruit used for immediate eating. Horticultural maturity is when the crop has developed to the point where it can be harvested so that it will be in the best possible condition for its intended use. For instance, many fruits are harvested when underripe so that they are ripe by the time they have been transported to a store and are ready to be sold.
9. (The paragraph should include at least five of the following points.) Farmer can monitor their crops and note when they do not grow optimally. Farm management is improved. Farmer can plan ahead and allocate time, money and other resources as needed. It is easier to notice problems such as pests and diseases when the farmer knows how the crop should look at any given stage. If farmers know at what stage of a crop's life cycle weeds, pests and diseases are likely to affect the plants, they can take steps to eliminate or reduce the threats. Farmers can plan ahead for tasks and processes such as the preparation of land, irrigation, the application of fertilisers, marketing and harvesting. Knowledge of maturity stages helps farmers to forecast the crop yield during a specific season, and plan accordingly.

## Check ...

Learners can:	Yes	No
1. Observe and describe differences in maturation of crops grown in different soils and on different seedbeds.		
2. Observe and record the maturity stages of different crops grown in different soils and seedbeds.		
3. Discuss the differences in maturity stages among the different crops on the different soils and seedbeds.		
4. Compare and contrast the maturity stages of crops and seedlings in the community/ school garden with others grown elsewhere.		
5. Observe and record the uses of different crops at different maturity stages.		
6. Discuss and write the uses of each maturity stage of each crop identified.		
7. Categorise crops by their different maturity stages and uses.		
8. Evaluate the importance of knowledge of the maturity stages of different crops to human beings.		
9. Explain the specific use(s) of each maturity stage of different crops to humans, other crops, animals and the environment.		
10. Explain how the knowledge of the maturity stages of different crops helps a farmer in crop selection, time of harvest, and others.		
11. Compare different stages of maturity of crops identified in the community with those used in other places.		

# Topic 4: Animal production

## Module 7

## Domestic and commercial animals

### Unit 7.1 Types of feed

#### Content standard

- B9.2.4.1: Demonstrate understanding of the preparation of feed for domestic and commercial animals.

#### Indicator

- B9.2.4.1.1: List the ingredients and the method of preparation of different feed for different domestic and commercial animals.

#### Exemplars

- Demonstrate how farmers prepare feed for different domestic and commercial animals with ingredients.
- Write down the process of preparing feed for different domestic and commercial animals with the ingredients.
- Compile a table, matching feed, ingredients and method of preparation.
- Formulate and prepare feed for domestic and commercial animals.

#### Unit in a nutshell

- Domestic and commercial animals can be categorised into three groups: ruminants, monogastrics and poultry.
- Ruminants have a complex stomach that consists of four compartments.
- Most farmers in Ghana cut fresh grass for their cattle or combine a number of different feed types, for example a mixture of different grains and/or root crops.
- The main groups of feed for livestock are roughage, hay, silage, concentrates and mixed feed.

#### ACTIVITY 7.1.1

#### Compiling a list of animal feed

LB page 112

(Groups)  
CP5.6, PL6.2, DL6.6

#### Guidelines

- Learners work in groups to compile a list of feeds commonly used in the community.
- Divide the class into groups.
- Each group should assign members to gather information from stores, farms and domestic animal owners in the community.
- The groups should try to gather information on feeds for each of the groups of animals (ruminants, monogastrics and poultry).
- Each group should compile a list of feeds from the information gathered.

- Two members of each group should present the information gathered with the rest of the class.
- Have a class discussion and create an overall list together as a class.

## TALK ABOUT

LB page 112

Ask the learners to tell you what they know about the feeding habit or method of feeding of the three classes of animals. They may know that cattle chew the cud, or that goats sometimes climb trees to reach the leaves. They will probably also know that poultry have no teeth and that they use their beaks to peck food. Extend the discussion and explain that cattle are the only animals in this group that have four stomachs. Encourage the learners to find out more about this in the library or on the internet.

## Talk about

### ACTIVITY 7.1.2

### Revising the classes of livestock

LB page 115

(Pairs)

CP5.6, PL6.2

## Guidelines

Learners work in pairs to answer the questions.

### Answers

1. Ruminants, for example cattle, goats, sheep  
Monogastrics, for example pigs, cats, dogs  
Poultry, for example chickens, turkeys, ducks, guinea fowl
2. Ruminants have a complex stomach that consists of four compartments. They chew the cud regurgitated from their rumen (first stomach). Monogastrics have only one stomach compartment.



## INTERNET INTERACT

There are many videos available online that explain the digestive systems of ruminants and monogastrics.

The video at the link below gives an overview of the digestive systems of different animals.

[https://www.youtube.com/watch?v=5OsmJ\\_ER03g](https://www.youtube.com/watch?v=5OsmJ_ER03g)

For more information on ruminant digestive systems, you can watch the video at the link below with the class.

[https://www.youtube.com/watch?v=HH4o\\_cJA5S4](https://www.youtube.com/watch?v=HH4o_cJA5S4)

The video at the link below gives a good explanation of the digestive system of chickens.

<https://www.youtube.com/watch?v=n3BW6m1HylI>

Explain any terms and concepts that the learners do not understand.



### ACTIVITY 7.1.3

### Choosing and describing different animal feeds

LB page 116

(Groups)

CP5.6, PL6.2, DL6.6

### Guidelines

- The learners work in groups.
- They should use what they have learned so far to answer the questions.
- Encourage the learners to approach this activity as if they were in a real-life situation, with consideration for the practical aspects of feeding livestock.

### Answers

1. Roughage, hay, silage, concentrate, mixed feed
2. Cereals and grains in either ground form or broken into pieces
3. Ground grains and cereals, kitchen, household and restaurant left-overs, cakes from oil-producing seeds with the oil extracted, ripened pawpaw

## Unit 7.2 Feeding practices and growth stages

### Content standard

- B9.2.4.2: Demonstrate skills and knowledge of feeding domestic and commercial animals

### Indicator

- B9.2.4.2.1: Describe and select appropriate feed for different domestic and commercial animals.
- B9.2.4.2.2: Differentiate between different types of feed for different stages of domestic and commercial animals.

### Exemplars

- Compile a list of feed commonly consumed by the different domestic and commercial animals in the environment.
- Compare and contrast the characteristics of different kinds of feed commonly consumed by categories of domestic and commercial animals (ruminants, monogastrics and poultry).
- Record feed used to feed domestic and commercial animals on farms over a period of time.
- Identify named samples of feed for three categories of domestic and commercial animals (ruminants, monogastrics and poultry).
- Categorise different types of animals according to their stages of growth (young, growing and matured stages).
- List the types of feed used for the various stages of growth in their domestic and commercial ruminants, monogastrics and poultry.
- Compare and construct the major functions of feed in each growth stage of different animals.
- Discuss types of feed used to feed different domestic and commercial animals at different stages of growth.

## Unit in a nutshell

- The feed for an animal should be chosen based on the age of the animal and the purpose for which it is being bred.
- The life cycle of a cow can be divided into three stages.
- There are different types of feed formulae for pigs, and will depend on the pig's age, weight and stage of development (four stages).
- Chickens have four stages of development.

### ACTIVITY 7.2.1

#### Making a poster of the growth stages in cattle

LB page 118

(Groups)

CC8.2, DL5.3, CP5.1, PL5.2

### Guidelines

- Learners work in groups.
- They should create a poster listing the growth stages of a calf and the type of feed that the calf requires at each stage, with illustrations.
- Before they start, discuss the characteristics of a good poster with the learners.
- Stress the importance of team work, and make sure that every learner contributes to the poster.
- Make sure you have enough paper, pencils and other artwork and supplies for the groups. If possible, also supply agricultural magazines that the learners can use to source photos.
- Walk through the class while the learners are working and give guidance where needed.

### Assessment

See the rubric for posters on page 194 and oral presentations on page 194 at the back of this guide.

### ACTIVITY 7.2.2

#### Discussing types of cattle feed

LB page 121

(Groups)

CC8.2, DL5.3, CP5.1, PL5.2

### Guidelines

- The learners discuss cattle feed in groups.
- They should discuss advantages and disadvantages of pellets, hay and silage.
- Guide the groups to discuss factors such as nutritional value, preparation times, storage space, storage length, etc.
- Encourage the learners to look for information on the internet.

### ACTIVITY 7.2.3

#### Researching feed for pigs

LB page 122

(Groups)

CP5.5, CC9.2, PL5.1, CC9.4

## Guidelines

- For this activity, the learners should be able to demonstrate an understanding of the different maturity stages of pigs.
- Before they start with the activity, ask a few learners to share with the class what they know about the maturity stages of pigs. This will help you to see if there are any aspects of the work that the learners are struggling with, and it will serve as a quick revision for the rest of the class.
- Learners may use the internet or books, and they may also talk to farmers to find practical information.
- If possible, invite a pig farmer to visit your class to share information.
- Each group should make notes of their research findings.
- The groups should each share their findings with the rest of the class.
- Guide the learners in a class discussion.

### ACTIVITY 7.2.4

### Thinking about poultry feed

LB page 125

(Individual)  
CC8.2

## Guidelines

- The learners work individually to answer the questions.
- They may refer to the information in the Learner's Book to answer the questions.

### Answers

1. Starter feed that has about 18% protein to support the growth of the chick. Protein sources such as groundnut cake, blood meal, soybean meal can be added to the feed.
2. They grow their pecking beaks. This allows them to peck food with the adult chickens.

## Unit 7.3 Feeding procedures

### Content standard

- B9.2.4.2: Demonstrate skills and knowledge of feeding domestic and commercial animals.

### Indicator

- B9.2.4.2.3: Perform the feeding of domestic and commercial animals.

### Exemplar

- Demonstrate how to feed domestic and commercial animals at different stages of growth and production, with appropriate feed in the school farm or a farm in the community.

### Unit in a nutshell

- Feeding a balanced diet, avoiding overfeeding, and providing abundant supplies of cool, clean and pure water will help to optimise feed and nutrient use on an animal farm.

- Water is the cheapest and least understood of all nutrients required for livestock production. Water is, however, becoming less and less abundant, and farmers should take special care to use water wisely and not waste it.
- Every effort should be made to use feeds of a high quality.
- There is a variety of feed and watering systems that can be used for all types of livestock to reduce feed and water spillage.

## PROJECT

### A visit to a farm: Feed animals in the community LB page 128

(Groups)

CP5.5, CC9.2, PL5.1, CC9.4, CC8.5, CP5.6

## Guidelines

- This project will need advance planning. It will be a good idea to discuss the broad outlines of the project with the learners at the beginning of the term so that they can start planting crops and thinking about the equipment that they would like to make.
- The learners work in groups to help to feed animals.
- They should do this either on your school farm if it has animals, or on a farm or smallholding in the community.
- If they are going to do this activity on farms, make the arrangements with the farmers, and organise transport if needed.
- Arrange additional adult help for supervision.
- Ensure that the learners do the necessary revision before their farm visit. Run through the instructions to make sure that they know what they are expected to do.

## Assessment

Use the rubric for projects on page 195 of this guide to help you assess the learners' projects.

## ACTIVITY 7.2.5

### Your quiz about cycles

LB page 129

(Groups)

CP5.1, CC 9.1

## Answers

1. It is the way nitrogen moves through the Earth system in a repeating cycle.
2. Incomplete metamorphosis. It is when the new individual that hatches looks similar to the adult.
3. The plant's nutritional needs are different in each stage. Plants can be harvested for different purposes at different stages of maturity.
4. Ruminants chew grass or vegetation only partially before they swallow it. The food mass is later regurgitated and then they chew the cud before swallowing it again. Examples of ruminants are cattle, goats and sheep.

Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1.
  - a) chicken
  - b) pasture
  - c) sheep
  - d) dried
  - e) carbohydrate
2. 12 weeks or after they have been weaned
3. Adult pig: (any four) corn, soybean meal, cassava peels, wheat or maize bran, palm kernel cake and bone meal, as well as vitamins and minerals  
Adult fowl: (any four): whole maize, rice bran or corn chaff, groundnut cake, fishmeal, lime, salt, and premixed feed
4.
  - a) 21 days old (transition stage): milk, grain and water. Eight months old: At the ruminant stage, the farmer can introduce the calves to some roughages and grains. Two weeks after weaning, the calves can start eating forages. This could be by allowing them to graze in the open field, feeding them on hay or silage that is prepared from forage, or giving them mixed formula mainly from cereals and grains.
  - b) During the transition stage, the rumen develops. By the time the calf has been weaned, the rumen is well developed and the calf can digest grain efficiently.
5. Prepare the silo or other containers. Harvest and chop the forage. Dry the forage. The plant matter must not be completely dry. If you squeeze a handful of forage, it should form a ball in your hand. Fill the container(s) with the chopped forage. Compact the forage. It is important that the forage is packed tightly in the container. You can use any heavy object to press the forage in as tightly as possible. Cover the container and leave the forage to ferment. Do not open the container while the process is taking place. Open the container after 10 days to inspect the silage. The fermentation can take up to 21 days.
6.
  - a) (Any four): whole maize, rice bran or corn chaff, groundnut cake, fishmeal, lime, salt, and premixed feed
  - b) They begin to lay eggs and they need more calcium in their diet.
7.
  - a) One should not feed animals on the ground.
  - b) Feeding container should be raised to stop animals from standing or lying in the container.
  - c) Food container should be at an appropriate height.
8. Any three: Feeding a balanced diet, avoiding overfeeding, and providing abundant supplies of cool, clean and fresh water

## Check ...

Learners can:	Yes	No
1. Demonstrate understanding of the ingredients and the method of preparation of different feed for different domestic and commercial animals.		
2. Describe how farmers prepare feed for different domestic and commercial animals with ingredients.		
3. Describe the process of preparing feed for different domestic and commercial animals with the ingredients.		
4. Tabulate a comparison of feed, ingredients and method of preparation.		
5. Formulate and prepare feed for domestic and commercial animals.		
6. Demonstrate skills and knowledge of feeding domestic and commercial animals.		
7. List feed commonly consumed by the different domestic and commercial animals in the environment.		
8. Compare the characteristics of different kinds of feed commonly consumed by categories of domestic and commercial animals (ruminants, monogastrics and poultry).		
9. Identify named samples of feed for three categories of domestic and commercial animals (ruminants, monogastrics and poultry).		
10. Differentiate between different types of feed for different stages of domestic and commercial animals.		
11. Categorise different types of animals according to their stages of growth (young, growing and matured stages).		
12. List the types of feed used for the various stages of growth in domestic and commercial ruminants, monogastrics and poultry.		
13. Compare and construct the major functions of feed in each growth stage of different animals.		
14. Select the types of feed used to feed different domestic and commercial animals at different stages of growth.		
15. Perform the feeding of domestic and commercial animals.		

**Activity 1: Multiple choice**

1. C nitrogen
2. A Leaching
3. C ammonia
4. C exoskeleton
5. A nymph
6. D chalky
7. D leaves
8. B maize
9. B goat
10. A calcium

**Activity 2: Short questions**

1. Atmosphere: The layers of gases (the air) around the Earth. The gaseous layers are held to the Earth's surface by gravity.  
Lithosphere (also called the geosphere): All the soil and rock on Earth, including the Earth's crust, mantle and core  
Hydrosphere: All the parts made of water in any of its phases (gas, liquid or ice) – all the oceans, rivers, water in the soil, ice sheets, and also moisture and ice crystals in the atmosphere  
Biosphere: All living organisms, including micro-organisms, plants and animals
2. It helps plants to synthesise chlorophyll from nitrogen compounds. Chlorophyll is essential for photosynthesis, which is the process that produces food for the plant. Plants with a nitrogen deficiency typically have yellow, wilted leaves.  
It helps to convert inert nitrogen gas into a usable form for plants through the biochemical process. In the process of ammonification, the bacteria help in decomposing the animal and plant matter, which indirectly helps to clean up the environment.  
Nitrates and nitrites are released into the soil, which helps to enrich the soil with necessary nutrients required for cultivation.  
Nitrogen is an integral component of the cell and it forms many crucial compounds and important biomolecules required by living organisms.
3. Large growths of algae as a result of too much nitrogen in the water
4. nitrogen fixation  
nitrification (converting ammonia into nitrates)  
assimilation (plants and animals using nitrogen)  
ammonification (adding organic nitrogen compounds to ammonia or ammonia formation)  
denitrification
5. Incomplete metamorphosis is when the new individual that hatches looks similar to the adult. There are three stages in the development, namely egg, nymph and adult. Examples (any one): grasshoppers, crickets, cockroaches, dragonflies  
Complete metamorphosis occurs when the insect undergoes a complete physical change before it becomes an adult. The process has four stages: embryo, larva, pupa and imago. Examples (any one): flies, butterflies, bees and ants
6. Herbivore: It eats plants.

7. a) Sands heats up quickly and retains heat. Water flows away too fast to be absorbed by the plant.  
b) loam
8. raised bed
9. a) Vegetative development stage: Suckers can be harvested and sold as planting materials.  
b) Flowering stage: The bract is edible and healthy and can be chopped up and cooked.  
c) Fruiting stage: The matured fruits can be harvested either green or ripe.
10. The main ingredient could be grains or cereals.
- Select dry, low-fat ingredients that meet the nutritional needs of your cattle.
  - Grind the ingredients to a fine powder.
  - Mix the crushed ingredients in a feed mixer. Add supplements such as vitamins and minerals. Make sure that the ingredients are blended well.
  - Put the mixture in a pelleting machine.
  - Let the pellets cool before storing them for future use.
11. A young cow between the ages of one and three years that has not yet given birth
12. a) It is a specific type of feed for piglets aged 2 to 8 weeks that are still suckling, to prepare their digestive systems for weaning. Creep feed can be fed to piglets from 7 to 10 days after farrowing (birth).
- b) Any two: maize, groundnut cake, brewer's dry grain, soybean meal, fish meal, bone meal, salt, vitamins and minerals, pig premix

### Activity 3: Essay

Guide the students to choose a topic and write an essay.

Use the rubric for essays on page 195 of this Teacher's Guide to help you assess the learners' essays.



## Learning outcomes

Content standard	Indicators and exemplars	Core competencies
<b>Topic 1: The human body system</b>		
<b>B9.3.1.1</b> Demonstrate understanding of the blood circulatory system, health problems associated with the system and its relationship with the respiratory system in humans.	<p><b>B9.3.1.1.1</b> Explain the concept of the circulatory system, state the function of each part of the system and the health challenges associated with it.</p> <ol style="list-style-type: none"> <li>1. Discuss the blood circulatory system in humans and the composition and functions of blood.</li> <li>2. Explain the functions of the parts of the circulatory system.</li> <li>3. Draw and label the longitudinal section of a mammalian heart.</li> <li>4. Describe the prevention and causes of diseases of the circulatory system.</li> <li>5. Describe what blood pressure is and ways of managing it.</li> </ol>	CP5.8, CC9.1, DL6.3, CI6.2, CC9.4
	<p><b>B9.3.1.1.2</b> Explain the concept of respiration and show how the respiratory and circulatory systems complement each other. (Note that respiration is a chemical reaction that releases carbon dioxide (CO<sub>2</sub>), water (H<sub>2</sub>O) and energy from glucose and oxygen.)</p> <ol style="list-style-type: none"> <li>1. Explain the concept of respiration.</li> <li>2. Explain how deoxygenated blood from circulation is oxygenated through inhalation for respiration to take place.</li> </ol>	CC7.5, CP5.3
<b>Topic 2: The solar system</b>		
<b>B9.3.2.1</b> Demonstrate knowledge of other non-planetary bodies such as comets, asteroids, and their relationship with the solar system.	<p><b>B9.3.2.1.1</b> Understand the movement of non-planetary bodies in the solar system.</p> <ol style="list-style-type: none"> <li>1. Research for information on the movement of non-planetary bodies in the solar system, e.g. asteroids and comets.</li> <li>2. Compare and contrast the movement of the non-planetary bodies in the solar system.</li> </ol>	DL5.6, CC8.2
<b>Topic 3: The ecosystem</b>		
<b>B9.3.3.1</b> Recognise the interdependence of organisms in an ecosystem and appreciate their interaction to maintain balance in the system.	<p><b>B9.3.3.1.1</b> Conduct research into the composition of an ecosystem and discuss how the components depend on each other for survival.</p> <ol style="list-style-type: none"> <li>1. Describe how organisms depend on each other in different ecosystems. (You may use pictures, charts and videos.)</li> <li>2. State the differences between an ecosystem and a habitat.</li> <li>3. Construct a food chain and a food web found in an ecosystem.</li> </ol>	DL5.3, CC9.3, CI5.2, CI5.4

Content standard	Indicators and exemplars	Core competencies
	<b>4.</b> Predict and justify your predictions on how interferences such as earthquakes, volcanic eruptions, hunting, farming, mining, 'galamsey', pollution, pesticides and bush burning will affect the balance in an ecosystem.	
<b>Topic 4: Farming systems</b>		
<b>B9.3.4.1</b> Demonstrate knowledge and skills in the preparation of different types of manure from animal and plant waste.	<b>B9.3.4.1.1</b> List and explain the different plant and animal waste used in preparing different types of manure. <ol style="list-style-type: none"> <li>1. List some types of manure used by farmers.</li> <li>2. Identify and write down the materials used in preparing manure and their sources.</li> <li>3. Categorise manure into those from plant wastes and animal wastes.</li> <li>4. Compile a list of plant parts/wastes and animal parts/wastes that are used to prepare manure.</li> <li>5. Justify the use of different animal and plant manures (poultry droppings, cow dung, animal parts and carcasses, pig dung, human excreta, domestic refuse, leaves, waste fruits, plant parts and shavings, etc.) under different soil and climatic conditions.</li> </ol>	CC9.1, CP5.3, CI6.5, CC7.3, CP5.6
	<b>B9.3.4.1.2</b> Demonstrate the preparation of different types of manure. <ol style="list-style-type: none"> <li>1. Prepare manure from the different plant and animal wastes.</li> <li>2. Discuss the preparation of manure using the plants and animal wastes that are available in a community.</li> </ol>	CP6.3, CC8.5
	<b>B9.3.4.1.3</b> Prepare different types of manure. <ol style="list-style-type: none"> <li>1. Treat various plant and animal wastes to generate manure (cleaning/sorting, curing/composting) in the field or school garden.</li> </ol>	CC9.1, CP6.7

# Topic 1: The human body system

## Module 8

## Human circulatory and respiratory systems

### Unit 8.1 The blood circulatory system

#### Content standard

- B9.3.1.1: Demonstrate understanding of the blood circulatory system, health problems associated with the system and its relationship with the respiratory system in humans.

#### Indicator

- B9.3.1.1.1: Explain the concept of the circulatory system, state the function of each part of the system and the health challenges associated with it.

#### Exemplars

- Discuss the blood circulatory system in humans and the composition and functions of blood.
- Explain the functions of the parts of the circulatory system.
- Draw and label the longitudinal section of a mammalian heart.
- Describe the prevention and causes of diseases of the circulatory system.
- Describe what blood pressure is and ways of managing it.

#### Unit in a nutshell

- Humans have a double circulatory system that consists of the pulmonary circuit and the systemic circuit.
- Blood passes through the heart twice – once in the pulmonary circuit to the lungs, and again in the systemic circuit to the rest of the body.
- The circulatory system consists of three major components, namely the heart, the blood vessels and the blood.
- The heart is a muscular pump made of specialised cardiac muscle tissue.
- The internal structure of the heart consists of four heart chambers and four valves.
- The purpose of the valves is to make sure that the blood flows in the correct direction when it enters and leaves the heart.
- Each heartbeat consists of two phases, namely the diastole and the systole.
- When blood circulates through the body, the blood exerts a force against the walls of the arteries. This force is referred to as blood pressure.
- The three main types of blood vessels are arteries, veins and capillaries.
- Blood carries oxygen, carbon dioxide, hormones, nutrients, antibodies and other essential substances through the body.
- Blood consists of four main parts, namely red blood cells, white blood cells, platelets and plasma.
- Common diseases that affect the circulatory system include high blood pressure, heart attacks, strokes and thrombosis.

**ACTIVITY 8.1.1****Discussing the circulatory system**

LB page 137

(Groups)

CP5.8, CC9.1, CI6.2, CC9.4

**Guidelines**

- The learners work in groups to discuss the circulatory system.
- Guide the discussion to include the information in the answers below.

**Answers**

1. The types of circulation include pulmonary and systemic.
2. The organs involved are the heart and blood vessels. While not strictly speaking an organ, the blood is also a major component of the circulatory system.
3. The circulatory system is of vital importance to carry oxygen and nutrients to the body and remove carbon dioxide and waste from the cells.

**ACTIVITY 8.1.2****Drawing the mammalian heart**

LB page 140

(Individual)

CP5.8, CI6.2

**Guidelines**

- The learners work on their own to make a labelled drawing of the internal structure of the heart.
- They may use the image in Figure 8.1.4 on page 139 of the Learner's Book as a reference.

**Assessment****INTERNET INTERACT**

Some learners may need guidance with drawing the human heart. There are various videos available online that show how to draw a heart. The one at the link below shows a simple drawing with labels.

<https://www.youtube.com/watch?v=TJUee4AsXfo>

**ACTIVITY 8.1.3****Drawing a Venn diagram for blood vessels**

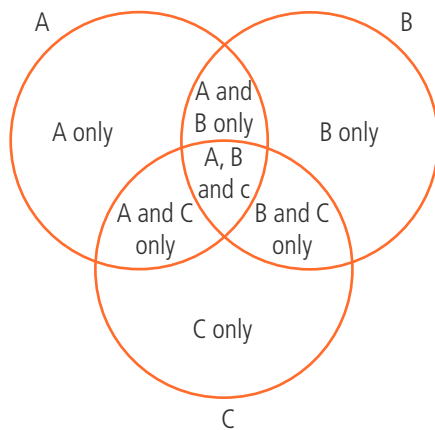
LB page 144

(Pairs)

CP5.8, DL6.3, CI6.2

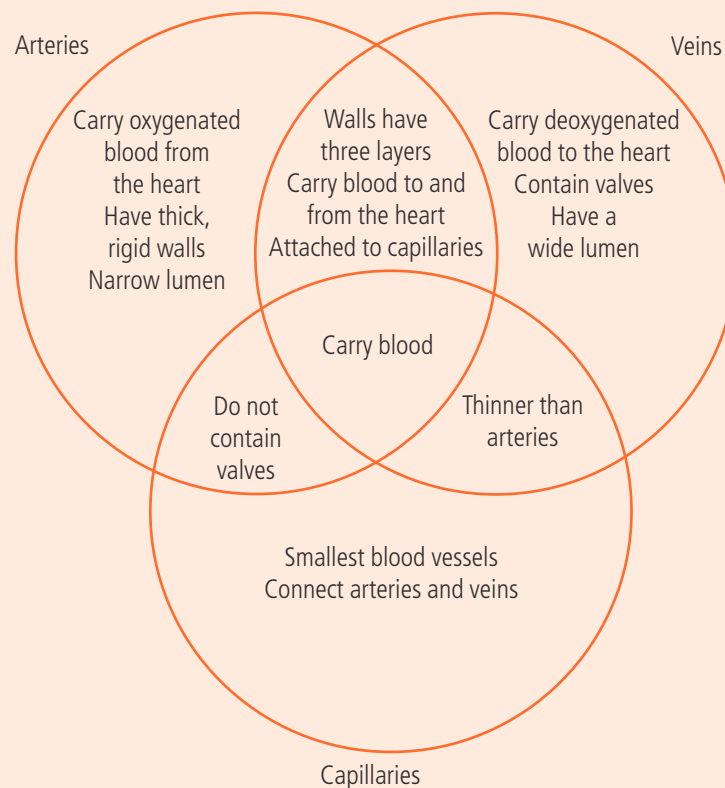
## Guidelines

- The learners work in pairs to draw a Venn diagram.
- Explain to the learners that a Venn diagram is a way of comparing sets of data – in this case, the properties of arteries, veins and capillaries. Guide them on how to place information in the diagram, using the diagram below as a reference.



- If there are computers available, the learners can use a word processing program to create their flowcharts.

## Answers





## INTERNET INTERACT

The video at the link below explains the concept of Venn diagrams with three circles.

<https://www.youtube.com/watch?v=TeV5UP7dWdc>

### ACTIVITY 8.1.4

### Designing a brochure or poster

LB page 145

(Pairs)

CP5.8, CC9.1, DL6.3, CI6.2, CC9.4

## Guidelines

- The learners work in pairs to create an informational brochure or poster about a heart disease.
- They should do research in books or on the internet to get information on a disease that can affect the heart.
- The poster should include information on the disease, including the causes, symptoms and prevention.
- The pairs should then take turns to share their poster or brochure with the class in an oral presentation.

## Answers

Answers will vary, depending on the disease chosen.

## Assessment

Use the rubric below to assess the learners' brochures or posters.

Criteria	1	2	3
Format	Material supplied on loose pages without any structure	Format is vague	Well-formatted as a poster or a brochure
Short and simple	Information is unnecessarily long and complicated	Most of the information is short and simple	Information is short and simple
Appearance	Appearance is off-putting	Appearance is bland and uninteresting	Appearance is lively and eye-catching
Use of pictures	There are no pictures	There are a few pictures	Pictures are used whenever possible; more pictures than words
Content	Inaccurate and/or lacking	Content is moderate	Accurate, interesting and well-researched content

### ACTIVITY 8.1.5

### Talking about a healthy lifestyle

LB page 146

(Class)

CP5.8

## Guidelines

- The learners should have a class discussion about things they can do to improve their health and prevent circulatory diseases.
- Guide the discussion to include the things they have learned about the prevention of circulatory diseases.
- The guidelines for prevention are on page 146 of the Learner's Book. As they mention each guideline, question the class on how they think it helps to prevent diseases.

## Unit 8.2 The respiratory system

### Content standard

- B9.3.1.1: Demonstrate understanding of the blood circulatory system, health problems associated with the system and its relationship with the respiratory system in humans.

### Indicator

- B9.3.1.1.1: Explain the concept of respiration and show how the respiratory and circulatory systems complement each other. (Note that respiration is a chemical reaction that releases carbon dioxide ( $\text{CO}_2$ ), water ( $\text{H}_2\text{O}$ ) and energy from glucose and oxygen.)

### Exemplars

- Explain the concept of respiration.
- Explain how deoxygenated blood from circulation is oxygenated through inhalation for respiration to take place.

### Unit in a nutshell

- Cellular respiration is a chemical reaction that releases carbon dioxide ( $\text{CO}_2$ ), water ( $\text{H}_2\text{O}$ ) and energy from glucose and oxygen ( $\text{O}_2$ ).
- When you breathe in, your body takes in oxygen, which is then used to maintain body processes.
- When you breathe out, you exhale the carbon dioxide that is released as a waste product during cellular respiration.
- The respiratory system is made up of the organs and other parts of the body involved in breathing, when  $\text{O}_2$  is exchanged for  $\text{CO}_2$  between the lungs and the outside of the body.
- The respiratory system cannot work alone to move oxygen through the body. It needs to work closely with the circulatory system.

#### ACTIVITY 8.2.1

#### Discussing respiration

LB page 148

(Pairs)  
CC7.5

## Guidelines

- The learners work in pairs to discuss respiration, what it is and the role played by the circulatory system.
- They should demonstrate a clear understanding of cellular, internal and external respiration.
- They should also demonstrate an understanding that the circulatory system transports both the ingredients for cellular respiration to the body and waste products away from it.

### ACTIVITY 8.2.2

### Thinking about the respiratory and circulatory systems

LB page 151

(Groups)  
CC7.5, CP5.3

## Guidelines

- The learners work in groups to discuss the ways in which the respiratory and circulatory systems work together.
- They should make a flowchart or a logic tree to explain the link between the two systems. A logic tree is a graphic way of presenting the components of a process or system, in order to make it easier to visualise or identify a pattern, a hypothesis or a solution to a problem. Logic trees can be drawn in many ways, and you can guide the learners to use your preferred version. (You will find examples if you do an online search.)

## Answers

Answers will vary, but the diagram should include the following steps:

- Heart (pumps deoxygenated blood to the lungs)
- Lungs (oxygenates the blood and removes carbon dioxide)
- Heart (pumps oxygenated blood to the body)
- Blood vessels (carry oxygenated blood to the body, and deoxygenated blood and carbon dioxide back to the heart)
- Heart (the cycle starts again)



### INTERNET INTERACT

The video at the link below shows how to create a logic tree or flowchart in Microsoft Word.

<https://www.youtube.com/watch?v=Nm65DeBMdZw>



Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1. D arteries
2. A septum
3. C diaphragm
4. **a)** True. The left-hand side of the heart receives oxygen-rich blood from the lungs and pumps it to the rest of the body.  
**b)** False. The heart contains valves.  
**c)** False. We exhale carbon dioxide.
5. A double circulatory system consists of two separate circuits. The pulmonary circuit is between the heart and the lungs, and the systemic circuit is between the heart and the other organs.
6. The atria are the two upper chambers of the heart. The atria receive the blood that enters the heart. The ventricles are the two lower chambers of the heart. They pump blood out of the heart.
7. The function of the heart valves is to make sure that the blood flows in the correct direction when it enters and leaves the heart.
8. **a)** He has high blood pressure.  
**b)** Any three: Eat a healthy diet, stop smoking, drink less alcohol, lose weight, exercise more, get more sleep, avoid stress.
9. During cellular respiration, a chemical reaction takes place that uses oxygen to break down glucose from food in order to obtain the energy it needs.  
$$\text{Glucose} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{Energy}$$
10. The circulatory and respiratory systems work together to circulate blood and oxygen throughout the body. The blood flows into the right ventricle and is pumped to the lungs (pulmonary circuit). In the lungs, gaseous exchange takes place. The carbon dioxide in the blood is replaced with oxygen. The oxygenated blood flows to the left ventricle and is pumped to the body (systemic circuit). The blood delivers oxygen to all the cells in the body and removes carbon dioxide and other waste materials from the cells. The waste materials are transported to organs such as the lungs, kidneys and liver and are subsequently expelled from the body. (Carbon dioxide is expelled through the lungs.) The deoxygenated blood returns to the heart, and the cycle starts again.

## Check ...

Learners can:	Yes	No
1. Explain the concept of the circulatory system, state the function of each part of the system and the health challenges associated with it.		
2. Discuss the blood circulatory system in humans and the composition and functions of blood.		
3. Explain the functions of the parts of the circulatory system.		
4. Draw and label the longitudinal section of a mammalian heart.		
5. Describe the prevention and causes of diseases of the circulatory system.		
6. Describe what blood pressure is and ways of managing it.		
7. Explain the concept of respiration and show how the respiratory and circulatory systems complement each other.		
8. Explain the concept of respiration.		
9. Explain how deoxygenated blood from circulation is oxygenated through inhalation for respiration to take place.		

# Topic 2: The solar system

## Module 9

## Non-planetary bodies

### Unit 9.1 The movement of non-planetary bodies in the solar system

#### Content standard

- B9.3.2.1: Demonstrate knowledge of other non-planetary bodies such as comets, asteroids, and their relationship with the solar system.

#### Indicator

- B9.3.2.1.1: Understand the movement of non-planetary bodies in the solar system.

#### Exemplars

- Research for information on the movement of non-planetary bodies in the solar system, e.g. asteroids and comets.
- Compare and contrast the movement of the non-planetary bodies in the solar system.

#### Unit in a nutshell

- Non-planetary bodies are the smaller objects that are in our planetary system, but are too small to be classified as planets. These objects include dwarf planets, asteroids, meteoroids and comets.
- Comets are large pieces of ice and rock in space that orbit the Sun at great distances.
- When comets get close to the Sun, portions of the comet melt down and produce a tail.
- Asteroids are smaller than planets but larger than meteoroids.
- Some asteroids cross Earth's orbit. These asteroids are referred to as potentially hazardous asteroids.
- A meteoroid is a solid body in space before it reaches the Earth's atmosphere.
- When a meteoroid enters the Earth's atmosphere, it is called a meteor.
- When a meteoroid crashes into the Earth's surface, it is called a meteorite.
- The non-planetary bodies in the solar system are in stable orbits around the Sun.
- All orbiting bodies in the solar system follow Kepler's Laws of Planetary Motion.
- Comets travel around the Sun in long, elliptical orbits that can be many decades long.
- Most of the asteroids in the solar system are found in the asteroid belt.
- Meteoroids move around the Sun in different orbits and at different speeds.

#### ACTIVITY 9.1.1

#### Thinking about the universe

LB page 160

(Individual)

DL5.6, CC8.2

## Guidelines

The learners work on their own to answer the questions.

### Answers

1. A galaxy is a system of millions or billions of stars, together with gas and dust, held together by gravitational attraction.
2. A planet orbits a star. It is big enough to have enough gravity to force it into a spherical shape. It is big enough that its gravity has cleared its orbit of smaller objects.
3. A meteoroid is a solid body in space before it reaches the Earth's atmosphere. When a meteoroid enters the Earth's atmosphere, it is called a meteor. When a meteoroid crashes into the Earth's surface, it is called a meteorite.



### INTERNET INTERACT

Encourage the learners to find out more about the solar system. There are many videos available online. The following are recommended:

- Solar system:  
<https://www.youtube.com/watch?v=libKVRa01L8>
- Asteroids, comets, and meteors:  
<https://www.youtube.com/watch?v=ammG6n4aeAM>
- Meteor showers:  
<https://www.youtube.com/watch?v=zkgIsG0K1IY>

### ACTIVITY 9.1.2

### Researching the movement of non-planetary bodies

LB page 162

(Groups)  
DL5.6, CC8.2

## Guidelines

- The learners work in groups to research the movement of non-planetary bodies in the solar system and create either a poster or a PowerPoint or Google Slides presentation.
- Divide the class into four groups, with each researching one type of non-planetary body (dwarf planets, comets, asteroids and meteoroids).
- The learners can use the internet or books to gather information.
- The learners should gather information on the planetary bodies themselves as well as the influences on their movement, such as other objects.

## Answers

Answers will vary.

## Assessment

Use the rubric for posters on page 194 of this guide to help you assess the learners' posters or slide presentations. You can adapt the rubric as needed for digital presentations.



### INTERNET INTERACT

The video at the link below explains Kepler's Laws of Planetary Motion.

<https://www.youtube.com/watch?v=6TGCPXhMLtU>

The series of three videos below give more information, with each law being discussed in a separate video.

- Kepler's First Law of Motion – Elliptical Orbits (Astronomy):  
<https://www.youtube.com/watch?v=qDHnWptz5Jo>
- Kepler's Second Law of Motion – Equal Area in Equal Time (Astronomy):  
<https://www.youtube.com/watch?v=qd3dlGJqRDU>
- Kepler's Third Law of Motion – Law of Periods (Astronomy):  
<https://www.youtube.com/watch?v=KbXVpdlmYZo>

Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1. A meteors
2. C Pluto
3. C It is big enough that its gravity has cleared its orbit of smaller objects.
4. Any three: dwarf planets, asteroids, meteoroids and comets.
5. Between the orbits of Mars and Jupiter
6. It is the path that an object follows when it circles around another, more massive object in a regular, repeating pattern.
7. Gravity from a larger object passing nearby can change the orbit of an object.
8. First law: A planet moves around the Sun in an elliptical orbit, with the Sun as one of the foci.  
Second law: An imaginary line drawn from the centre of the Sun to the centre of the planet will sweep out equal areas in equal intervals of time.  
Third law: The square root of the period is proportional to the cube of the semi-major axis.

### Check ...

Learners can:	Yes	No
1. Demonstrate knowledge of other non-planetary bodies such as comets, asteroids, and their relationship with the solar system.		
2. Describe the movement of non-planetary bodies in the solar system.		
3. Compare the movement of the non-planetary bodies in the solar system.		

# Topic 3: The ecosystem

## Module 10 Ecosystems

### Unit 10.1 Interdependence and interactions in ecosystems

#### Content standard

- B9.3.3.1: Recognise the interdependence of organisms in an ecosystem and appreciate their interaction to maintain balance in the system.

#### Indicator

- B9.3.3.1.1: Conduct research into the composition of an ecosystem and discuss how the components depend on each other for survival.

#### Exemplars

- Describe how organisms depend on each other in different ecosystems. (You may use pictures, charts and videos.)
- State the differences between an ecosystem and a habitat.
- Construct a food chain and a food web found in an ecosystem.
- Predict and justify your predictions on how interferences such as earthquake, volcanic eruptions, hunting, farming, mining, 'galamsey', pollution, pesticides and bush burning will affect the balance in an ecosystem.

#### Unit in a nutshell

- An ecosystem is an area where a variety of organisms live and interact with one another and with the non-living things around them.
- Species in an ecosystem are interdependent.
- In any ecosystem, there should be a balance between the predators and the prey.
- Symbiosis is a close association between two types of organism.
- The part of an ecosystem in which an organism lives is its habitat.
- Each organism has a specific role within the ecosystem.
- A food chain is a linear representation of a series of organisms that rely on one another as a source of food.
- A food web is a combination of the food chains in an ecosystem.
- The success and health of an ecosystem depends on maintaining the delicate balance of the ecosystem.
- Natural events and human activities can disrupt the balance of an ecosystem.

**ACTIVITY 10.1.1****Thinking about the impact of human activities on ecosystems**

LB page 167

(Groups)

DL5.3, CC9.3, CI5.2, CI5.4

**Guidelines**

- This activity gives the learners the opportunity to think about the effect of human activities on the ecosystem, and how every action has a chain reaction.
- Walk through the class and guide the discussions.
- It may be easier for some learners to grasp the process if they can visualise it. Encourage the learners to draw diagrams or flowcharts during their discussion.

**Answers**

1. The reduction in the number of snakes would lead to an increase in the number of frogs and a corresponding reduction in the number of insects. Taken to the extreme, the frogs could destroy the populations of insects and then, also die out.
2. The answer will depend on the learners' own research.

**INTERNET INTERACT**

The video at the link below explains the concept of food chains and food webs, and how the removal of one organism can cause the whole system to collapse.

[https://www.youtube.com/watch?v=2lqhJNgn\\_Wg](https://www.youtube.com/watch?v=2lqhJNgn_Wg)

**ACTIVITY 10.1.2****Studying a food chain**

LB page 171

(Pairs)

CC9.3, CI5.2, CI5.4

**Guidelines**

The learners work in pairs to answer the questions on the food chain as pictured in Figure 10.1.7.

**Answers**

1. Grassland
2. The flower is the producer. The snail is the primary consumer. The hedgehog is the secondary consumer and the eagle is the tertiary consumer.
3. After the eagle.
4. Answers will vary, depending on the specific ecosystem and creatures the learners select. Check that the drawings, labels and levels they include are correct.



**ACTIVITY 10.1.3****Studying a food web**

LB page 173

(Pairs)

CC9.3, C15.2, C15.4

**Guidelines**

The learners study the food web in Figure 10.1.8, then answer the questions.

**Answers**

1. Red oat grass
2. Any two: Aardvark, serval, mongoose
3. Any two: Red oat grass → mouse → mongoose  
Red oat grass → mouse → caracal  
Red oat grass → mouse → serval  
Red oat grass → mouse → tawny eagle
4. Animals that depend on the organism for food will starve. Organisms that are eaten by the organism will overpopulate and destroy the population of organisms that they eat.

**EXTENSION ACTIVITY**

LB page 173

Encourage the learners to draw a food web that would be typical of any ecosystem in Ghana. They can use books, the internet, or local knowledge as resources.

**ACTIVITY 10.1.4****Discussing impacts on ecosystems**

LB page 177

(Groups)

CC9.3, C15.2

**Guidelines**

- The learners work in groups to discuss the effects of earthquakes, volcanic activities, hunting, mining, galamsey, pollution, pesticides, farming and bush burning on ecosystems.
- Divide the class into groups. Assign one influence that affects ecosystems to each group to discuss.
- They should determine if this influence is preventable, and provide solutions to reduce its impact.

**Answers**

Answers will vary. Learners can give their own opinion, and can also refer to the Learner's Book

Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

- 1 B community
- 2 D parasitism
- 3 A population is a group of individuals of the same species.
- 4 False. An ecosystem consists of biotic and abiotic components. In an ecosystem, a variety of organisms live and interact with one another and with the non-living things such as rocks, soil and water around them. Example: A plant (a biotic organism) needs sunlight, water, soil and air (abiotic components) to survive. (Accept any valid explanation and example.)
- 5 An ecosystem is an area where a variety of organisms live and interact with one another and with the non-living things such as rocks, soil and water around them. A habitat is the part of an ecosystem in which an organism lives. There can be many habitats in an ecosystem.
- 6 The relationship between coexisting species or organisms in the environment.
- 7 Mutualism is a symbiotic relationship that is beneficial to both species in the association. Commensalism is a symbiotic relationship in which one species of organism benefits and the other is unaffected.
- 8 It is an organism that hunts and kills other organisms for food.
- 9 Answers may vary. Any example where humans and another species of organism are interdependent is acceptable.
- 10 mangrove tree (producer) → fish (primary consumers) → heron (secondary consumer) → crocodile (tertiary consumer) → decomposers (Accept any other valid examples.)
11. a) A food web. A food chain is a linear representation of a series of organisms that rely on one another as a source of food. A food web is a combination of the food chains in an ecosystem.
  - b) i) a primary producer: grass
  - ii) primary consumers (any one): rabbit, mouse, grasshopper
  - iii) secondary consumers (any one): frog, bird
  - iv) tertiary consumers (any one): owl, fox, snake, eagle
- c) Any two: rabbit, mouse, grasshopper
- d) Any two: frog, bird, owl, fox, snake, eagle
12. They can have positive effects. A volcanic eruption often deposits a layer of rock and soil that produce fertile soil.
13. a) When miners dig pits, the digging destroys plants and other organisms that live in the soil. Sometimes the pits are filled in with rock or waste material from the mines. Mining operations remove the fertile topsoil, leaving behind barren, infertile soil that can easily be washed away, resulting in erosion.
- b) The chemicals that gamseyers use pollute the water and harm the organisms that live in it. The mining activities and the artificial pools that are created can change the course of rivers and streams, thereby flooding some ecosystems and leaving others without water. Gamseyers often operate on the banks of rivers. The activity destroys the river banks, which can result in flooding after heavy rain.

## Check ...

Learners can:	Yes	No
1. Recognise the interdependence of organisms in an ecosystem and appreciate their interactions to maintain balance in the system.		
2. Describe how organisms depend on each other in different ecosystems.		
3. State the differences between an ecosystem and a habitat.		
4. Construct a food chain and a food web found in an ecosystem.		
5. Predict and justify their predictions on how interferences such as earthquakes, volcanic eruptions, hunting, farming, mining, galamsey, pollution, pesticides and bush burning will affect the balance in an ecosystem.		

# Topic 4: Farming systems

## Module 11

## Different types of manure

### Unit 11.1 Types of manure

#### Content standard

- B9.3.4.1: Demonstrate knowledge and skills in the preparation of different types of manure from animal and plant waste.

#### Indicator

- B9.3.4.1.1: List and explain the different plant and animal waste used in preparing different types of manure.

#### Exemplars

- List some types of manure used by farmers.
- Identify and write down the materials used in preparing manure and their sources.
- Categorise manure into those from plant wastes and animal wastes.
- Compile a list of plant parts/wastes and animal parts/wastes that are used to prepare manure.
- Justify the use of different animal and plant manures (poultry droppings, cow dung, animal parts and carcasses, pig dung, human excreta, domestic refuse, leaves, waste fruits, plant parts and shavings, etc.) under different soil and climatic conditions.

#### Unit in a nutshell

- Manure is decomposed animal waste and plant material that is used as fertiliser to provide nutrients for plants.
- There are three main types of manure, namely farmyard manure, compost and green manure.
- Farmyard manure, also known as FYM, is a mixture of urine and dung of farm animals, together with material from the animals' bedding and waste from fodder.
- Poultry manure is obtained mostly from chickens.
- Cattle manure, or cow dung, is the second most popular animal manure in Ghana, after chicken manure.
- Sheep and goat droppings contain higher nutrients than farmyard manure and compost.
- Concentrated organic manures are also known as organic nitrogen fertilisers.
- After oil is extracted from oilseeds, the remaining solid portion is dried as cakes.
- Husks are the dry outer layer that covers some fruits and seeds.
- Green manuring *in situ* is when the manure crop is planted either as an intercrop or as a sole crop.
- Green leaf manuring is when green leaves and twigs are collected from other areas and dug into the soil.
- Ghana is divided into six agro-ecological regions.
- There are many factors that affect the choice of manure in different regions.

**ACTIVITY 11.1.1****Listing manure types**

LB page 181

(Groups)

CC9.1, CI6.5, CC7.3, CP5.6

**Guidelines**

- Explain to the learners that they will learn about types of compost in this unit, but that this activity will require of them to think about what they already know about manure. They can also talk to experts to find information. You can give them a few days to complete the lists.

**Answers**

1. The learners' answers will vary, but they should include the main types of manure, namely farmyard manure, green manure and compost.
2. Cow dung (farmyard manure), green plants that are still growing or cuttings from green plants (green manure), kitchen waste (for compost).

**ACTIVITY 11.1.2****Discussing animal manure**

LB page 184

(Groups)

CC9.1, CI6.5, CC7.3, CP5.6

**Guidelines**

- Learners work in groups to discuss the advantages and disadvantages of manure from poultry, cattle, sheep and goats.
- They should draw up a table to compare the nutrient content of manure from poultry, cattle, sheep and goats.
- Once they have completed the table they should discuss how animal waste, other than dung or droppings, can be used to make manure.

**Answers**

1. This is a discussion activity, so there are no specific answers. The learners can refer back to the text in this unit, and mention points such as the following:
  - Cattle manure has a relatively low nutrient content, but the nutrient value of cattle manure can be improved by adding other organic substances such as oil cakes. The high amount of ammonia in cattle manure can burn plants if it is applied directly.
  - Sheep and goat droppings contain higher levels of nutrients than farmyard manure and compost.
  - The amount of phosphorus and nitrogen in chicken manure is higher than what is present in other organic manures. Poultry manure ferments very quickly. If it is exposed, it can lose 50% of its nitrogen in 30 days.

2. The learners refer to the information in the unit to draw up a table to guide their discussion.

Type of manure	Nitrogen (N)	Phosphorus (P)	Potassium (K)	Other
Poultry	2.20%	0.77%	0.91%	1.70% Ca and 0.42% Mg
Cattle	1.20%	0.07%	0.09%	
Sheep and goats	3%	1% P <sub>2</sub> O <sub>5</sub>	2% K <sub>2</sub> O	

3. Blood meal is locally obtained from animal slaughterhouses. The meat of dead animals is dried and converted into meat meal, which is a good source of nitrogen. It is very rich in nitrogen and can be used as a fast-acting tonic for weak or wilting plants.

Bone meal is animal bones that have been ground to a fine powder. It has a very high phosphate content and promotes root development. As a result, it is often sprinkled in planting holes.

Fish meal is made from fish or fish parts, which are usually obtained from fishmongers or from the bigger landing beaches. Fish meal is rich in nitrogen and phosphate.

Accept any other valid examples.

### ACTIVITY 11.1.3

### Discussing plant manure

LB page 186

(Pairs)

CC9.1, CI6.5, CC7.3, CP5.6

## Guidelines

- The learners can refer to the text in the unit, but encourage them to think of any other plants that have not been mentioned in the text.

## Answers

Answers may vary, but should include the following:

- oil cakes (examples: palm kernel seeds, coconut seeds or peanuts, soybean seeds)
- husks (examples: cocoa pods, rice)

### ACTIVITY 11.1.4

### Thinking about the use of manure in different areas

LB page 188

(Groups)

CC9.1, CP5.3, CI6.5, CC7.3, CP5.6

## Guidelines

- Learners work in groups to create a mind map. They can do research or use their own knowledge of regions in Ghana.

## Answers

Answers will vary. They could, for example, include information such as the following:

- Northern Region – vegetable crops – poultry manure
- northern and coastal savannas – grassland – cattle farming – cattle manure
- forest regions – crops such as cassava, plantain, yam, cocoyam, maize, and rice – manure from plant parts
- Upper East Region – millet and sorghum – sheep and goat manure

## Unit 11.2 The preparation of compost

### Content standard

- B9.3.4.1: Demonstrate knowledge and skills in the preparation of different types of manure from animal and plant waste.

### Indicator

- B9.3.4.1.2: Demonstrate the preparation of different types of manure.

### Exemplars

- Prepare manure from the different plant and animal wastes.
- Discuss the preparation of manure using the plant and animal wastes that are available in a community.

### Unit in a nutshell

- Compost can be prepared either commercially on a large scale or domestically for home gardens.
- Household waste can be used to make compost.
- On a small scale, compost can be made in bins.
- The Bokashi method is an anaerobic way of composting.

#### ACTIVITY 11.2.1

#### Discussing the use of manure in your community

LB page 189

(Groups)  
CP6.3, CC8.5

### Guidelines

- Learners work in groups to discuss how people in the community can prepare manure.
- They should take into account the sources of materials available in the area, practical methods for preparing the manure and where it can be best used in the area.

## Answers

Answers will vary. Learners should share information gathered from their own communities.

(Groups)  
CP6.3, CC8.5

## Guidelines

- Read the text in the Learner's Book again with the class to make sure that all the learners understand the steps.
- Point out to the learners that the use of compost can improve the yield of small-scale farms and domestic gardens, thereby helping the whole community.
- The groups discuss the compost-making process and get the information that should go on the posters.
- Each group should create an illustrated poster that lays out all the steps. Make sure that all the members of a group participate.
- Once finished, the learners can display their posters in the community. Remind them that they should ask permission before putting up posters in shops and other buildings.

## Assessment

Use the rubric for posters on page 194 of this guide to assess the learners' posters.

# Unit 11.3 Preparing manure

## Content standard

- B9.3.4.1: Demonstrate knowledge and skills in the preparation of different types of manure from animal and plant waste.

## Indicator

- B9.3.4.1.3: Prepare different types of manure.

## Exemplar

- Treat various plant and animal wastes to generate manure (cleaning/sorting, curing/composting) in the field or school garden.

## Unit in a nutshell

- Site selection is important to make sure that the effluent from compost can drain.
- On bigger farms, compost is usually placed in a pile or a windrow.
- The optimum carbon:nitrogen ratio varies, depending on the type of manure.
- Compost must be moist but not too wet.
- The internal temperature of a compost pile must be monitored.
- The micro-organisms that transform manure into compost need oxygen to perform their function.
- Curing is the stage at the end of the composting cycle, when the temperature of the compost no longer increases after it has been turned.



**ACTIVITY 11.3.1****Listing the steps of making compost**

LB page 195

(Individual)  
CP6.7

**Guidelines**

- Learners work by themselves to make a list in their workbooks of the main steps in the composting process.
- Walk through the class while the learners work. Stop at random learners and check if they understand the steps.
- Once finished, they should exchange their list with another learner to evaluate.

**Answers**

The main steps are as follows:

- Select a site.
- Gather the compost material.
- Manage the chemical balance.
- Manage the water content.
- Aerate the compost.
- Cure the compost.

**ACTIVITY 11.3.2****Preparing compost**

LB page 195

(Groups)  
CC9.1, CP6.7

**Guidelines**

- Learners work in groups to make compost. Each group should choose a method to prepare compost that they can use at home or in the school garden. Guide the groups to ensure that their choices are practical.
- If the learners are going to make the compost on the school grounds, make the necessary arrangements with the principal in advance to ensure that the compost heaps will not be in the way, or that other learners or staff members would not be inconvenienced.
- Before the learners start with their composting, allow time for a planning session during which the groups can decide what they are going to do, and allocate tasks to the group members. Encourage the learners to draw up a list of the steps and the tasks for each group member.
- Give guidance during the planning session.
- Make sure that the learners follow the correct safety procedures and wear gloves when they handle composting material. If you do not have rubber or gardening gloves available, the learners can pull plastic bags over their hands and secure the bags around their wrists with rubber bands or string.

**Answers**

This is a practical activity.

(Groups)

CP5.1, CC 9.1

**Answers**

1. arteries, veins and capillaries
2. It is a system of planets orbiting a host star.
3. Biome, ecosystem, community, population, individual
4. Manure is organic material that is used as fertiliser to provide nutrients for plants. It consists of decomposed animal wastes and plant materials.

Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1. Manure is organic material that used as fertiliser to provide nutrients for plants. It consists of decomposed animal wastes and plant materials. Compost is decayed plant and animal material. The process of composting involves the activities of micro-organisms that break down the solid organic material into compost.
2. Dogs and cats are omnivores so their droppings may include parasites that are not good for the soil.

3.
 

Green material	Brown material
grass clippings	dry leaves
food scraps	shredded cardboard
coffee grounds	straw
fresh leaves	wood chips
animal dung	sawdust
recently pulled weeds	corn stalks
eggshells	newspaper

4. Place kitchen waste in an airtight drum for fermentation. The waste can include dairy products, meat and bone. Add a layer of Bokashi powder (EM), then close the lid tightly. When the container is full, leave it to stand for 10–14 days. After a few days, liquid will start collecting in the waste material. The container has a tap to regularly drain the liquid, which can be used as liquid fertiliser. By day 14 there should be white mould growing in the drum. This is a beneficial fungus that suppresses pathogens. When the fermentation process is completed, dig a trench in the field or garden, place the fermented mixture in the trench and cover it with soil. The compost will be ready to use after three weeks.
5. Cocoa pod husks are common in Bono Region. There are many cocoa farms in the region, and they produce a large amount of waste from cocoa plants.
6. It often needs more nitrogen, which can be added by including straw, corn stalks or wood chippings.
7. Green manuring *in situ*: A manure crop is planted as an intercrop or sole crop. When the green crop is ready, it is dug into the soil as a form of manure. Common green manure crops are *Mucuna pruriens* (velvet beans), *Pueraria phaseoloides* (tropical kudzu) and *Centrosema pubescens* (centro, or butterfly pea).  
Green leaf manuring: Green leaves, cuttings and twigs are spread over the soil and dug or ploughed into the soil. Plants such as *Tithonia diversifolia* (Mexican sunflower), *Chromolaena odorata* (Siam weed), *Crotalaria juncea* and *Panicum maximum* (Guinea grass) are commonly used for green leaf manuring.
8. 5%
9. To test the compost material, you can use a moisture meter to check the moisture level or you can check by hand. You can use a compost thermometer to monitor the internal temperature of a compost pile.

- 10.** The stage at the end of the composting cycle, when the temperature of the compost no longer increases after it is turned. During the curing stage, bacterial action stops and the compost becomes stable, and other small organisms such as earthworms and beneficial fungi become active.

### Check ...

Learners can:	Yes	No
1. List and explain the different plant and animal waste used in preparing different types of manure.		
2. List some types of manure used by farmers.		
3. Identify and write down the materials used in preparing manure and their sources.		
4. Categorise manure into those from plant wastes and animal wastes.		
5. Compile a list of plant parts/wastes and animal parts/wastes that are used to prepare manure.		
6. Justify the use of different animal and plant manures (poultry droppings, cow dung, animal parts and carcasses, pig dung, human excreta, domestic refuse, leaves, waste fruits, plant parts and shavings, etc.) under different soil and climatic conditions.		

**Activity 1: Multiple choice**

1. C circulatory
2. A aorta
3. A sinuses
4. A diaphragm
5. C orbits a star
6. D from the outer solar system to the inner solar system
7. D herbivores
8. D beneficial to both species in the association
9. C straw
10. D poultry

**Activity 2: Short questions**

1. Deoxygenated blood from the body enters the right atrium.  
The blood flows into the right ventricle and is pumped to the lungs (pulmonary circuit).  
In the lungs, gaseous exchange takes place. The carbon dioxide in the blood is replaced with oxygen.  
We say that the blood becomes oxygenated.  
The oxygenated blood flows to the left ventricle and is pumped to the body (systemic circuit).  
The blood delivers oxygen to all the cells in the body and removes carbon dioxide and other waste materials from the cells. The waste materials are transported to organs such as the lungs, kidneys and liver and are subsequently expelled from the body.  
The deoxygenated blood returns to the heart, and the cycle starts again.
2. The heart is divided into four chambers. The two upper chambers are called atria. The two lower chambers are called ventricles. The chambers on the left-hand and right-hand sides are separated by a thick inner wall called the septum. The right-hand side of the heart pumps blood to the lungs to collect oxygen. The left-hand side of the heart receives oxygen-rich blood from the lungs and pumps it to the rest of the body. The two lower chambers (the ventricles) pump blood out of the heart. They are more muscular than the upper chambers, because the pumping action must be strong enough to create enough pressure to send blood to the rest of the body. The upper chambers (the atria) receive the blood that enters the heart.
3. Cellular respiration is a chemical reaction that releases carbon dioxide ( $\text{CO}_2$ ), water ( $\text{H}_2\text{O}$ ) and energy from glucose and oxygen ( $\text{O}_2$ ).
4. A planetary system is a system of planets orbiting a host star.
5. Any three: dwarf planets, comets, asteroids, meteorites
6. A meteoroid is a solid body in space before it reaches Earth's atmosphere.  
When a meteoroid enters Earth's atmosphere, it is called a meteor.  
When a meteoroid survives a journey through the atmosphere and lands on Earth's surface, it is called a meteorite.
7. **a)** An ecosystem is an area where a variety of organisms live and interact with one another and with the non-living things such as rocks, soil and water around them.  
**b)** Any two physical, chemical and other natural forces, such as sunlight, altitude, temperature, water, air.

8. A community consists of various living organisms that live together in a specific area. A population is a group of individuals of the same species.
9. a) grass → grasshopper → frog → snake → eagle  
b) grass
10. Any five: It is cheap and readily available on farms.  
It adds nutrients to the soil, thereby making the soil more fertile.  
It improves the soil structure and water-holding capacity.  
It changes the balance of micro-organisms in the soil, and in doing so helps to eliminate parasitic organisms in the soil.  
It releases carbon dioxide, which acts as a fertiliser, into the soil.
11. air, moisture, optimum temperature, a small quantity of nitrogen

### Activity 3: Essay

Guide the students to choose a topic and write an essay.

Use the rubric for essays on page 195 of this Teacher's Guide to help you assess the learners' essays.

## Learning outcomes

Content standard	Indicators and exemplars	Core competencies
<b>Topic 1: Energy</b>		
<b>B9.4.1.1</b> Show understanding of the concept of conservation of energy and ways of conserving energy.	<b>B9.4.1.1.1</b> List the ways to conserve energy. Examples: ironing in bulk, using energy efficient appliances and switching off appliances when not in use. <b>1.</b> Identify and discuss various strategies of conserving energy.	CI5.3, CC8.1
	<b>B9.4.1.1.2</b> Explain the importance of energy conservation in daily life. <b>1.</b> Research information about energy conservation and discuss its importance to life.	DL5.3
<b>B9.4.1.2</b> Demonstrate understanding in and the capability to do calculations involving energy.	<b>B9.4.1.2.1</b> Explain how to calculate energy consumed over a period of time. <b>1.</b> Calculate electrical energy consumed by the use of electrical appliances in kilowatt hours (kWh). $P = IV$ , where $P$ is power, $I$ is current, $V$ is voltage.	CP6.1
<b>B9.4.1.3</b> Evaluate the application of light energy in life.	<b>B9.4.1.3.1</b> Demonstrate that light changes path when it travels from one medium to a different medium. <b>1.</b> Carry out a practical activity to show that light bends as it travels from one medium to another, e.g. a rod appears bent in water; deep water appears shallower than its real depth.	CI6.1, DL5.3
	<b>B9.4.1.2.2</b> Describe how images are formed in cameras. <b>1.</b> Create a model of a camera and describe how it works to form an image.	CI6.3
	<b>B9.4.1.2.3</b> Describe the formation of shadows. <b>1.</b> Discuss the terms umbra and penumbra in relation to the formation of shadows and explain how they are formed.	CC8.1
	<b>B9.4.1.2.4</b> Demonstrate the formation of an eclipse. <b>1.</b> Use a model to illustrate how an eclipse is formed.	CI, DL5.3

Content standard	Indicators and exemplars	Core competencies
<b>Topic 2: Electricity and electronics</b>		
<b>B9.4.2.1</b> Construct electrical circuits and illustrate how electrical energy is transformed into other forms of energy and perform electrical calculations.	<p><b>B9.4.2.1.1</b> Demonstrate transformation of energy to other forms of energy in both series and parallel circuits and perform simple calculations involving the flow of current in circuits.</p> <ol style="list-style-type: none"> <li>1. Predict the impact of changes in electrical circuits with regard to the output of bulbs. Describe how electrical energy transformation occurs in series and parallel circuits.</li> <li>2. Construct simple electrical circuits and measure the voltage, current and resistance.</li> <li>3. Calculate the potential difference in a circuit using the formula: <math>V = IR</math> (where <math>I</math> is the current and <math>R</math> the resistance).</li> </ol>	CC8.1, CP5.5, CP6.5
<b>B9.4.2.2</b> Demonstrate an understanding of forward and reverse bias and explain the behaviour of LEDs, diodes, resistors and capacitors in electronic circuits.	<p><b>B9.4.2.2.1</b> Describe forward bias and reverse bias and explain the relationship among the components, such as: LEDs, diodes, resistors and capacitors, in an electronic circuit.</p> <ol style="list-style-type: none"> <li>1. Explain forward bias and reverse bias in an electronic circuit.</li> <li>2. Construct different electronic circuits (the forward and reverse bias), and observe what happens to the LED.</li> <li>3. Construct different electronic circuits involving resistors and capacitors and observe what happens to the LED and report on their findings.</li> </ol>	CC8.2, CI5.1, CI5.1
<b>Topic 3: Conversion and conservation of energy</b>		
<b>B9.4.3.1</b> Show an understanding of conversion and conservation of energy and their application to life.	<p><b>B9.4.3.1.1</b> Describe how energy can be converted from one form to another and show how conservation of energy occurs.</p> <ol style="list-style-type: none"> <li>1. Differentiate between conversion of energy and conservation of energy and show their application to life.</li> </ol>	CC7.5
	<p><b>B9.4.3.1.2</b> Describe how conversion and conservation of energy are applied in life.</p> <ol style="list-style-type: none"> <li>1. Distinguish between energy conversion and conservation using everyday examples.</li> <li>2. Identify opportunities to conserve energy and produce a report of your work.</li> </ol>	CC7.5



Content standard	Indicators and exemplars	Core competencies
<b>Topic 4: Force and motion</b>		
<b>B9.4.4.1</b> Demonstrate understanding of the concept of pressure and explain how pressure acts in everyday life.	<p><b>B9.4.4.1.1</b> Explain the concept of pressure and show how pressure relates to force; perform activities that work on the principle of pressure in the daily lives of humans.</p> <ol style="list-style-type: none"> <li>1. Demonstrate the action of pressure through a number of activities such as using a drinking straw, pumping car tyres, filling of balloons, water jets at washing bays, etc. to understand the concept of pressure.</li> <li>2. Describe the relationship between pressure and force and discuss the application of pressure in everyday life.</li> </ol>	CI5.1; CC8.1
<b>B9.4.4.1</b> Demonstrate understanding of the concept of pressure and explain how pressure acts in everyday life.	<p><b>B9.4.4.1.1</b> Explain the concept of pressure and show how pressure relates to force; perform activities that work on the principle of pressure in the daily lives of humans.</p> <ol style="list-style-type: none"> <li>1. Demonstrate the action of pressure through a number of activities such as using a drinking straw, pumping car tyres, filling of balloons, water jets at washing bays, etc. to understand the concept of pressure.</li> <li>2. Describe the relationship between pressure and force and discuss the application of pressure in everyday life.</li> </ol>	CI5.1; CC8.1
<b>B9.4.4.2</b> Demonstrate an understanding of Newton's Third Law of Motion and its application in everyday life.	<p><b>B9.4.4.2.1</b> Explain the importance of Newton's Third Law of Motion in life.</p> <ol style="list-style-type: none"> <li>1. State Newton's Third Law of Motion.</li> <li>2. Discuss Newton's Third Law of Motion and show its importance to life.</li> </ol>	CC8.3, CC8.2
	<p><b>B9.4.4.1.2</b> Demonstrate the application of Newton's Third Law of Motion in life.</p> <ol style="list-style-type: none"> <li>1. Predict what happens when: <ol style="list-style-type: none"> <li>a) a force is exerted on an object.</li> <li>b) There is a reaction from the object</li> <li>c) the force exerted is the same as the reaction of the object.</li> </ol> </li> <li>2. Perform an activity to justify your predictions.</li> </ol>	CI6.1, CP5.4
<b>B9.4.4.2</b> Demonstrate understanding of Newton's laws of motion and ability to apply the laws to solve problems in everyday life	<p><b>B9.4.4.2.1</b> Explain Newton's laws of motion and their applications to daily life.</p> <ol style="list-style-type: none"> <li>1. Explain Newton's laws of motion and relate them to momentum.</li> <li>2. Demonstrate the application of Newton's laws of motion in everyday life.</li> <li>3. Derive the formula, <math>f = ma</math>, where <math>F</math> is the force, <math>m</math> the mass of the object, and <math>a</math>, the acceleration, from Newton's three laws of motion and use the formula to calculate the force that a moving mass of body exerts when moving with known acceleration.</li> </ol>	CP5.2, CI5.1, CI5.2

Content standard	Indicators and exemplars	Core competencies
<b>Topic 5: Agricultural tools</b>		
<b>B9.4.5.1</b> Demonstrate knowledge and skills in making simple agricultural tools for on-farm activities.	<b>B9.4.5.1.1</b> Identify materials used in making simple agricultural tools. <b>1.</b> Describe simple agricultural tools assembled from their environment. <b>2.</b> Identify the materials used to make the tools assembled in exemplar 1 and show how the parts are connected.	CI5.7, CI5.3, CP5.1
	<b>B9.4.5.1.2</b> Discuss and write activities involved in making simple agricultural tools. <b>1.</b> Describe the activities and processes involved in making different agricultural tools. <b>2.</b> Explain the materials, processes, constraints and precautions involved in manufacturing simple agricultural tools.	CC8.1, CC8.2
	<b>B9.4.5.1.3</b> Manufacture simple agricultural tools. <b>1.</b> Produce simple farm tools using materials from the environment.	CI5.2

# Topic 1: Energy

## Module 12 Energy

### Unit 12.1 Ways to conserve energy

#### Content standard

- B9.4.1.1: Show understanding of the concept of conservation of energy and ways of conserving energy.

#### Indicator

- B9.4.1.1.1: List the ways to conserve energy. Examples: ironing in bulk, using energy efficient appliances and switching off appliances when not in use.

#### Exemplars

- Identify and discuss various strategies of conserving energy.

#### Unit in a nutshell

- Energy conservation refers to the practice of reducing the amount of energy used.
- There are many things that you can do to reduce the amount of energy that you use, for example switching off lights when you leave a room.
- The efficient use of energy refers to the practice of using less energy to perform the same task.
- Many household appliances have a power-efficiency rating. Energy-efficient appliances help to conserve energy.
- Solar power is a renewable source of energy that can be used effectively to reduce the amount of energy used to heat water.
- You can save energy by using alternative options that cost nothing and that will not harm the environment.

#### ACTIVITY 12.1.1

#### Discussing ways of conserving energy

LB page 208

(Groups)

CI5.3, CC8.1, CL5.3

#### Guidelines

- The learners work in groups to identify and discuss strategies of conserving energy as well as the importance of conserving energy.
- Encourage the learners to tell the other members of their group which appliances and machines they and their family use at home. Guide the learners to think of alternatives that could conserve energy, save money, and benefit the environment.
- Guide the discussion and help learners who struggle.

## Answers

There are no fixed answers for this group discussion. The learners can give their own opinion, and can also refer to the Learner's Book for guidance.

## Unit 12.2 The importance of conserving energy

### Content standard

- B9.4.1.1: Show understanding of the concept of conservation of energy and ways of conserving energy.

### Indicators

- B9.4.1.1.2: Explain the importance of energy conservation in daily life.

### Exemplars

- Research information about energy conservation and discuss its importance to life.

### Unit in a nutshell

- Conserving energy helps the environment by reducing pollution and the use of fossil fuels.
- You save money if you save energy.
- A reduction in energy use will help to stabilise the national power supply.
- Your health and well-being will benefit if you use less electrical energy.

#### TALK ABOUT

LB page 211

Facilitate a class discussion about energy supply in Ghana. Guide the learners to think about the energy requirement in Ghana, and how that compares with the current energy supply. Guide them to find information about power stations in Ghana, and the type of electricity that is generated (from fossil fuels, hydroelectric, etc.). Also talk about sustainable resources and the use of renewable energy.

#### ACTIVITY 12.2.1

#### Finding out more about the importance of energy conservation

LB page 211

(Groups)  
*CI5.3, CC8.1, DL5.3*

### Guidelines

- The learners work in groups to discover how energy conservation can help their community and the environment and present their findings to the class.
- The groups can use the internet or a library for research, as well as asking people they know what they do to conserve energy, and how energy conservation affects them.
- Finally, the groups should write a report on their findings and present it to the rest of the class.

## Answers

Answers will depend on the learners' research.

## Assessment

Use the rubric for reports on page 194 of this guide to help you assess the learners' investigation.

### EXTENSION ACTIVITY

LB page 211

Ask the learners to find out more about energy supply in Ghana. Encourage them to prepare a presentation to share their findings with the rest of the class.



### INTERNET INTERACT

The following websites have useful information about energy supply in Ghana.

<http://www.energycom.gov.gh/>

<https://www.energymin.gov.gh/>

<http://www.ecggh.com/index.php>

## Unit 12.3 Calculations involving energy

### Content standard

- B9.4.1.2: Demonstrate understanding in and the capability to do calculations involving energy.

### Indicator

- B9.4.1.2.1: Explain how to calculate energy consumed over a period of time.

### Exemplars

- Calculate electrical energy consumed by the use of electrical appliances in kilowatt hours (kWh).  $P = IV$ , where  $P$  is power,  $I$  is current,  $V$  is voltage.

### Unit in a nutshell

- The power rating of an electrical appliance depends on the electric current measured in ampere (A) passing through it and the voltage measured in volts (V).
- The unit of electrical energy is the kilowatt hour (kWh).
- The formula for calculating a kilowatt hour is  $P = IV$ .
- To calculate the amount of electrical energy used: power  $\times$  hours.
- Cost of electrical energy used = cost per hour  $\times$  electrical energy used.
- A 100 W bulb uses 100 J of electrical energy each second. In one minute, the bulb uses 6 000 J of energy. In one hour, it will use 360 000 J of energy.

(Individual)  
CP6.1

## Guidelines

- Work through the worked examples in the Learner's Book with the class. Make sure that they understand the calculations, and why they are done in this way.
- If there are any learners who are struggling with the calculations, spend extra time on explaining the method. You can also give them additional calculations for further practice.
- Bear in mind that some learners may be put off by the idea of 'having to make sums' and may think that they cannot do mathematics. Break down the method of calculation to simple steps so that the calculations make practical sense to the learners.
- When you are sure that the learners have mastered the concept, learners work individually to do the activity.

## Answers

1.  $\frac{50}{0.369} = 135.5 \text{ kWh}$

2.  $P = IV$

$$30 \times 240 = 7\,200 \text{ Wh} = 7.2 \text{ kWh}$$

$$7.2 \text{ kWh} \times 1 \text{ h} \times 7 \text{ days}$$

$$= 50.4 \text{ kWh}$$

3.  $135.5 - 50.4 = 85.1 \text{ kWh}$

Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1. Any five: Switch off lights and appliances when you are not using them. Wait till you have a large batch of clothes to iron instead of ironing one item at a time. Use less water in your bath or take a shower. Use light-coloured curtains or blinds and paint the walls white. Use larger windows. When using an air conditioner close all the windows. Open the refrigerator or freezer as seldom as possible.
2. Efficient energy use is using less energy to perform the same task. Reduced energy use means using fewer electrical appliances, using them for shorter periods, or using them sparingly.
3. The Energy Efficiency Standards and Labels Programme
4. Compact fluorescent lamp
5. LED. LED lighting is more energy efficient as it uses less energy than CFL to produce the same amount of light.
6. Solar hot water cylinders
7. You can adjust the settings of a refrigerator or an air conditioner to the most energy-efficient setting. A smart home system can also learn to make these adjustments automatically. It can also automatically turn off appliances.
8. We can calculate electricity used by multiplying the power used (in kW) by the number of hours (h) the device has used that power. This gives us the electrical energy used in kilowatt hours (kWh).
9.  $P = IV$
10. TV:  $120 \text{ W} \times 4 \text{ h} = 480 \text{ Wh} \times 7 \text{ days} = 3.36 \text{ kWh}$   
refrigerator:  $200 \text{ W} \times 16 \text{ h} \times 7 \text{ days} = 22.4 \text{ kWh}$   
fan:  $100 \text{ W} \times 2 \text{ h} \times 7 \text{ days} = 1.4 \text{ kWh}$
11. Household A:  $8 \times 11 \text{ W} \times 6 \text{ h} = 528 \text{ Wh}$   
Household B:  $8 \times 60 \text{ W} \times 6 \text{ h} = 2.88 \text{ kWh}$   
Difference  $2.88 \text{ kWh} - 0.528 = 2.352 \text{ kWh}$

### Check ...

Learners can:	Yes	No
1. List the ways to conserve energy.		
2. Identify and discuss various strategies of conserving energy.		
3. Explain the importance of energy conservation in daily life.		
4. Research information about energy conservation and discuss its importance to life.		
5. Explain how to calculate energy consumed over a period of time.		
6. Calculate electrical energy consumed by the use of electrical appliances in kilowatt-hour (kWh). $P = IV$ , where $P$ is power, $I$ is current, $V$ is voltage.		

# Topic 1: Energy

## Module 13 Light

### Unit 13.1 The pathway of light

#### Content standard

- B9.4.1.3: Evaluate the application of light energy in life.

#### Indicator

- B9.4.1.3.1: Demonstrate that light changes path when it travels from one medium to a different medium.

#### Exemplar

- Carry out a practical activity to show that light bends as it travels from one medium to another, e.g. a rod appears bent in water; deep water appears shallower than its real depth.

#### Unit in a nutshell

- The electromagnetic (EM) spectrum is the complete range of frequencies of electromagnetic radiation.
- The EM spectrum includes radio waves, microwaves, infrared light, visible light, ultraviolet light, X-rays and gamma rays.
- Light is an electromagnetic wave that travels in straight lines.
- When light travels from one medium to another, it changes speed. This change causes the light to refract (bend).
- When a ray of light falls onto a surface, parts of the ray can be absorbed by the substance on which it falls.

#### EXPERIMENT 1.3.1.1 Investigating light refraction

LB page 219

(Pairs)

CI6.1, DL5.3

#### Materials and apparatus

Glass filled with water, a pencil or a straight wooden stick

#### Guidelines

- Make sure to have the materials needed for the experiment. If you do not have enough glasses, the learners can work in bigger groups. Alternatively, you can set up the glass and pencil on your desk and ask the learners to come to the front of the class in small groups to look at the glass and pencil.
- As water is involved, do the experiment where spillage will drain away or be contained. Also have cloths or towels on hand to clean up any spillage.



- As glassware is being used, have a first-aid kit on hand in case a glass breaks and a learner cuts their hand.
- Follow the instructions given in the Learner's Book.
- Allow time for the learners to discuss their observations.

### ACTIVITY 13.1.1

### Discussing refraction and absorption

LB page 223

(Groups)

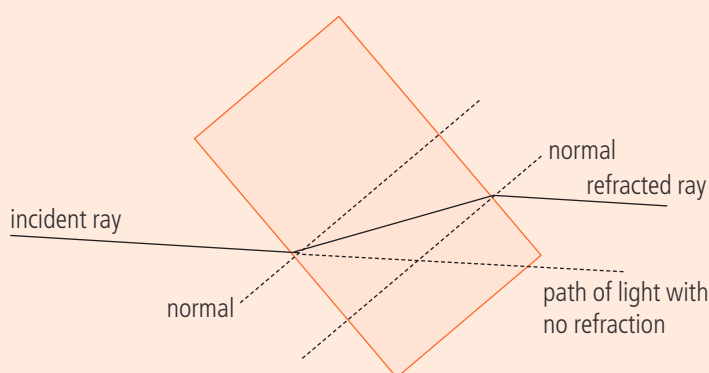
CI6.1, DL5.3

## Guidelines

- The learners work in groups to discuss and answer the questions.

## Answers

1. a) two  
b)



- c) It bends away from the normal line.
2. The black T-shirt absorbs more light than the white T-shirt.
3. The learners' lists will depend on their searches and the examples they find. Examples of refraction include microscopes and telescopes, which use the principle of refraction to make things look closer than they are. Spectacles, contact lenses and the human eye also use the principle of refraction. Examples of absorption are any black objects (where all the light is absorbed) or coloured objects. For example, grass looks green in white light because it absorbs the colours violet indigo, yellow, orange and red, but it reflects green light.

## Unit 13.2 Cameras

### Content standard

- B9.4.1.3: Evaluate the application of light energy in life.

### Indicator

- B9.4.1.2.2: Describe how images are formed in cameras.

## Exemplar

- Create a model of a camera and describe how it works to form an image.

## Unit in a nutshell

- Light rays move through the different parts of a camera lens to create an inverted image, which falls on the sensor and is captured.
- A pinhole camera has a tiny opening through which light enters the camera.
- Rays of light from an object placed in front of a pinhole camera travel in straight lines through the hole and form a tiny, inverted image on the screen.

### ACTIVITY 13.1.2

### Explaining how a camera works

LB page 224

(Pairs)

C/6.3

## Guidelines

- The learners work in pairs to explain to each other how a camera captures an image.
- They may use the information in the Learner's Book or do additional research on the internet or in library books to help them.

### Answers

The photographer looks through the camera's eye piece and focuses on a scene or an object.

Light rays from the object fall on the lens. An opening in the lens, called the aperture, controls how much light goes into the camera. The photographer can set the aperture to be smaller or bigger to allow more or less light into the camera.

When the photographer presses the shutter button to take a photo, the shutter opens and allows rays of light to enter the lens. The shutter is an opaque 'flap' or shield that prevents light from falling onto the sensor continuously.

The rays of light from the object are of different lengths and enter the lens at different angles. The rays move through the different parts of the lens, which refract the rays so that they all come together (converge) in the same spot. This creates an inverted image, which falls on the sensor and is captured electronically. In cameras that use film, the image is captured on the film, which must then be developed to produce a photograph.

### PRACTICAL ACTIVITY 13.2.1

### Making a pinhole camera

LB page 225

(Groups)

C/6.3

## Guidelines

- Assemble the materials and apparatus needed to make the pinhole camera.
- Read the instructions in the Learner's Book with the learners to make sure that they understand the steps.
- If you have enough resources on hand, the learners can work in groups to make their own pinhole cameras. Alternatively, you can make one pinhole camera to demonstrate the process.
- Allow the learners to try out the camera to see how it works.

## Unit 13.3 Shadows

### Content standard

- B9.4.1.3: Evaluate the application of light energy in life.

### Indicator

- B9.4.1.2.3: Describe the formation of shadows.

### Exemplar

- Discuss the terms umbra and penumbra in relation to the formation of shadows and explain how they are formed.

### Unit in a nutshell

- Shadows are formed when an opaque object is placed in the path of light rays.
- The size and position of an object's shadow change through the course of a day.
- The umbra is the darker part of a shadow, and is created when most of the light is being blocked by the object.
- The penumbra is a lighter shadow, and is created when some light travels around the object blocking the light.

#### ACTIVITY 13.3.1

#### Making shadow creatures

LB page 228

(Class)  
CC8.1

## Guidelines

- Provide an electric light source. Do not use a naked flame as a light source.
- Darken the room if possible.
- Allow the learners to take turns to make shadow creatures.
- The other members of the group should guess which creature is being shown.

**ACTIVITY 13.3.2****Discussing shadows**

LB page 230

(Groups)  
CC8.1

**Guidelines**

- The learners work in groups to answer the questions.
- Make sure that all the learners in a group participate in the discussion.
- Walk around the class while the learners have their discussions and give guidance where needed.

**Answers**

1. The shadow will be small and directly underneath where she stands.
2. An umbra is a dark shadow with sharp edges. A penumbra is a lighter shadow that forms around an umbra when the source of light is larger than the opaque object casting the shadow.

**Unit 13.4 Eclipses****Content standard**

- B9.4.1.3: Evaluate the application of light energy in life.

**Indicator**

- B9.4.1.2.4: Demonstrate the formation of an eclipse.

**Exemplar**

- Use a model to illustrate how an eclipse is formed.

**Unit in a nutshell**

- A solar eclipse occurs when the moon passes between the Sun and the Earth.
- There are three main types of solar eclipse: total, partial and annular.
- A lunar eclipse occurs when the Earth passes between the Sun and the moon.
- There are two types of lunar eclipse: total and partial.

**PRACTICAL ACTIVITY 13.4.1****Making a model to represent eclipses**

LB page 233

(Groups)  
CI, DL5.3

## Guidelines

- Divide the class into groups.
- Provide enough materials and apparatus for each group to make their own models.
- Instruct the learners to follow the instructions given in the Learner's Book.
- Have a class discussion to critique each group's models.

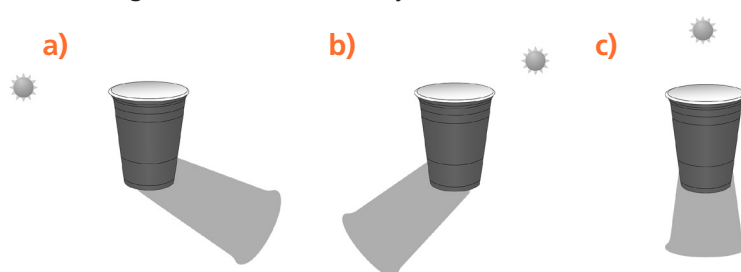
## Assessment

Use the rubric for models on page 194 of this guide to assess the learners' models.

Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1.
  - a) False. A film camera uses chemicals to capture an image on a film. OR A digital camera uses a sensor to capture a digital image and store it on a memory card or computer.
  - b) False. The aperture is the opening through which light enters the camera. OR A lens focuses the light on the sensor or film.
  - c) True. A pinhole camera creates an inverse image.
  - d) False. The shadow of a translucent object will be lighter than the shadow of an opaque object.
  - e) True. Light moves more slowly in a dense substance than in air.

2.



3. Specular reflection occurs when light rays are reflected evenly from a smooth, flat surface. This is the type of reflection that a mirror has.  
Diffuse or scattered reflection occurs on surfaces that are rough or uneven and dull, for example paper and clothing. The rays reflect at different angles and have different lengths.
4. Any five: It is an electromagnetic wave. It can travel through a vacuum. It travels in straight lines. It changes direction and speed when it moves through different mediums (refraction). It can be reflected from polished (shiny) surfaces, for example metal. It can be absorbed by dark or opaque surfaces, for example wood. It can travel through transparent materials, for example glass.
5.
  - a) Solar eclipse. The moon is between the Sun and the Earth, causing a shadow to fall on the Earth.
  - b) A: umbra, B: penumbra
  - c) Lunar eclipse. When the Earth passes between the Sun and the moon and the moon is in the Earth's shadow.

## Check ...

Learners can:	Yes	No
1. Demonstrate that light changes path when it travels from one medium to a different medium.		
2. Use apparatus and explanations to describe the pathway of light.		
3. Describe how images are formed in cameras.		
4. Create a model of a camera and describe how it works to form an image.		
5. Describe the formation of shadows.		
6. Explain the terms umbra and penumbra in relation to the formation of shadows and explain how they are formed.		
7. Describe the formation of an eclipse using a model.		
8. Use a model to illustrate how an eclipse is formed.		

# Topic 2: Electricity and electronics

## Module 14 Electrical and electronic circuits

### Unit 14.1 Electrical circuits

#### Content standard

- B9.4.2.1: Construct electrical circuits and illustrate how electrical energy is transformed into other forms of energy and perform electrical calculations.

#### Indicator

- B9.4.2.1.1: Demonstrate transformation of energy to other forms of energy in both series and parallel circuits and perform simple calculations involving the flow of current in circuits.

#### Exemplars

- Predict the impact of changes in electrical circuits with regard to the output of bulbs. Describe how electrical energy transformation occurs in series and parallel circuits.
- Construct simple electrical circuits and measure the voltage, current and resistance.
- Calculate the potential difference in a circuit using the formula:  $V = IR$  (where  $I$  is the current and  $R$  the resistance).

#### Unit in a nutshell

- An electrical circuit is a path through which electrical energy flows.
- Electrical energy is energy that comes from a flow of electrons in a circuit.
- Current ( $I$ ) is the flow of electrons in a circuit.
- Current is measured in amperes (A) and is measured using an ammeter.
- Resistance ( $R$ ) is the opposition to the current in a circuit.
- Resistance is measured in ohm ( $\Omega$ ) and is measured using a voltmeter.
- Ohm's law states that the current passing through a conductor is proportional to the voltage over the resistance.
- You can use Ohm's triangle to calculate current, voltage and resistance.
- Components that are connected one after another in the circuit loop are connected in series.
- Components connected on separate branches are connected in parallel.

#### ACTIVITY 14.1.1 Calculating current, voltage and resistance LB page 240

(Individual)  
CC8.1, CP5.5, CP6.5



## Guidelines

- Make sure that the learners understand Ohm's law, and that they know how to use Ohm's triangle.
- Learners work on their own to complete the calculations and write the answers in their workbooks.

### Answers

$$\begin{aligned} 1. \quad I &= \frac{V}{R} \\ &= \frac{9}{3} \\ &= 3 \text{ A} \end{aligned}$$

$$\begin{aligned} 2. \quad V &= IR \\ &= 1 \times 6 \\ &= 6 \text{ V} \end{aligned}$$

$$\begin{aligned} 3. \quad R &= \frac{V}{I} \\ &= \frac{12}{3} \\ &= 4 \, \Omega \end{aligned}$$



### INTERNET INTERACT

If you have access to the internet, let the learners watch a video that explains Ohm's law and the use of Ohm's triangle. Here are two examples:

<https://www.youtube.com/watch?v=rYOK1aT2z2Y>

<https://www.youtube.com/watch?v=Rexyl2V829g>

### PRACTICAL ACTIVITY 14.1.1

#### Creating an electrical circuit in series

LB page 242

(Groups)

CC8.1, CP5.5, CP6.5

### Materials and apparatus

A battery, a switch and two lamps

## Guidelines

- Explain to the learners that they are going to construct a simple electrical circuit in series.
- Ask a few learners to explain to the class what a series circuit is, and make sure that all the learners understand the concept.
- Make sure that you have the components needed on hand. Divide the class into groups depending on the resources you have available.
- If you only have one set of components, do the activity as a class demonstration.
- The learners should follow the instructions in the Learner's Book to do the activity.
- Walk through the class while the learners are busy and give guidance where necessary.

### Answers

Learners should observe that if one lamp is unscrewed and removed, both lamps stop shining. Explain that this is because the electrical energy first flows through one lamp and then the other – in series – and that removing one lamp breaks the circuit to the other lamp.

**PRACTICAL ACTIVITY 14.1.2****Creating an electrical circuit in parallel**

LB page 242

(Groups)

CC8.1, CP5.5, CP6.5

**Materials and apparatus**

A battery, a switch and two lamps

**Guidelines**

- Explain to the learners that they are going to construct a simple electrical circuit in parallel.
- Ask a few learners to explain to the class what the difference between a series circuit and a parallel circuit is, and make sure that all the learners understand the concept.
- Make sure that you have the components needed on hand. Divide the class into groups depending on the resources you have available.
- If you only have one set of components, do the activity as a class demonstration.
- The learners should follow the instructions in the Learner's Book to do the activity.
- Walk through the class while the learners are busy and give guidance where necessary.

**Answers**

The learners should observe that if one lamp is unscrewed and removed, the other lamp will continue shining. Explain that this is because the electrical energy flows through separate paths or branches to each lamp and that removing one lamp does not break the circuit to the other lamp.

**PRACTICAL ACTIVITY 14.1.3****Measuring current and voltage** LB page 243

(Groups)

CC8.1, CP5.5, CP6.5

**Materials and apparatus**

A battery, a lamp, an ammeter, a voltmeter

**Guidelines**

- Demonstrate to the class how an ammeter and a voltmeter works. Show them how to connect the devices to a circuit.
- Make sure that you have the components needed on hand and divide the class into groups depending on the resources you have available.
- If you only have one set of components do the activity as a class demonstration.
- Learners should follow the instructions in the Learner's Book to do the activity.
- Walk through the class while the learners are busy and give guidance where necessary.

## Answers

The learners should know how to connect the ammeter in series with the lamp to measure the current. They should also know to connect the voltmeter in parallel with the lamp to measure the voltage.

## Unit 14.2 Electronic circuits

### Content standard

- B9.4.2.2: Demonstrate an understanding of forward and reverse bias and explain the behaviour of LEDs, diodes, resistors and capacitors in electronic circuits.

### Indicator

- B9.4.2.2.1: Describe forward bias and reverse bias and explain the relationship among the components, such as: LEDs, diodes, resistors and capacitors, in an electronic circuit.

### Exemplars

- Explain forward bias and reverse bias in an electronic circuit.
- Construct different electronic circuits (the forward and reverse bias), and observe what happens to the LED.
- Construct different electronic circuits involving resistors and capacitors and observe what happens to the LED and report on their findings.

### Unit in a nutshell

- Electronic components include resistors, capacitors, diodes, transistors and integrated circuits (ICs).
- With forward biasing, the anode of the diode is connected to the positive voltage and the cathode to the negative voltage. The current flows through the diode.
- With reverse biasing, the positive terminal of the diode is connected to the negative voltage and the negative terminal to the positive voltage.

#### PRACTICAL ACTIVITY 14.2.1

#### Testing the bias of a diode

LB page 245

(Groups)  
CC8.2, CI5.1, CI5.1

#### Materials and apparatus

A battery, a diode and a lamp

### Guidelines

- Make sure that the learners understand the concept of bias.
- Make sure that you have the components needed on hand and divide the class into groups depending on the resources you have available.

- If you only have one set of components do the activity as a class demonstration.
- The learners should follow the instructions in the Learner's Book to do the activity.
- Walk through the class while the learners are busy and give guidance where necessary.

### Answers

The learners should be able to determine the bias of the diode from the state of the lamp. If the lamp lights up, the diode is forward biased. If the lamp does not light up, then it is reverse biased.

### PRACTICAL ACTIVITY 14.2.2

### Creating a 9 V polarity tester

LB page 247

(Groups)

CC8.2, CI5.1, CI5.1

### Materials and apparatus

two LEDs, a slinky spring, small piece of ribbon, two resistors of  $470\ \Omega$  each, a black probe, a red probe, a 9 V battery

### Guidelines

- Make sure that you have the components needed on hand and divide the class into groups depending on the resources you have available.
- If you only have one set of components do the activity as a class demonstration.
- The learners should follow the instructions in the Learner's Book to do the activity.
- This is a more advanced circuit, so help any groups that are having difficulty to troubleshoot. Give guidance where necessary.
- If any learners struggle to understand the concept of how the circuit works, ask the other learners in the group to explain it to them.

### Answers

The learners should be able to achieve the results as set out in the Learner's Book.

Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1. Power source, conductive path (wire), load.
2. When components in a circuit are connected one after another, they are in series. Components connected on different branches of the circuit are in parallel.
3. Ohm's law states that the current passing through a conductor is proportional to the voltage over the resistance.
4. To use Ohm's triangle, we simply cover the value we want. The other two symbols that are visible is the formula we need to calculate the third value.
5.
  - a) Resistance is the opposition to the current in a circuit.
  - b) Current is the flow of electrons in a circuit.
  - c) Voltage is the difference in electrical charge between two points in a circuit.
  - d) Potential difference is the same as voltage.
6. 
 

a) $I = \frac{V}{R}$	b) $V = IR$	c) $R = \frac{V}{I}$
$= \frac{12}{10}$	$= 5 \times 1.33$	$= \frac{240}{3}$
$= 1.2 \text{ A}$	$= 6.65 \text{ V}$	$= 80 \Omega$

### Check ...

Learners can:	Yes	No
1. Demonstrate the transformation of electrical energy to other forms of energy in both series and parallel circuits and perform simple calculations involving the flow of current in circuits.		
2. Predict the impact of changes in electrical circuits with regard to the output of bulbs.		
3. Describe how electrical energy transformation occurs in series and parallel circuits.		
4. Construct simple electrical circuits and measure the voltage, current and resistance.		
5. Calculate the potential difference in a circuit using the formula: $V = IR$ (where $I$ is the current and $R$ the resistance).		
6. Describe forward bias and reverse bias and explain the relationship among the components – such as LEDs, diodes, resistors and capacitors – in an electronic circuit.		
7. Explain forward bias and reverse bias in an electronic circuit.		
8. Construct different electronic circuits (the forward and reverse bias), and observe what happens to the LED.		
9. Construct different electronic circuits involving resistors and capacitors and observe what happens to the LED and report on findings.		

# Topic 3: Conversion and conservation of energy

## Module 15

## Energy conversions

### Unit 15.1 Conversion and conservation of energy

#### Content standard

- B9.4.3.1: Show an understanding of conversion and conservation of energy and their application to life.

#### Indicator

- B9.4.3.1.1: Describe how energy can be converted from one form to another and show how conservation of energy occurs.

#### Exemplars

- Differentiate between conversion of energy and conservation of energy and show their application to life.

#### Unit in a nutshell

- Energy can be converted from one type to another.
- When energy is changed from one form to another, the total amount of energy in the energy system remains the same.
- The law of the conservation of energy states that energy can never be created or destroyed – it can only be converted from one form of energy to another.

#### ACTIVITY 15.1.1

#### Identifying types of energy conversions LB page 251

(Pairs)  
CC7.5

#### Guidelines

- Make sure that the learners understand the concept of energy conversion (also called energy transformation).
- Ask the learners to name some electrical appliances that they use at home. Then ask them to say where the energy for that appliance comes from. Guide them to make the link between the type of energy that is used and its function.
- Let the learners work in pairs to complete the activity. If there isn't time to do the activity in class, you could also give it as homework as an individual exercise.
- Learners can swap their answers with a partner to mark and correct the work. Then go through the answers with the class.

## Answers

- Chemical energy to electrical energy
  - Electrical energy to light (and some heat) energy
  - Electrical energy to heat energy
- Accept any reasonable answer that is a form of heat energy, for example, heat from the sun, gas heaters, a kettle that boils water, a cup of hot coffee that gives off heat.
  - Accept any reasonable answer that is a form of mechanical energy, for example, riding a bicycle, typing on a keyboard, turning a doorknob, hammering a nail.
  - Accept any reasonable answer that is a form of electrical energy, for example, lightning, a battery-powered flashlight, solar cells, any electrical appliance.



## INTERNET INTERACT

There are many videos available on YouTube that can help learners to understand the concepts of energy and energy conversions (transformations). Below are a few useful links.

- What is energy?  
<https://www.youtube.com/watch?v=Q4M-q8fiJ2I>  
[https://www.youtube.com/watch?v=CW0\\_S5YpYVo](https://www.youtube.com/watch?v=CW0_S5YpYVo)
- Where does energy come from?  
<https://www.youtube.com/watch?v=dmcevC55K3s>
- Energy transformations  
<https://www.youtube.com/watch?v=FeXblXxuKHE>  
<https://www.youtube.com/watch?v=bVxDhXTOLcA>

### ACTIVITY 15.1.2

### Discussing energy conversions in everyday life

LB page 253

(Pairs)

CC7.5

## Guidelines

- The learners work in pairs to discuss energy conversions in everyday life.
- They should write down two of these conversions and list which type of energy each is.
- They should also list any types of energy that is wasted as undesirable (similar to the heat energy from a light bulb).

## Answers

Answers will vary.

## Unit 15.2 Applications of the conversion and conservation of energy

### Content standard

- B9.4.3.1: Show an understanding of conversion and conservation of energy and their application to life.

### Indicator

- B9.4.3.1.2: Describe how conversion and conservation of energy are applied in life.

### Exemplars

- Distinguish between energy conversion and conservation using everyday examples.
- Identify opportunities to conserve energy and produce a report of your work.

### Unit in a nutshell

- We use the principle of energy conversion in many ways to perform a wide variety of tasks.
- Water has a lot of potential energy and can be used to generate hydroelectrical power.
- When the energy in a system is converted to a different kind of energy, it does not always result only in the type of energy we need.
- Energy can be wasted in the form of heat, light or noise.
- Any device or system can be made more efficient to save energy.

#### ACTIVITY 15.2.1

#### Identifying kinetic energy and potential energy

LB page 255

(Pairs)  
CC7.5

### Guidelines

- The learners work in pairs to make a list of examples of kinetic energy and potential energy around them.

#### Answers

Answers will vary.

#### ACTIVITY 15.2.2

#### Writing a report on energy conservation

LB page 257

(Groups)  
CC7.5



## Guidelines

- The learners work in groups to come up with ways to conserve energy in the home and write a report.
- Explain the concept of recovering wasted energy in a system and repurposing it as a usable form of energy. As another example of this you can explain that an electric car can use its brakes to generate electricity that recharges the batteries, saving the energy that would otherwise be lost as heat as electrical energy.
- Also remind the learners that there are ways to conserve energy such as insulation.

## Answers

Answers will vary.

Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1.
  - a) Energy is the capacity of an object to perform work.
  - b) Work is the movement of energy from one object to another.
  - c) Power is the rate at which energy moves from one object to another.
2. Potential energy and kinetic energy. Potential energy is the energy that is stored in an object. Kinetic energy is the energy an object has while moving.
3. Energy can never be created or destroyed – it can only be converted from one form of energy to another.
4. Any two: heat, mechanical, radiant, chemical, sound
5. Chemical energy
6. Sound energy
7. Electrical energy is converted to kinetic energy in the fan's motor. Some of the energy is lost as it is converted to heat in the motor. The kinetic energy in the motor turns the blades, which move the air.
8.
  - a) The radiant energy from the sun is converted to chemical energy by the process of photosynthesis. The chemical energy is converted to growth during cellular respiration in the cells.
  - b) Photosynthesis
9. A dam holds water that has potential energy. When the dam gate is opened, water flows and the potential energy changes to kinetic energy as it moves. The moving water flows through the turbines, passing some of its kinetic energy to the turbines. The kinetic energy from the turbines is used to activate the generators. The generators convert the kinetic energy into electrical energy. The electrical energy is distributed to homes and businesses around the country, where it is converted into mechanical energy, light energy, heat energy, sound energy, and so on.

### Check ...

Learners can:	Yes	No
1. Describe how energy can be converted from one form to another and show how conservation of energy occurs.		
2. Explain conversions of energy in everyday life showing how energy is not lost but rather transferred from one form to another.		
3. Describe how conversion and conservation of energy are applied in everyday life.		
4. Distinguish between energy conversion and conservation using everyday examples.		

# Topic 4: Force and motion

## Module 16

## Pressure

### Unit 16.1 Principles of pressure

#### Content standard

- B9.4.4.1: Demonstrate understanding of the concept of pressure and explain how pressure acts in everyday life.

#### Indicator

- B9.4.4.1.1: Explain the concept of pressure and show how pressure relates to force; perform activities that work on the principle of pressure in the daily lives of humans.

#### Exemplars

- Demonstrate the action of pressure through a number of activities such as using a drinking straw, pumping car tyres, filling of balloons, water jets at washing bays, etc. to understand the concept of pressure.
- Describe the relationship between pressure and force and discuss the application of pressure in everyday life.

#### Unit in a nutshell

- Pressure is the amount of force acting on the surface of an object, expressed per unit area.
- Pressure is measured in  $\text{N/m}^2$  (newton per square metre), sometimes called the pascal (Pa).
- The formula for pressure is  $P = \frac{F}{A}$ .
- Pressure is directly related to both force and area.
- Pressure makes it possible to perform various actions.
- There are various instruments that are used to measure pressure.
- Pressure is also exerted by fluid substances such as liquids and gases.
- Gases exert pressure.
- The pressure from the atmosphere is constantly around us.
- Atmospheric pressure affects the weather that we experience.

#### ACTIVITY 16.1.1

#### Thinking about pressure and force

LB page 260

(Individual)  
CI5.1

## Guidelines

- The learners work on their own, answering the question in their workbooks.
- They should identify which of the two items would penetrate further into a wall if hit with a hammer and the same force. They should also explain why they think this.

### Answers

The nail will penetrate further into the wall than the bolt.

The nail's sharp point focuses all the force from the hammer at its tip, increasing the pressure so that it is able to penetrate the wall more easily than the broad, flat end of the bolt.

#### ACTIVITY 16.1.2

#### Discussing and answering questions

LB page 262

(Groups)

CI5.1, CC8.1

## Guidelines

- The learners work in groups to discuss the questions.
- Once each group has arrived at their answers, have a class discussion to compare the answers.

### Answers

1. When the bubbles form at the bottom of the pot, they are under greater pressure from the body of water above them. As they rise to the surface, the water pressure reduces and the bubbles expand.
2. The dry sand in the desert can be difficult to walk on as it is very dry and loose. Camels have very broad feet to distribute the pressure from their weight over a larger area of sand so that they can walk over the sand easier without sinking into it.

#### EXPERIMENT 16.1.1

#### Showing that pressure increases with depth

LB page 265

(Pairs)

CI5.1

## Guidelines

- The learners work in pairs to conduct the experiment.
- Ensure you have enough bottles and nails for the pairs.
- If resources are limited, increase the size of groups so fewer materials are needed.
- Make sure the learners follow the instructions for the experiment.
- Discuss the results and conclusions with the class to ensure they understand them.

**EXPERIMENT 16.1.2****Examining the pressure exerted by air** LB page 266

(Pairs)

CI5.1

**Guidelines**

- Learners work in pairs to conduct the experiment.
- Ensure you have enough straws and glasses. Plastic straws will be easier to use than paper straws.
- If resources are limited, the learners can work in groups and take turns to use the straw.
- Make sure that the learners follow the instructions for the experiment.
- Discuss the results and conclusions with the class to ensure that everybody understands the principle involved.

**ACTIVITY 16.1.3****Using pressure in our daily lives**

LB page 269

(Pairs)

CC8.1

**Guidelines**

- The learners work in pairs to analyse the images and then write how they think the pressure in each image is being used.

**Answers**

- a) The force of the person holding the stick and the weight of the stick is being applied to the fufu by the end of the stick.
- b) The scissors have sharp cutting edges that focus the force of the cutting action into a narrow surface area, allowing them to cut easily.
- c) The water in the pipe is at a relatively high pressure, so that when the tap is opened, the water flows out.
- d) The blood pressure cuff inflates around the arm, applying pressure to the arm. The blood pressure meter then measures the changes in this pressure caused by the pressure of the blood moving through the patient's arm.

Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1. Pressure is the amount of force acting on the surface of an object, expressed per unit area.
2. They distribute the weight of the bridge or building so that it is spread over a wider surface area and the pressure is lower.
3. The wide, flat-soled shoes (B) as they will distribute the pressure from the woman's weight more evenly over the ground so her heels will not sink into the lawn and make it difficult to walk.

$$\begin{aligned}
 4. \quad P &= \frac{F}{A} \\
 &= \frac{1\,220}{2} \\
 &= 610 \text{ N/m}^2
 \end{aligned}$$

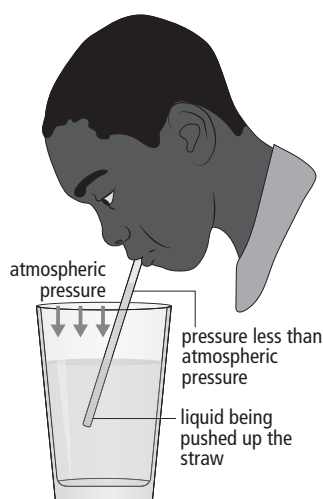
$$5. \quad \text{a)} \quad A = 1 \times 2 = 2 \text{ m}^2$$

$$\begin{aligned}
 P &= \frac{F}{A} \\
 &= \frac{100}{2} \\
 &= 50 \text{ N/m}^2
 \end{aligned}$$

$$\text{b)} \quad A = 2 \times 2 = 4 \text{ m}^2$$

$$\begin{aligned}
 P &= \frac{F}{A} \\
 &= \frac{100}{4} \\
 &= 25 \text{ N/m}^2
 \end{aligned}$$

6. The force of the person holding the stick and the weight of the stick is concentrated as a higher pressure at the end of the stick.
7. The suction on the straw lowers the pressure in the straw. The atmospheric pressure pushing down on the liquid pushes it up into the straw to equalise the pressure.



## Check ...

Learners can:	Yes	No
1. Explain the concept of pressure and show how pressure relates to force; perform activities that work on the principle of pressure in the daily lives of humans.		
2. Demonstrate the action of pressure through a number of activities such as using a drinking straw, pumping car tyres, filling of balloons, water jets at washing bays, etc. to understand the concept of pressure.		
3. Describe the relationship between pressure and force and discuss the application of pressure in everyday life.		

# Topic 4: Force and motion

## Module 17

## Newton's Third Law of Motion

### Unit 17.1 The importance of Newton's Third Law of Motion

#### Content standard

- B9.4.4.2: Demonstrate an understanding of Newton's Third Law of Motion and its application in everyday life.

#### Indicators

- B9.4.4.2.1: Explain the importance of Newton's Third Law of Motion in life.

#### Exemplars

- Predict what happens when:
  - a force is exerted on an object
  - there is a reaction from the object
  - the force exerted is the same as the reaction of the object.
- Perform an activity to justify your predictions.

#### Unit in a nutshell

- Newton's Third Law of Motion states that when two bodies interact, they apply forces to one another that are equal in magnitude and opposite in direction.
- A force is a push or a pull that acts upon an object.
- We can represent the Third Law of Motion as follows, as a mathematical equation:  $F_A = -F_B$ .
- If there were no equal and opposite reaction, movement would not happen.

#### ACTIVITY 17.1.1

#### Discussing the Third Law of Motion

LB page 274

(Groups)  
CI6.1, CP5.4

#### Guidelines

- The learners work in groups to discuss everyday examples and the importance of Newton's Third Law of Motion.
- Divide the class into groups.
- Ask each group to identify and write down at least five different everyday examples of Newton's Third Law in action.
- The learners should then state why they think the Third Law is important in everyday life.



- Guide the discussions to the conclusion that the Third Law is integral to anything that moves, and as such is crucial to everything around us every day.

## Answers

Answers will vary.

## TALK ABOUT

LB page 274

Guide the learners to understand that everything that involves motion is a manifestation of Newton's laws. Here are a few sports-related examples:

- Athletes use their leg muscles to push against the track. The track exerts an equal and opposite force on the athletes, thereby pushing them forward.
- The greater the force that pushes an athlete (or any other person who has to run during a game) forward, the greater their acceleration will be. The same applies to the force exerted on a ball when it is kicked, thrown or hit.
- Soccer players can cause a ball to move, stop or change direction, depending on the amount of force they exert on the ball, and the direction in which the force is applied.



## INTERNET INTERACT

There are many helpful videos available on YouTube, ranging from serious discussions to humorous cartoons. The video at the link below explains how Newton's Third Law of Motion applies to swimmers.

<https://www.youtube.com/watch?v=6SA8-E2X7Xg>

# Unit 17.2 Application of Newton's Third Law of Motion

## Content standard

- B9.4.4.2: Demonstrate an understanding of Newton's Third Law of Motion and its application in everyday life.

## Indicator

- B9.4.4.1.2: Demonstrate the application of Newton's Third Law of motion in life.

## Exemplars

- Explain Newton's laws of motion and relate them to momentum.
- Demonstrate the application of Newton's laws of motion in everyday life.

## Unit in a nutshell

- Newton's Third Law of Motion states that when an action acts upon an object, it exerts forces that are equal in magnitude and opposite in direction.
- Action and reaction forces always occur in pair.
- Action and reaction forces are equal (in size) and opposite (in direction).
- The forces do not cancel because they act on different bodies.

### ACTIVITY 17.2.1

### Discussing action and reaction

LB page 276

(Groups)

CP5.2, CI5.1, CI5.2

## Guidelines

- The learners work in groups to analyse the photos given, which show actions and reactions.
- They should identify both the action and reaction in each photo and answer the questions.
- The groups should compare their answers with each other.

## Answers

- a) Action: The paddle pushes backwards against the water. Reaction: The boat moves forwards.
  - b) Action: The springbok's legs push down into the ground. Reaction: The springbok is pushed upwards away from the ground.
  - c) Action: The force of gravity is pulling the apple towards the ground. Reaction: The table is pushing upwards, so the apple stays where it is.
  - d) Action: The expanding gases from the burning fuel push downwards out of the exhaust. Reaction: The rocket is pushed upwards.
2. The action and reaction forces are balanced.



### INTERNET INTERACT

The video at the link below explains the concept of forces.

<https://www.youtube.com/watch?v=kKKM8Y-u7ds>

## Unit 17.3 Newton's laws of motion and their applications in daily life

### Content standard

- B9.4.4.2: Demonstrate understanding of Newton's laws of motion and ability to apply the laws to solve problems in everyday life.

### Indicator

- B9.4.4.2.1: Explain Newton's laws of motion and their applications to daily life.

## Exemplar

- Derive the formula,  $F = ma$ , where  $F$  is the force,  $m$  the mass of the object, and  $a$  the acceleration, from Newton's three laws of motion and use the formula to calculate the force that a moving mass of body exerts when moving with known acceleration.

## Unit in a nutshell

- Newton's First Law of Motion states that a body at rest stays at rest, and a body in motion stays in motion with the same speed and in the same direction, unless acted upon by an unbalanced force.
- Newton's First Law of Motion is also called the law of inertia.
- Inertia is the resistance objects have to changes to their state of motion.
- Newton's Second Law of Motion states that when a force is applied to an object, its acceleration changes in proportion to the amount of force applied, and this change takes place in the same direction as the applied force.
- The formula for Newton's Second Law of Motion is  $F = ma$ .
- Momentum refers to the quantity of motion that an object has.
- The equation for momentum is  $P = mv$ .
- Acceleration is the amount of change in an object's velocity.
- Velocity is the speed of an object in a given direction.

### ACTIVITY 17.3.1

### Revising Newton's laws of motion

LB page 277

(Individual)  
CI5.1; CC8.1

## Guidelines

- Use this activity as revision of Newton's laws of motion, before you go on to discuss them in more detail in this unit.

### Answers

Newton's law	Also known as	Explanation
1. Newton's First Law of Motion	C. The law of inertia	b) An object will continue in its state of rest or uniform motion unless an external force acts on it.
2. Newton's Second Law of Motion	A. The law of action and reaction, or the law opposing forces	c) The rate of change of momentum of an object is directly proportional to the applied force on the object and the change in momentum takes place in the direction of the applied force.
3. Newton's Third Law of Motion	B. The law of acceleration	a) Every action has an equal and opposite reaction.

(Pairs)

CP5.2, CI5.1, CI5.2

### Materials and apparatus

A coin, a piece of cardboard (about 10 cm × 15 cm), a cup or glass

### Procedure

1. Gather the materials needed.
2. Divide the class into groups, the number of groups depending on the amount of materials you have available.
3. Have the learners follow the instructions to complete the experiment.
4. If necessary, first demonstrate the experiment to the class yourself to make sure that they understand what is required.
5. Allow the learners to repeat the experiment as often as is necessary for them to grasp the results.
6. The learners should record their observations.
7. Have a class discussion about the observations. Explain that this experiment shows that the coin has inertia, and demonstrates Newton's First Law of Motion.
8. As an advanced and extended demonstration, you can stick or tape the coin to the card and repeat the experiment. Then explain to the class that when the card and the coin are joined together, they operate as one object with more mass. The combined object has more inertia, and thus requires more energy to move.

### ACTIVITY 17.3.2

### Calculating force, acceleration, mass and momentum

LB page 283

(Individual)

CP5.2, CI5.1, CI5.2

## Answers

1.  $F = ma$   
 $= 2 \times 5$   
 $F = 10 \text{ N}$
2.  $a = \frac{F}{m}$   
 $= \frac{12}{3}$   
 $a = 4 \text{ m/s}^2$
3.  $m = \frac{F}{a}$   
 $= \frac{12}{3}$   
 $m = 4 \text{ kg}$
4.  $P = mv$   
 $= 3 \times 4$   
 $P = 12 \text{ kg m/s}$

### ACTIVITY 17.3.3

### Giving examples of Newton's laws of motion

LB page 283

(Groups)

CP5.2, CI5.1, CI5.2

## Guidelines

- The learners work in groups to discuss and list examples of Newton's laws of motion in everyday life.
- They should list some examples of Newton's laws of motion found in everyday life.
- For each example they should identify which laws are operating and how they apply.

Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1. Every action has an equal and opposite reaction. Accept any example given that shows the Third Law in action.
2.
  - a) It moves forward.
  - b) Newton's Third Law of Motion. The balloon pushes the air backward (the action) and the air pushes the balloon in the opposite direction (the reaction).
3. 
$$a = \frac{F}{m}$$
$$= \frac{450}{50}$$
$$= 9 \text{ m/s}^2$$
4. Inertia is the resistance objects have to changes to their state of motion. The more mass an object has, the more it resists changes to its state of motion.
5. Your legs push down against the ground, performing an action. The reaction to the action pushes you in the opposite direction, upwards into the sky.
6. 
$$m = \frac{F}{a}$$
$$= \frac{750}{12.5}$$
$$= 60 \text{ kg}$$
7. Momentum is mass in motion and equals mass times velocity.
8. 
$$P = mv$$
$$= 10 \times 8$$
$$P = 80 \text{ kg m/s}$$
9. Answers will vary. Accept any three examples of Newton's Third Law of Motion in everyday life.
10.
  - a) A body at rest stays at rest, and a body in motion stays in motion with the same speed and in the same direction, unless acted upon by an unbalanced force.
  - b) A ball that is at rest will stay at rest until it is kicked. A ball that is moving along the ground will keep moving unless it is stopped by a player applying force to it or it is slowed and stopped by friction. A ball kicked up into the air will gradually slow then fall and accelerate towards the ground as the force of gravity operates on it.
11.
  - a) When a force is applied to an object, its acceleration changes in proportion to the amount of force applied, and this change takes place in the same direction as the applied force.
  - b) When you pedal a bicycle, you are applying a force to it. The force moves the bicycle forwards in the same direction the force is applied. The more force that is applied to the pedals of the bicycle, the faster it will accelerate.
12.
  - a) Second and third laws.
  - b) The swimmer applies force to the water with his hands and feet pushing backwards against it. The third law propels the swimmer forwards in opposition to the force he is applying. The force pushing the swimmer forwards is due to the first law and the more force that is applied, the faster he will swim.

## Check ...

Learners can:	Yes	No
1. Explain the importance of Newton's Third Law of Motion in life.		
2. State Newton's Third Law of Motion.		
3. Explain Newton's Third Law of Motion and show its importance to life.		
4. Demonstrate the application of Newton's Third Law of Motion in life.		
5. Demonstrate an understanding of Newton's laws of motion and ability to apply the laws to solve problems in everyday life.		
6. Explain Newton's laws of motion and relate them to momentum.		
7. Demonstrate the application of Newton's laws of motion in everyday life		
8. Derive the formula $F = ma$ , where $F$ is the force, $m$ the mass of the object, and $a$ the acceleration, from Newton's three laws of motion and use the formula to calculate the force that a moving mass of a body exerts when moving with known acceleration.		

# Topic 5: Agricultural tools

## Module 18 Agricultural tools

### Unit 18.1 Agricultural tools and their materials

#### Content standard

- B9.4.5.1: Demonstrate knowledge and skills in making simple agricultural tools for on-farm activities.

#### Indicator

- B9.4.5.1.1: Identify materials used in making simple agricultural tools.

#### Exemplars

- Describe simple agricultural tools assembled from their environment.
- Identify the materials used to make the tools assembled in exemplar 1 and show how the parts are connected.

#### Unit in a nutshell

- The majority of farms in Ghana are small or medium-sized and are not mechanised.
- Most farmers in Ghana use hand tools and manual labour for tasks such as weeding, soil preparation and harvesting.
- Most agricultural tools are made from wood, metal and plastic.
- Hoes have a metal blade and a wooden handle.
- A cutlass has a curved blade made of steel, and a wooden or plastic handle.
- Rakes can be made from cast iron and either wood or plastic.

#### ACTIVITY 18.1.1

#### Talking about what tools are made of

LB page 288

(Pairs)

CI5.7, CI5.3, CP5.1

#### Guidelines

- The learners work in pairs.
- Each learner should first complete the table given and then exchange it with their partner to compare answers.



## Answers

Name of tool	Parts of tool	Materials used to make tool
Spade	Blade, handle	Metal, wood
Trowel	Blade, handle	Metal, wood
Cultivator	Tines, handle	Metal, wood
Rake	Tines, handle	Metal, wood
Hoe	Blade, handle	Metal, wood
Wheelbarrow	Bucket, handle, wheel	Metal, rubber
Cutlass	Blade, handle	Metal, wood
Watering can	Bucket, handle, spout	Metal or plastic
Pruning knife	Blade, handle	Metal, wood
Pickaxe	Blade, handle	Metal, wood

Note that plastic can sometimes be used for handles.

### ACTIVITY 18.1.2

### Discussing what tools could be made by hand

LB page 290

(Groups)

CI5.7, CI5.3, CP5.1

## Guidelines

- The learners work in groups to discuss toolmaking.
- The groups should discuss the questions given. For most of the tools, the farmer would need wood or a metal pipe for a handle, and metal for the blades or tines.
- Point out that many of the tools are similar and would require similar toolmaking skills. Some tools would require a high level of skill and specialised equipment to make. The head of a pickaxe, for example, would have to be made by someone who is skilled in metalwork and who has the necessary equipment to forge the steel.
- Encourage the learners to be creative in their thinking and to come up with innovative solutions to problems.
- Stress the importance of recycling or re-using objects. An old broomstock, for example, could be used to make a handle for a rake. A large plastic container could be used to fashion a watering can.
- Once the groups have reached their answers, have a class discussion where they can compare their answers and share ideas.

## Answers

- All the tools could be made by hand, but they would need varying levels of skill. It could be problematic to find the raw materials and equipment needed to make the tools.



## INTERNET INTERACT

There are many websites and videos about toolmaking. If possible, spend some time online and do a search for handmade or do-it-yourself farm tools. Below are two interesting videos. The first features no power tools, while the second one shows how power tools could be used to make a simple tool.

<https://www.youtube.com/watch?v=G78KQPO5ST4>

<https://www.youtube.com/watch?v=oWli-04NhU0>

## Unit 18.2 Processes involved in making agricultural tools

### Content standard

- B9.4.5.1: Demonstrate knowledge and skills in making simple agricultural tools for on-farm activities.

### Indicator

- B9.4.5.1.2: Discuss and write activities involved in making simple agricultural tools.

### Exemplars

- Describe the activities and processes involved in making different agricultural tools.
- Explain the materials, processes, constraints and precautions involved in manufacturing simple agricultural tools.

### Unit in a nutshell

- The processes involved in making tools include cutting, fixing and fastening, forming and shaping, filing and sanding, and sharpening.
- There are constraints that could make it more economical and efficient to buy a tool instead of making it.
- Safety measures should be followed to ensure safe and efficient toolmaking.
- Farmers can use creative and inventive thinking to solve practical problems.

#### ACTIVITY 18.2.1

#### Explaining processes of toolmaking

LB page 292

(Pairs)

CC8.1, CC8.2

### Guidelines

- The learners work in pairs.
- They take turns to explain each process to one another.
- Ensure that the learners have an understanding of each process and what it entails.
- Walk around the class while the learners are busy and give guidance where needed.

## Answers

Answers will vary, but should conform to the content they have learned from the LB.

### ACTIVITY 18.2.2

### Giving a presentation about toolmaking LB page 294

(Groups)  
CC8.1, CC8.2

## Guidelines

- The learners work in groups to discuss, list and then make a presentation on toolmaking.
- Once completed, each group should make their presentation to the entire class.

## Assessment

Use the rubric for oral presentations on page 194 of this guide to assess the learners' presentations.

## Extension

Encourage the learners to design and create a pamphlet that sets out the safety measures that should be followed in workshops. The completed pamphlets can be distributed in the community.

# Unit 18.3 Make simple farm tools

## Content standard

- B9.4.5.1: Demonstrate knowledge and skills in making simple agricultural tools for on-farm activities.

## Indicator

- B9.4.5.1.3: Manufacture simple agricultural tools.

## Exemplars

- Produce simple farm tools using materials from the environment.

## Unit in a nutshell

- Farmers who are far from shops and markets may need to make the tools that they need.
- Locally available tools can be used to make a variety of simple tools.
- Having the correct tool for a job will not only help the farmer to get the work done quicker and more efficiently, but will also help to prevent injuries.
- Farmers can use creative and inventive thinking to solve practical problems.

### ACTIVITY 18.3.1

### Making a simple tool

LB page 299

(Groups)  
CI5.2

## Guidelines

- The learners work in groups to make tools.
- Ensure that the groups have the raw materials and tools needed for their project.
- You can allow more advanced groups to formulate their own designs and manufacture their own or other versions of tools.
- Ensure that the learners all follow safe practices, and that you have first aid on hand.
- Do whatever is needed to arrange the learners' trip to a farm for their tools to be evaluated by a farmer. Alternatively, the learners can take their tools to small-scale farmers they know and who live close by, and then report back to the class.
- Finally, have a class discussion in which the learners discuss how each of the tools they made might be improved upon.

### ACTIVITY 18.3.2

### Brainstorming solutions and inventions LB page 301

(Groups)  
CI5.2

## Guidelines

- The learners work in groups to discuss and generate ideas for new or modified tools that are safer or more efficient than those currently available.
- Guide discussion to identify problems and drawbacks with existing tools as a means to generate ideas on how they might be improved.

### ACTIVITY 18.3.3

### Your quiz about forces and energy

LB page 301

(Groups)  
CP5.1, CC 9.1

## Answers

1. Solar power is a renewable source of energy that can be used effectively to reduce the amount of energy used to heat water. Solar hot water cylinders use less energy because the heat of the Sun helps to heat the water.
2. A solar eclipse, also known as an eclipse of the Sun, occurs when the moon passes between the Sun and the Earth, causing a shadow to fall on the Earth. This blocks the view of the Sun from the Earth, so the Sun is eclipsed by the moon.
3. Current is the flow of electrons in a circuit. Current is measured in amperes (A) and is measured using an ammeter.
4. It means that a system always contains the same amount of energy and, in an energy conversion, the total amount of energy stays constant before and after conversion from one form of energy to another.
5. Pressure cookers, car tyres, blowing up a balloon, getting an injection, flushing a toilet, aerosol cans, water supply systems, bicycle pumps, blood pressure monitors
6. Newton's third law of motion states that when two bodies interact, they apply forces to one another that are equal in magnitude and opposite in direction. In simple terms, this law states that every action has an equal and opposite reaction.
7. Ploughs, hoes, cutlasses, rakes, trowels

Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1. Any five: Spade, trowel, cultivator, rake, hoe, wheelbarrow, cutlass, watering can, pruning knife, pickaxe. All the tools except the watering can are made of metal and wood. The watering can is made of metal.
2. The blade can be attached to the handle with screws or bolts, tied with rope or with rubber or leather strips. Home-made hoes can also have a metal blade that is inserted into the handle.
3. So that it can be positioned over the weeds to pull them out
4. A file
5. With epoxy glue and a few small bolts or screws
6. Smithing is the activity or process where metals are manipulated to give specific shapes and sizes.
7. Filing and sanding
8. Availability of raw materials, availability of specialised tools, machinery and work space, difficulty of working with raw materials, knowledge of toolmaking, safety
9. Loose, baggy clothing, scarves, ties or jewellery can get tangled up in your tools
10. Tools make work easier and faster, and increase productivity.

### Check ...

Learners can:	Yes	No
1. Identify materials used in making simple agricultural tools.		
2. Describe simple agricultural tools assembled from their environment.		
3. Identify the materials used to make the tools assembled in an example and show how the parts are connected.		
4. Discuss and write activities involved in making simple agricultural tools.		
5. Describe the activities and processes involved in making different agricultural tools.		
6. Explain the materials, processes, constraints and precautions involved in manufacturing simple agricultural tools.		
7. Manufacture simple agricultural tools.		
8. Produce simple farm tools using materials from the environment.		

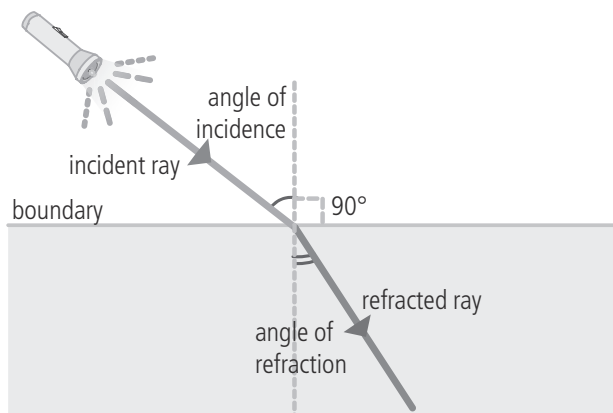
## Activity 1: Multiple choice

1. B It cannot travel through a vacuum.
2. A short and dark
3. B the moon moves between the Sun and the Earth
4. A current
5. C motor
6. A vibrations
7. C  $KE_i + PE_i = KE_f + PE_f$
8. B mechanical
9. A barometer
10. A inertia

## Activity 2: Short questions

1. reduced, efficient
2. Current = 15 A, Voltage = 240 V, Time = 1 h  
Power ( $P$ ) = Current ( $I$ )  $\times$  Voltage ( $V$ )  
 $15 \times 240 = 3\,600\text{ W (or } 3.6\text{ kW)}$   
Power ( $P$ )  $\times$  Time (h) = electrical energy consumed  
 $3.6\text{ kW} \times 1\text{ h} = 3.6\text{ kWh}$
3. An LED light bulb uses light-emitting diodes (LEDs) to produce light. These light bulbs use about 84% less energy than incandescent light bulbs. When used, LED light bulbs remain cool to the touch, which means that they waste hardly any energy as heat.
4. Visible light is a type of electromagnetic energy that our eyes can sense, enabling us to see.

5.



6. a) umbra and penumbra  
b) umbra
7. a) True  
b) False
8. a)  $I = \frac{V}{R}$   
 $= \frac{12}{3}$   
 $= 4\text{ A}$

$$\begin{aligned}\text{b)} \quad V &= IR \\ &= 2 \times 3 \\ &= 6 \text{ V}\end{aligned}$$

$$\begin{aligned}\text{c)} \quad R &= \frac{V}{I} \\ &= \frac{12}{2} \\ &= 6 \, \Omega\end{aligned}$$

9. The ball held over the player's head. This is because it has gravitational potential energy from being held up above the ground. The ball on the ground has no potential energy. The fact that a ball is about to be kicked or thrown is not potential energy.

10. Rock A:

$$\begin{aligned}PE &= mgh \\ &= 10 \times 9.8 \times 20 \\ &= 1\,960 \text{ J}\end{aligned}$$

Rock B:

$$\begin{aligned}PE &= mgh \\ &= 15 \times 9.8 \times 15 \\ &= 2\,205 \text{ J}\end{aligned}$$

Rock B has the greater potential energy.

11. Pressure is the amount of force acting on the surface of an object, expressed per unit area.  
12. The drinker's suction on the straw lowers the pressure in the straw. The atmospheric pressure pushes down on the drink. The pressure pushing on the drink pushes it up into the straw to equalise the pressure.

$$\begin{aligned}\text{13. } P &= \frac{F}{A} \\ &= 40 \div 8 \\ &= 5 \text{ N/m}^2\end{aligned}$$

14. In a confined fluid an externally applied pressure is transmitted equally in all directions.

15. a) Every action has an equal and opposite reaction.

$$\text{b)} \quad F_A = -F_B$$

16. Accept any reasonable answer, for example: a balloon flying forward as the air rushes out backwards, jumping by pushing against the ground.

$$\begin{aligned}\text{17. } A &= \frac{f}{m} \\ &= \frac{12}{3} \\ A &= 4 \text{ m/s}^2\end{aligned}$$

$$\text{18. } P = mv$$

19. Any three: nails, screws, rivets, bolts

20. Smithing is the activity or process where metals are manipulated to give specific shapes and sizes.

With the use of pliers, metals can be moulded into flat, concave or convex shapes.

Metals can also be heated and hammered into a shape. The heat helps to make the metal malleable.

### Activity 3: Essay

Guide the students to choose a topic and write an essay.

Use the rubric for essays on page 195 of this Teacher's Guide to help you assess the learners' essays.

## Learning outcomes

Content standard	Indicators and exemplars	Core competencies
<b>Topic 1: Waste management</b>		
<b>B9.5.1.1</b> Demonstrate an understanding of the scientific ways of waste management.	<b>B9.5.1.1.1</b> Investigate the scientific methods used in waste management. <ol style="list-style-type: none"> <li>1. Identify scientific methods such as recycling, composting used in waste management.</li> <li>2. Explain the scientific principles underlying the methods used in waste management.</li> <li>3. Conduct an audit of waste management methods in schools and assess the effectiveness of each.</li> </ol>	CC8.2, CP5.3, CI5.4
<b>B9.5.1.2</b> Demonstrate an understanding of the impact of waste on an environment, innovative waste management technologies for sustainable development and waste management practices in Ghana.	<b>B9.5.1.2.1</b> Describe innovative ways of waste management for sustainable development. <ol style="list-style-type: none"> <li>1. Explain the impact of waste produced on the environment.</li> <li>2. Identify innovative ways to manage waste for sustainable development.</li> <li>3. Describe the types of waste produced within communities in Ghana.</li> <li>4. Examine and critique the waste management practices in Ghana identifying positives and negatives and opportunities for improvement.</li> </ol>	CP5.2, CP6.3, CI6.8
<b>Topic 2: Human health</b>		
<b>B9.5.2.1</b> Demonstrate knowledge of common non-communicable diseases of humans, their causes, symptoms, effects and prevention.	<b>B9.5.2.1.1</b> Explain the symptoms, effects and prevention of some non-communicable diseases and analyse the risk factors associated with them. <ol style="list-style-type: none"> <li>1. Describe what non-communicable diseases are and determine their common causes.</li> <li>2. Identify symptoms, effects and prevention of non-communicable diseases (refer to teachers pack for specific diseases) that are associated with malnutrition, poor working environment and exposure to drugs.</li> <li>3. Explain the causes, symptoms, effects and prevention of cancer.</li> <li>4. Identify common cancers that affect humans and link them to life style.</li> </ol>	CC8.2, CP5.1, DL5.5, CG5.5
<b>B9.5.2.2</b> Demonstrate understanding of the relationship of health and disease, the concept of common diseases in the environment and how to control them.	<b>B9.5.2.2.1</b> Explain the concepts of health and disease and show their relationship. <ol style="list-style-type: none"> <li>1. Define health as stipulated by World Health Organisation (WHO) and show the relationship between health and disease.</li> </ol>	CI6.1



Content standard	Indicators and exemplars	Core competencies
	<b>B9.5.2.2.2</b> Explain the concept of common diseases in an environment. <ol style="list-style-type: none"> <li>1. Conduct a survey about common diseases and analyse the findings to show what constitutes a common disease in a community.</li> <li>2. Identify causes, symptoms and prevention of common diseases.</li> </ol>	CP6.3
<b>B9.5.2.2</b> Demonstrate knowledge of selected fungal, diseases of humans, their causes, symptoms, effects and prevention.	<b>B9.5.2.2.1</b> Explain the nature of fungal diseases with special emphasis on ringworm/candidiasis/ fingernail and toe nail infection, their causes, symptoms, effects on humans and their prevention. <ol style="list-style-type: none"> <li>1. Discuss the nature of fungal diseases.</li> <li>2. Search for information and make presentations on ringworm, candidiasis and fungal eye infection diseases their mode of transmission from person to person, community to community and from country to country.</li> <li>3. Describe the symptoms, effects and prevention of ringworm, candidiasis and fungal eye infection diseases.</li> <li>4. Describe the role of individuals, community members and government in managing ringworm, candidiasis and fungal eye infection diseases.</li> <li>5. Design and produce a poster to educate their community members on the incidence and control of named fungal diseases: ringworm, candidiasis and fungal eye infection.</li> </ol>	CP5.1, DL5.1, CC8.1, CC8.1, CI5.2
<b>Topic 3: Science and industry</b>		
<b>B9.5.3.1</b> Analyse the scientific concepts, principles and processes applied in industries in and outside their community.	<b>B9.5.3.1.1</b> Investigate the scientific concepts, principles and processes involved in industries in their environment. <ol style="list-style-type: none"> <li>1. Identify products of industries within and outside their community and describe the process of production.</li> <li>2. Investigate and outline scientific concepts, principles and processes underlying the production of common everyday industrial products.</li> </ol>	CC9.1, CP5.8, DL5.1
<b>B9.5.3.2</b> Demonstrate an understanding of the concept of industry, the science underpinning the processes of production in industries, the technologies in indigenous industries and western industries.	<b>B9.5.3.2.1</b> Explain the concept of industry and distinguish between modern and indigenous industries. <ol style="list-style-type: none"> <li>1. Identify an industry as individual firms producing the same commodity and give examples of industries in their community.</li> <li>2. Describe how technology affects industry and compare the technologies in indigenous and modern industries.</li> </ol>	CP5.1, CI6.8

Content standard	Indicators and exemplars	Core competencies
	<p><b>B9.5.3.2.2</b> Examine indigenous industries in their communities and show the scientific processes in the stages of production.</p> <ol style="list-style-type: none"> <li>1. Discuss indigenous industries in their communities and identify the scientific processes, concepts and principles underlying the stages of production in the industries.</li> <li>2. Identify indigenous practices at home, school and the community and the science involved in the practices.</li> </ol>	CC9.1, CP6.4, CP6.3
<b>Topic 4: Climate change and green economy</b>		
<p><b>B9.5.4.1</b> Demonstrate an understanding of the natural and human factors that influence climate change and a green economy.</p>	<p><b>B9.5.4.1.1</b> Examine various natural and human factors that influence climate change and green economy in their localities.</p> <ol style="list-style-type: none"> <li>1. Identify the natural factors that influence climate change.</li> <li>2. Describe ways of minimising human activities that influence climate change.</li> <li>3. Compare natural and human factors that influence climate change and green economy.</li> </ol>	DL6.4, CC7.5, CI6.3
<p><b>B9.5.4.2</b> Evaluate the effectiveness of initiatives that address the issue of climate change and green economy in Ghana and the world at large.</p>	<p><b>B9.5.4.2.1</b> Assess data on climate change and green economy actions/activities globally including Ghana and other countries.</p> <ol style="list-style-type: none"> <li>1. Research into climate change and green economy actions in Ghana.</li> <li>2. Access climate change and green economy actions in other countries.</li> <li>3. Compare and contrast climate change and green economy actions in Ghana and other countries.</li> <li>4. Identify and write the effective initiatives that address climate change and green economy issues in Ghana and other countries.</li> <li>5. Prescribe with reasons best practices to serve as possible solutions to address climate change and green economy issues in Ghana.</li> </ol>	CP6.3, DL5.1, CP6.4, CP5.1

Content standard	Indicators and exemplars	Core competencies
<b>Topic 5: Understanding the environment</b>		
<b>B9.5.5.1</b> Demonstrate knowledge and skills in the use of plant roots, stems, leaves, flowers, and fruits for agricultural and non-agricultural purposes.	<p><b>B9.5.5.1.1</b> Show and list the uses of different plant parts for agricultural and non-agricultural purposes.</p> <ol style="list-style-type: none"> <li>1. Identify plant parts that are used for agricultural and non-agricultural purposes.</li> <li>2. Describe how plant parts are used for agricultural and non-agricultural purposes.</li> <li>3. List the uses of plant parts for agricultural purposes (such as planting, tools, animal housing, animal feed, soil improvement, pest and disease control, etc.).</li> <li>4. List the uses of plant parts for non-agricultural purposes (such as herbal medicine, construction of houses, bridges and furniture, artefacts, ceremonies, rituals, education, etc.).</li> </ol>	CC7.3, CP5.5, CI5.3, DL5.5
	<p><b>B9.5.5.1.2</b> Demonstrate the use of different plant parts for agricultural and non-agricultural purposes.</p> <ol style="list-style-type: none"> <li>1. Create agricultural materials from different plant parts that are used to carry out agricultural activities.</li> <li>2. Create non-agricultural materials from different plant parts to carry out non-agricultural activities.</li> </ol>	CC9.1, CP5.6, CI5.3

# Topic 1: Waste management

## Module 19

## Scientific waste management

### Unit 19.1 Scientific methods used in waste management

#### Content standard

- B9.5.1.1: Demonstrate an understanding of the scientific ways of waste management.

#### Indicator

- B9.5.1.1.1: Investigate the scientific methods used in waste management.

#### Exemplars

- Identify scientific methods such as recycling, composting used in waste management.
- Explain the scientific principles underlying the methods used in waste management.
- Conduct an audit of waste management methods in schools and assess the effectiveness of each.

#### Unit in a nutshell

- Waste management refers to all the steps involved in handling waste to ensure a clean and healthy environment.
- Waste management strategies include recycling, composting, landfills and incineration.
- Scientific principles are applied to process different types of waste.
- Waste can be used as a source of energy.
- Composting is an environmentally friendly way of reducing organic waste. It can also be done on a small scale at homes and schools.
- Landfills are the most common method of waste disposal in Ghana.

#### ACTIVITY 19.1.1

#### Discussing waste disposal at home

LB page 308

(Group and class)  
CC8.2, CP5.3, CI5.4

#### Guidelines

- Let the learners work in groups for the first part of the discussion. Make sure that all the learners in a group contribute to the discussion.
- They should describe how rubbish is gathered and stored in their homes and how it is disposed of. They should also write why they think it should be disposed of safely and in an organised way.
- When all the learners have answered the questions, they should compile all the answers from the group.

- Encourage groups to share their lists with the class.
- Have a class discussion about the advantages and disadvantages of each method.
- Make sure that no learner is shamed or singled out for the methods used in their home.

### Answers

Answers will vary.

#### ACTIVITY 19.1.2

#### Making e-waste recycling safer

LB page 311

(Groups)

CC8.2, CP5.3, CI5.4

### Guidelines

- Make sure that the learners understand what e-waste is. Invite learners to tell the class how they or their family dispose of e-waste.
- The learners work in groups to discuss safety in the recycling of e-waste.
- They should read the case study and discuss the questions. If they have access to the internet, for example on their phones, they can look online to extend their answers.
- Walk through the class while the groups are busy and give guidance where needed.

### Answers

1. They want to extract valuable metals from the objects.
- 2.–5. Learners' own answers. Accept any valid answers.



#### INTERNET INTERACT

The videos at the links below give more information about Agbogbloshie. If there is time, watch the videos in class or encourage the learners to watch them in their free time. Pay special attention to the third video here, which gives a different view of the activities at the waste dump.

- The world's biggest e-waste site:  
<https://www.youtube.com/watch?v=aDjDGrrDD7o>
- Support E-Waste Workers' Rights at Agbogbloshie in Accra, Ghana:  
<https://www.youtube.com/watch?v=0UMWTbab80Y>
- What a scrapyard in Ghana can teach us about innovation:  
[https://www.youtube.com/watch?v=i\\_wtaoHCw3k](https://www.youtube.com/watch?v=i_wtaoHCw3k)

#### ACTIVITY 19.1.3

#### Discussing some scientific principles of waste management

LB page 315

(Groups)

CC8.2, CP5.3, CI5.4

## Guidelines

- The learners work in groups to research scientific processes in waste management.
- They may use books or the internet for research.
- The groups should each draw a simple logic tree or flowchart to show how the principles and processes are related. Show the learners how to make simple logic trees and show them a few examples.

### PROJECT

### Audit of waste management methods in my school and some schools nearby

LB page 315

(Groups)

CC8.2, CP5.3, CI5.4

## Guidelines

- For this project, the learners should investigate the waste management at school and some of the other schools in your neighbourhood.
- Each group should designate learners to speak to the relevant person at each school who will be able to supply the information needed.
- Help them to draw up a questionnaire that can be used to gather the relevant information.
- Once they have the information, they should collate it and compare the differences between the schools.
- Once all the information is gathered, they should have a class discussion to decide which school uses the best methods of waste management. They should also discuss ways in which waste management in schools could be improved.
- Finally, they should report to the class.

## Assessment

Use the rubric for reports on page 194 of this guide to assess the learners' reports.

## Unit 19.2 Waste management for sustainable development

### Content standard

- B9.5.1.2: Demonstrate an understanding of the impact of waste on an environment, innovative waste management technologies for sustainable development and waste management practices in Ghana.

### Indicator

- B9.5.1.2.1: Describe innovative ways of waste management for sustainable development.

### Exemplars

- Explain the impact of waste produced on the environment.
- Identify innovative ways to manage waste for sustainable development.
- Describe the types of waste produced within communities in Ghana.
- Examine and critique the waste management practices in Ghana identifying positives and negatives and opportunities for improvement.

## Unit in a nutshell

- Waste can cause extensive harm to the environment.
- Inefficient waste management can cause pollution, contribute to climate change, harm animal life, disrupt ecosystems and cause the spread of disease.
- The different types of waste include organic waste, plastic waste, electronic waste, construction waste and industrial waste.
- Waste management is a serious problem in Ghana, and there is an urgent need to implement innovative waste management strategies in the country.
- Government must enforce laws and regulations to control waste management.
- Education and awareness campaigns can be implemented to change the public's attitude towards waste.
- Waste recovery, recycling and reuse could reduce the amount of waste produced.
- There should be financial incentives to manage waste.
- Efficient waste management can create job opportunities.
- Technology can help to establish efficient waste management practices.

### ACTIVITY 19.2.1

#### The impact of waste around you

LB page 317

(Class)

CP5.2, CP6.3, CI6.8

### Guidelines

- The learners work together as a class to discuss places near home or school where waste has had a noticeable effect on the environment.
- Guide them to identify the reasons for this, and discuss what can be done to improve the situation.

### ACTIVITY 19.2.2

#### Identifying waste and its uses

LB page 319

(Pairs)

CP5.2, CP6.3, CI6.8

### Guidelines

- The learners work together in pairs to identify and list waste in their neighbourhood.
- They should then draw up a table following the example in the Learner's Book and complete all the columns with the information they gathered.

### TALK ABOUT

LB page 321

If there is time, facilitate a discussion about ways in which people can earn money from waste management. Guide the learners to think about selling waste materials to recycling centres, or to make craft objects from recycled material that they can sell.



## INTERNET INTERACT

The videos at the links below show how some people in Ghana process plastic to sell to the manufacturers of plastic products.

- Plastic recycling in Ghana – Coliba:  
<https://www.youtube.com/watch?v=o4ZYPmLzfZc>
- Making profit from plastic waste collection and recycling in Ghana:  
<https://www.youtube.com/watch?v=k-K5psKRzyE>

## PROJECT

### Waste management practices in Ghana

LB page 321

(Groups)

CP5.2, CP6.3, CI6.8

## Guidelines

- The learners work in groups to create and complete a survey about waste management practices in Ghana.
- If possible, invite somebody from the local municipality or town council to visit your class to explain how waste is managed in your area.
- Learners should also try to talk to workers in various sectors of the waste management industry. Remember to include informal workers who collect and recycle waste.
- They may also use the internet or libraries to get more information.
- From the information gathered, the learners should make a list of positive and negative factors and add reasons to support each classification.
- Finally, they should write a report, setting out their findings and suggesting ways to improve waste management in Ghana and their area.

## Assessment

Use the rubric for reports on page 194 of this guide to assess the learners' reports.



Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1. **a)** Waste management refers to all the steps involved in handling waste to ensure a clean and healthy environment.  
**b)** recycling, composting, landfills and incineration
2. Growing population, urbanisation, an increase in manufactured and processed products, increased consumerism
3. Recycling is the collection and processing of waste material to convert it into new products.
4. Converting waste into raw material that can be used to manufacture new products and using waste as fuel to generate energy
5. Fermentation
6. Waste materials can be burnt as fuel. Biogas obtained from decomposition can be used as fuel.
- 7.

Advantages of a well-constructed landfill	Disadvantages of a poorly constructed landfill
<ul style="list-style-type: none"> <li>Landfills are relatively cheap.</li> <li>They are a source of employment.</li> <li>They could be a source of cheap energy and biofuel generation.</li> </ul>	<ul style="list-style-type: none"> <li>Construction can be expensive.</li> <li>They pose serious environmental and health problems.</li> <li>Toxic substances in the waste may end up in the water supply systems of communities.</li> <li>Landfills have a tendency to give off odours and potentially harmful gases.</li> </ul>

8. Any five of the following, with an example of each:
  - Organic waste. Examples: residues of food stuff, droppings from farm animals and human waste
  - Plastic waste. Examples: bottles, polythene bags and sachets or wrappers
  - Electronic waste. Examples: old computers, televisions, mobile phones and other used electronic equipment
  - Non-hazardous construction waste. Examples: wood, dry wall, plastics, roofing, bricks, glass, ceramic tiles, asphalt and metals
  - Hazardous construction waste. Examples: batteries, fluorescent light bulbs, paints, thermostats, lead-coated surfaces, and cleaning agents
  - Industrial waste. Examples: waste from electric power plants, agricultural activities that involve inorganic chemicals, iron and steel manufacturers, water treatment plants, plastic and resin manufacturers.
9. Paragraphs may vary but should include: soil and water pollution, climate change, harm to animal life, disruption of ecosystems, spread of disease.

## Check ...

Learners can:	Yes	No
1. Investigate the scientific methods used in waste management.		
2. Identify scientific methods such as recycling and composting used in waste management.		
3. Explain the scientific principles underlying the methods used in waste management.		
4. Conduct an audit of waste management methods in schools and assess the effectiveness of each.		
5. Describe innovative ways of waste management for sustainable development.		
6. Explain the impact of waste produced on the environment.		
7. Identify innovative ways to manage waste for sustainable development.		
8. Describe the types of waste produced within communities in Ghana.		
9. Examine and critique the waste management practices in Ghana, identifying positives and negatives and opportunities for improvement.		

# Topic 2: Human health

## Module 20

## Non-communicable diseases

### Unit 20.1 Non-communicable diseases

#### Content standard

- B9.5.2.1: Demonstrate knowledge of common non-communicable diseases of humans, their causes, symptoms, effects and prevention.

#### Indicator

- B9.5.2.1.1: Explain the symptoms, effects and prevention of some non-communicable diseases and analyse the risk factors associated with them.

#### Exemplars

- Describe what non-communicable diseases are and determine their common causes.
- Identify symptoms, effects and prevention of non-communicable diseases (refer to teachers pack for specific diseases) that are associated with malnutrition, poor working environment and exposure to drugs.
- Explain the causes, symptoms, effects and prevention of cancer.
- Identify common cancers that affect humans and link them to lifestyle.

#### Unit in a nutshell

- A non-communicable disease (NCD) cannot be transmitted from one person to another.
- Some NCDs are hereditary, which means that they are caused by genetic factors.
- Other NCDs are caused by factors in the environment or a person's lifestyle, and are called lifestyle diseases.
- The most common examples of NCDs are heart diseases, diabetes, respiratory diseases and cancer.
- Cardiovascular diseases affect any part of the circulatory system, including the heart.
- With diabetes, a high blood sugar content can damage the organs and tissues in the body.
- Respiratory diseases affect the lungs and the airways, making it difficult to breathe.
- A healthy lifestyle is the most important factor in preventing non-communicable diseases that are not caused by genetic factors.
- Cancer is a group of diseases that can affect any part of the body.
- Cancer is characterised by the uncontrolled growth of abnormal cells, which can spread throughout the body.

#### ACTIVITY 20.1.1

#### Thinking about non-communicable diseases

LB page 325

(Groups)

CC8.2, CP5.1, DL5.5, CG5.5

## Guidelines

- Divide the learners into mixed-ability groups.
- Each group should make a list of all the non-communicable diseases that they can think of.
- Once they have their lists, guide them in a discussion of what the causes of these diseases might be and what could be done to prevent them.

### Answers

Answers will vary, depending on the diseases listed.

#### ACTIVITY 20.1.2

#### Discussing NCDs and their causes

LB page 329

(Pairs)

CC8.2, CP5.1, DL5.5, CG5.5

## Guidelines

- The learners work in pairs to list the most common non-communicable diseases and their common causes. They can refer to the table on page 328 of the Learner's Book.
- Point out to the learners that the genetic factors are not included in the table, because in this unit we are focussing on the factors that can, to varying extents, be controlled by individuals.

#### ACTIVITY 20.1.3

#### Writing a report

LB page 330

(Individual)

CC8.2, CP5.1, DL5.5, CG5.5

## Guidelines

- The learners work on their own to find out about the effect of cigarette smoke on the human body, and then write a report.
- They may use the internet, books, magazines or discussion with knowledgeable people to find the information they need.
- Let learners present their findings for discussion.

### Answers

- Answers will vary.
- Make sure that the report is approximately 300 words long, uses appropriate subheadings and is structured in a clear and logical way.
- Develop criteria for presentation, e.g. clearly stating the purpose of the report.

## Assessment

Use the rubric for reports on page 194 of this guide to assess the learners' reports.

(Groups)

CC8.2, CP5.1, DL5.5, CG5.5

## Guidelines

- The learners work in groups to research how lifestyle is linked to specific types of cancers.
- Divide the class into four groups.
- They may use books or the internet for research.
- Once they have done this, assign each group one type of cancer on which to create a poster.
- Each group should then use the poster as an illustration for a presentation to the rest of the class.

## Unit 20.2 The relationship between health and disease

### Content standard

- B9.5.2.2: Demonstrate understanding of the relationship of health and disease, the concept of common diseases in the environment and how to control them.

### Indicators

- B9.5.2.2.1: Explain the concepts of health and disease and show their relationship.
- B9.5.2.2.2: Explain the concept of common diseases in an environment.

### Exemplars

- Define health as stipulated by World Health Organization (WHO) and show the relationship between health and disease.
- Conduct a survey about common diseases and analyse the findings to show what constitutes a common disease in a community.
- Identify causes, symptoms and prevention of common diseases.

### Unit in a nutshell

- The World Health Organization (WHO) defines health as follows: 'Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.'
- Health includes physical, mental and social health.
- Disease is an abnormal condition that affects a part or parts of the body in a negative way.
- A disease affects a person's physical health, but it can also have an influence on the person's mental and social health.
- There are diseases that are common in many communities, regions or countries.
- The occurrence of common diseases is influenced by environmental, social and cultural factors.



## INTERNET INTERACT

There are many websites with medical information on the internet. Encourage the learners to do online research, but point out to them – and stress this clearly – that they should make sure that the websites they visit are reputable. Some people claim to be medical experts and publish false or misleading information online.

Also point out to the learners that it is very easy to fall into the trap of thinking that you have a certain disease because the symptoms described on a website may sound similar to something you have experienced – or *think* you have experienced. The learners should understand that they should always visit a trained medical professional if they have any doubts or fears about health-related issues.

### ACTIVITY 20.2.1

#### Researching common diseases in different countries

LB page 339

(Pairs)

CI6.1, CP6.3

### Guidelines

- The learners work in pairs to research common diseases in Ghana and compare them to other countries.
- They may use the internet or books for research.
- Each pair should choose and list five common diseases in Ghana and give reasons why they think those particular diseases are common in certain regions or in certain communities.
- Once they have their list, they should compare the diseases found in Ghana with those that are common in the rest of the world.
- They should then discover that different countries have a different prevalence of common diseases and should then discuss the reasons for this.

### ACTIVITY 20.2.2

#### Conducting a survey of common diseases

LB page 340

(Groups)

CI6.1, CP6.3

### Guidelines

- Divide the class into groups.
- Explain that they are going to conduct a survey to find out which diseases are common in your community. You will then analyse the information and identify what may contribute to the prevalence of these diseases.
- Guide the learners to draw up a list of questions. The learners should contact at least 10 people in the community and ask them if they would be prepared to answer the questions.
- Point out to the learners that health and medical conditions are sensitive issues for many people, and that they should be very diplomatic and considerate when they approach people. The learners should

assure respondents that the information will be anonymous. Make sure that the learners work ethically and considerately throughout.

- When the learners get all the questionnaires back, help them to use a systematic and efficient way to analyse the information. They could at first use tally marks to count specific diseases. They should then convert the data and present it as a graph.
- When the learners have completed their graphs, ask a representative of each group to share their findings with the rest of the class in an oral presentation.

### Answers

The answers to the questions in number 3 will vary for each group.

### Assessment

Use the rubric for graphs on page 193 of this guide to assess the learners' graphs.

You can use the rubric for oral presentations on page 194 of this guide to assess the learners' presentations.

## Unit 20.3 Fungal diseases

### Content standard

- B9.5.2.2: Demonstrate knowledge of selected fungal diseases of humans, their causes, symptoms, effects and prevention.

### Indicator

- B9.5.2.2.1: Explain the nature of fungal diseases with special emphasis on ringworm/candidiasis/fingernail and toe nail infection, their causes, symptoms, effects on humans and their prevention.

### Exemplars

- Discuss the nature of fungal diseases.
- Search for information and make presentations on ringworm, candidiasis and fungal eye infection diseases and their mode of transmission from person to person, community to community and from country to country.
- Describe the symptoms, effects and prevention of ringworm, candidiasis and fungal eye infection diseases.
- Describe the role of individuals, community members and government in managing ringworm, candidiasis and fungal eye infection diseases.
- Design and produce a poster to educate their community members on the incidence and control of named fungal diseases: ringworm, candidiasis and fungal eye infection.

### Unit in a nutshell

- Fungal diseases are caused by fungi such as moulds, mildews and yeasts.
- Ringworm is a fungal infection that affects the skin and scalp.
- Candidiasis can affect various parts of the body, but infection most often occurs on the skin, in the mouth and throat, and the genitals.
- Fungal eye infections can follow injury to the eye.

- Infections of the toenails and fingernails are caused by the same family of fungi that cause ringworm and athlete's foot.
- Personal hygiene is important in preventing the spread of fungal infections.
- People with a weakened immune system are more prone to fungal infections.
- Accurate and practical information is essential to help prevent the spread of fungal diseases.

### ACTIVITY 20.3.1

### Finding out about fungal infections

LB page 341

(Groups)

CP5.1, DL5.1, CC8.1, CI5.2

### Guidelines

- Divide the class into groups and explain to the learners that they will have a discussion about fungal infections. Point out that they should be sensitive to learners who might have had any of these infections, and that there should be no shame or prejudice.
- While the activity states that learners should give their opinions on what a fungal infection is, their opinion should align with facts. The learners should understand that fungal infections are caused by fungi such as moulds, mildews and yeasts.
- Each group should compile a list of the fungal infections that they know. Help to identify any of their suggestions that are wrong.
- Allow the groups to do research to identify the symptoms of the fungal infections that they have listed.

### ACTIVITY 20.3.2

### Comparing ringworm and candidiasis

LB page 344

(Individual)

CP5.1, DL5.1, CI5.2

### Guidelines

- The learners should work on their own to copy the table and then complete it with the correct information.

### TALK ABOUT

LB page 345

Guide the learners to understand that if a person has poor blood circulation, the white blood cells cannot function optimally to fight infections.



## Answers

	Ringworm	Candidiasis
Fungi that cause it	Dermatophytes	Candida
Main symptoms	Itchy rash, red rings or round patches on lighter skin, brown-grey circles or patches on darker skin, glows under a black light, scalp ringworm can cause hair to break or fall out	Itching, soreness and inflammation. Symptoms of vaginal candidiasis also include thick white discharge and burning pain when urinating
Parts of body affected	Skin, particularly in warm, damp areas of the body	On the skin, in the mouth, throat and genitals
How the fungi are transmitted	Direct contact with infected humans or animals	Occurs naturally

### ACTIVITY 20.3.3

### Preparing a presentation about fungal infections

LB page 346

(Class)

CP5.1, DL5.1, CC8.1, CI5.2

## Guidelines

- The learners work as a class to research and discuss fungal infections.
- They may use the internet or a library, or talk to healthcare workers to research the topic.
- Guide them to create a table to record the results of their research. This will help them to make sure that they find out everything that is needed, including symptoms, causes, frequency in area and methods of transmission.
- The information should be kept to create a poster in Activity 20.3.4.

## Assessment

Use the rubric for oral presentations on page 194 of this guide to assess the learners' presentations.

### ACTIVITY 20.3.4

### Creating a poster

LB page 347

(Groups)

CP5.1, DL5.1, CI5.2

## Guidelines

- Learners work in groups to create a poster using the information they gathered in Activity 20.3.3.
- Ensure that the learners have the resources available to create their posters.
- Once completed, groups should display the posters they have created to the whole class for critique.

## Assessment

Use the rubric for posters on page 194 of this guide to assess the learners' posters.

Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1. B lasts a long time
2. C sugar
3. C high blood pressure
4. C naturally occurring fungi
5. It is a disease that cannot be transmitted from one person to another.
6. heart diseases, diabetes, respiratory diseases and cancer
7. Learners should name the four risk factors below, with any one example of a disease caused by each factor:  
 Tobacco smoking: emphysema, chronic obstructive pulmonary disease (COPD), heart attack, stroke, coronary artery disease, eye diseases, rheumatoid arthritis, diabetes  
 Unhealthy diet: chronic obstructive pulmonary disease (COPD), heart attack, stroke, coronary artery disease, cancer, diabetes  
 Lack of physical exercise: chronic obstructive pulmonary disease (COPD), heart attack, stroke, coronary artery disease, arthritis  
 Excessive consumption of alcohol: heart arrhythmia, coronary artery disease, high blood pressure, stroke, steatosis (fatty liver), hepatitis, cirrhosis, cancer
8. A stroke is when the blood flow to the brain is blocked or interrupted.
9. With Type 1 diabetes, the body does not produce insulin. With Type 2 diabetes, the body produces insulin but does not use it properly.
10. Cancer is a group of diseases that can affect any part of the body. The disease is characterised by the uncontrolled growth of abnormal cells, which can spread throughout the body. Cancer cells usually stick together to form a growth known as tumours. Unlike benign tumours, cancer tumours can invade tissues other than the one in which the cancerous cells have formed. In some types of cancer, cells from the original tumour can break away and move to other body parts. This process is called metastasis. When this happens, we say that the cancer has metastasised.
11. 'Health' refers to more than just a healthy body. There are three aspects of health, and to ensure good overall health they should be balanced.  
 Physical health refers to a body that is free of disease and impairments, that is fit and that functions well.  
 Mental health refers to the way a person thinks, feels and behaves. It has to do with a person's feelings and emotions, and the way in which they see themselves. Good mental health includes a positive but realistic attitude, and an ability to enjoy life and cope with the ups and downs of everyday life.  
 Social health refers to a person's ability to function in society, to form friendships and relationships and to adjust well to social situations.
12. a) Any four: cholera, typhoid, pulmonary tuberculosis, anthrax, pertussis, tetanus, chickenpox, yellow fever, measles, infectious hepatitis, trachoma, malaria, HIV and schistosomiasis  
 b) Accept any reasonable answer.
13. ringworm, candidiasis, fungal eye infections, and fingernail and toenail infections.

- 14.** Any five: Keep skin clean. Dry thoroughly after a bath or shower, or when feet get wet. Do not wear tight shoes that make feet sweaty. Air must be able to circulate around your feet. Wear clean socks and underwear every day. Keep nails clean and short. Do not share personal items such as combs, towels, sheets or clothing. Wear flip-flops in public showers or locker rooms. Shower immediately after contact sports and do not share clothing or helmets with other players. Make sure pets are not infected. Wash hands after touching pets. Wash bed sheets and pillow cases regularly.

## Check ...

Learners can:	Yes	No
<b>1.</b> Explain the symptoms, effects and prevention of some non-communicable diseases and analyse the risk factors associated with them.		
<b>2.</b> Describe what non-communicable diseases are and determine their common causes.		
<b>3.</b> Identify symptoms, effects and prevention of non-communicable diseases that are associated with malnutrition, poor working environment and exposure to drugs.		
<b>4.</b> Explain the causes, symptoms, effects and prevention of cancer.		
<b>5.</b> Identify common cancers that affect humans, and link them to lifestyle.		
<b>6.</b> Explain the concepts of health and disease and show their relationship.		
<b>7.</b> Define health as stipulated by the World Health Organization (WHO) and show the relationship between health and disease.		
<b>8.</b> Explain the concept of common diseases in an environment.		
<b>9.</b> Conduct a survey about common diseases and analyse the findings to show what constitutes a common disease in a community.		
<b>10.</b> Identify causes, symptoms and prevention of common diseases.		

# Topic 3: Science and industry

## Module 21 Science and industry

### Unit 21.1 Scientific concepts, principles and processes involved in industries

#### Content standard

- B9.5.3.1: Analyse the scientific concepts, principles and processes applied in industries in and outside their community.

#### Indicator

- B9.5.3.1.1: Investigate the scientific concepts, principles and processes involved in industries in their environment.

#### Exemplars

- Identify products of industries within and outside their community and describe the process of production.
- Investigate and outline scientific concepts, principles and processes underlying the production of common everyday industrial products.

#### Unit in a nutshell

- Important industries in Ghana include electronics, cars, cement, mining, aluminium smelting, food processing, petroleum refining, and small ship building.
- Science is a systematic and logical study of how systems and processes work.
- Scientists and inventors follow the scientific method to produce products or plan processes.
- The manufacturing process transforms raw materials or existing products into new products.
- Scientific concepts, principles and processes play a role in most manufacturing processes.

#### ACTIVITY 21.1.1 Thinking about products of industries LB page 351

(Individual)  
CP5.8, DL5.1

#### Guidelines

- Engage learners to work on their own to compile a list of products that are used in their homes. They should also list which type of industry made the products and where they were made.
- Encourage and guide the learners to list a range of products made in a variety of industries, such as appliances, woodwork, textiles, electronics and chemicals, etc.

## Answers

Answers will vary, depending on the products selected to list.

### ACTIVITY 21.1.2

#### Discussing scientific processes in industry LB page 352

(Groups)

CC9.1, CP5.8, DL5.1

## Guidelines

- Divide the class into groups.
- The learners should work in groups to select and discuss the manufacturing of products.
- They should select at least five products to discuss.
- They should research the making of each product in books or on the internet.
- They should discuss the scientific principles and processes that are involved in the manufacturing of each product.

## Answers

Answers will vary.

### ACTIVITY 21.1.3

#### Analysing the scientific concepts, principles and processes involved in industries LB page 355

(Groups)

CC9.1, CP5.8, DL5.1

## Guidelines

- The learners work in groups to research a company within an industry.
- Each group should choose one or two of the following industries to investigate: mining, lumbering, light manufacturing, aluminium smelting, food processing, cement, small commercial ship building, petroleum.
- The groups should choose a specific company within their chosen industry and also select one of their products.
- They should research the product as laid out in the activity in the Learner's Book using whatever resources they have available.
- The groups should discuss the scientific principles or concepts applied at each stage of the manufacturing process.
- Once they have completed their research, they should use their results to write a report summarising their findings.
- When their reports are completed, each group should select one or two learners to present the report to the rest of the class in an oral presentation.

## Answers

Answers will vary.

## Assessment

Use the rubric for oral presentations on page 194 of this guide to assess the learners' presentations.

# Unit 21.2 Modern and indigenous industries

## Content standard

- B9.5.3.2: Demonstrate an understanding of the concept of industry, the science underpinning the processes of production in industries, the technologies in indigenous industries and western industries.

## Indicators

- B9.5.3.2.1: Explain the concept of industry and distinguish between modern and indigenous industries.
- B9.5.3.2.2: Examine indigenous industries in their communities and show the scientific processes in the stages of production.

## Exemplars

- Identify an industry as individual firms producing the same commodity and give examples of industries in their community.
- Describe how technology affects industry and compare the technologies in indigenous and modern industries.
- Discuss indigenous industries in their communities and identify the scientific processes, concepts and principles underlying the stages of production in the industries.
- Identify indigenous practices at home, school and the community and the science involved in the practices.

## Unit in a nutshell

- An industry is a group of individual firms that produce the same commodity or supply the same service.
- An industry can consist of many different types of businesses, but all the businesses within an industry have the same goal.
- Technology is the way in which we apply scientific or indigenous knowledge for practical purposes to solve problems or to make it easier to do certain tasks.
- Improved technology makes it possible for industry to get work done faster and more efficiently.
- There are advantages and disadvantages to using new forms of technology.
- Indigenous technology is usually based on methods and practices that have been developed by people who had to find a practical and affordable way of performing a task.
- In most Ghanaian communities, people use technologies that have been handed down from generation to generation.
- Most modern industries evolved from indigenous technologies.
- Many of the practices and activities that we carry out in our communities are based on scientific principles.

**ACTIVITY 21.2.1****Talking about the impact of technology on industries**

LB page 359

(Groups)

CP5.1, CI6.8, CC9.1, CP6.4, CP6.3

**Guidelines**

- The learners work in groups to investigate and discuss the impact that technology has had on industries.
- Divide the class into groups and assign each group an industry to investigate.
- The groups may use books or the internet to research the impact of technology on their assigned industry.
- If they have the time and resources, they should also investigate what technologies are expected to have an influence on the industries in the future, and how these technologies are expected to change the industry.
- Once they have completed their research, the learners should discuss their findings within their group.

**Answers**

Answers will vary.

**ACTIVITY 21.2.2****Comparing old and new technologies**

LB page 360

(Groups)

CP5.1, CI6.8, CC9.1, CP6.4, CP6.3

**Guidelines**

The learners work in pairs to compare old and new technologies and answer the questions in the Learner's Book.

**Answers**

1. plough – tractor, candle – electric light, typewriter – computer, alarm clock – electronic clock or phone alarm, donkey – truck.
2. Accept any well-motivated answers. In all cases, the newer technology will usually be judged as better. However, also accept and point out that there can be downsides to newer, better technology, such as pollution and higher costs.

**EXTENSION ACTIVITY**

LB page 366

Ask the learners to read the list of old and new forms of technology in Table 21.2.1 again. Encourage them to talk about which scientific principle or concept, in their opinion, is applied when using these objects. This extension activity will give the learners a chance to think more deeply about how machines and devices work. The website at the link below gives interesting information about how products are made.

<http://www.madehow.com/>

**ACTIVITY 21.2.3****Explaining scientific processes in industry**

LB page 366

(Individual)

DL5.1

**Guidelines**

The learners work on their own to answer the questions.

**Answers**

1. fractionation
2.
  - a) The process of making something free from bacteria or other living micro-organisms
  - b) When a liquid changes state to a solid
  - c) When oil is heated to remove water
  - d) The change in a chemical substance when oxygen is added to it
  - e) The chemical breakdown of a substance using micro-organisms
  - f) The process of a liquid turning to vapour.
3. A saturated solution is a liquid that has the maximum amount of a chemical such as salt or sugar dissolved in it, so it cannot dissolve any more.

**ACTIVITY 21.2.4****Talking about indigenous practices**

LB page 368

(Groups)

CC9.1, CP6.4, CP6.3

**Guidelines**

- The learners work in groups to research and discuss indigenous practices. Encourage them to share information about practices with which they are familiar.
- Once they have researched these practices as per the guidelines in the Learner's Book activity, they should discuss their findings in the group.
- Walk through the class and guide the discussions.
- If possible, make arrangements with other classes to have joint discussions.
- Finally, they should summarise the results of their findings and discussion in their workbooks.

**Answers**

Answers will vary.



Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1. An industry is a group of individual firms that produce the same commodity or supply the same service. An industry can consist of many different types of businesses, but all the businesses within an industry have the same goal.
2. Any four: electronics, cars, cement, mining, aluminium smelting, food processing, petroleum refining, and small ship building
3. Technology is the way in which we apply scientific or indigenous knowledge for practical purposes to solve problems or to make it easier to do certain tasks.
4. Observation: Make notes of what you see or notice.  
Research: Find out if there is any information available that could help you to solve the problem.  
Hypothesis: Write down what you think could be done to solve the problem.  
Experiment: Test your hypothesis. Try out various methods or procedures to see if they would work.  
Analyse: Review what you have seen in your experiments and draw a conclusion.  
Conclusion: Write down your conclusions. Decide if your hypothesis was correct. If it wasn't, think why it was incorrect and what could be done to correct it.
5.  $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$
6. Rubber is heated with sulfur in vulcanisation. This leads to a reaction that causes the sulfur atoms to form extra bonds, known as cross-links, between the rubber molecules. These additional chains of atoms strengthen the rubber and increase its elasticity.
7. Any three:  
food processor – mortar and pestle  
electric razor – razor  
electric grinder or food processor – grinding stone or bowl  
refrigerator – clay pots  
smartphones, email – drums  
electric lamps or torches – hurricane lamps
8. Materials used in the object: Plastic, metal (copper)  
Purpose of the object: Electrical conduction and insulation. Metal parts conduct electricity for the appliance to use, plastic is used to insulate and protect the user from the electricity.
9. Indigenous. Accept any valid reason, for example beads predate modern industry, beads are used in historical indigenous culture.

## Check ...

Learners can:	Yes	No
1. Investigate the scientific concepts, principles and processes involved in industries in their environment.		
2. Identify products of industries within and outside their community and describe the process of production.		
3. Investigate and outline scientific concepts, principles and processes underlying the production of common everyday industrial products.		
4. Explain the concept of industry and distinguish between modern and indigenous industries.		
5. Identify an industry as individual firms producing the same commodity and give examples of industries in their community.		
6. Describe how technology affects industry and compare the technologies in indigenous and modern industries.		
7. Examine indigenous industries in their communities and show the scientific processes in the stages of production.		
8. Discuss indigenous industries in their communities and identify the scientific processes, concepts and principles underlying the stages of production in the industries.		
9. Identify indigenous practices at home, school and in the community and the science involved in the practices.		

# Topic 4: Climate change and green economy

## Module 22

## Climate change and green economy

### Unit 22.1 Factors that influence climate change and a green economy

#### Content standard

- B9.5.4.1: Demonstrate an understanding of the natural and human factors that influence climate change and a green economy.

#### Indicator

- B9.5.4.1.1: Examine various natural and human factors that influence climate change and a green economy in their localities.

#### Exemplars

- Identify the natural factors that influence climate change.
- Describe ways of minimising human activities that influence climate change.
- Compare natural and human factors that influence climate change and a green economy.

#### Unit in a nutshell

- Climate change refers to long-term changes to the climate of a region or country, or even the whole world.
- The term green economy refers to the way in which a country or region develops and maintains its economy and standards of living.
- Natural causes of climate change include volcanic eruptions, ocean currents, the Earth's orbital changes, solar variations, and internal variability.
- The increased rate of climate change since the middle of the 20th century is mainly the result of human activities.
- The burning of fossil fuels (coal, gas and oil) to generate heat and electricity is one of the major causes of climate change.
- Other human activities that cause climate change are deforestation, agricultural activities, industrial activities and mining.
- Heat that is trapped in the atmosphere causes the greenhouse effect.
- The impact of human activities on climate greatly exceeds the impact due to natural processes.
- Climate change has a harmful effect on the environment, people's health, agriculture and the economy.

**ACTIVITY 22.1.1****Discussing and researching green economies** LB page 373

(Groups)

*DL6.4, CC7.5, CI6.3***Guidelines**

- The learners work in groups to discuss the meaning of the term 'green economy'.
- They should also discuss ways they think that businesses and organisations can move to a green economy.
- Make sure that they consider the difficulties in changing to greener methods of doing business. Point out that sometimes, greener business practices are more expensive and difficult to implement. This can cause businesses great difficulty and make products and services more expensive.
- The learners may use books, magazine articles and the internet to find more ideas. They can also speak to other people in the community for ideas and local businesses for information about difficulties.

**ACTIVITY 22.1.2****Thinking about natural causes of climate change**

LB page 378

(Pairs)

*DL6.4, CC7.5, CI6.3***Guidelines**

- The learners work in pairs and take turns explaining to one another how natural occurrences can influence climate change.

**ACTIVITY 22.1.3****Discussing human activities that affect climate change**

LB page 380

(Group)

*DL6.4, CC7.5, CI6.3***Guidelines**

- The learners work in groups to discuss and identify human activities that influence climate change and create a list of those they identify.
- They should think specifically about and identify activities in their community that contribute to climate change.
- Once each group has made their list, they should then get together and compare their lists and combine them into one list with everything that they have identified.

**ACTIVITY 22.1.4****Comparing causes of climate change**

LB page 382

(Pairs)

*CC7.5, CI6.3*

## Guidelines

- The learners work in pairs to complete and then expand the table.

### Answers

1.

Observation	Natural cause	Human cause	Specific cause
More CO <sub>2</sub> from fossil fuels in air		✓	Humans burn fossil fuels for heat and energy
Rising sea levels		✓	Melting ice sheets and glaciers
Less oxygen in the air		✓	Deforestation
Short-term cooling of atmosphere	✓		Volcanic eruptions
Melting glaciers and ice sheets		✓	Climate change
Warm water builds up along the equator	✓		El Niño
Fluorinated gases in the atmosphere		✓	Humans created greenhouse gasses
N <sub>2</sub> O in the atmosphere		✓	Fertilisers

2. Answers will vary. Accept any reasonable additions.

### ACTIVITY 22.1.5

### Helping to minimise climate change in your community

LB page 385

(Group)

DL6.4, CC7.5, CI6.3

## Guidelines

- The learners work in groups to discuss solutions to minimise climate change by human activities.
- They should create a proposal of ways in which they and their family and friends can contribute.
- They should create their own version of the Climate Change Commitment given and display it where they will see it as a constant reminder.



### INTERNET INTERACT

Watch the video below about youth and climate change in Ghana with the class to show how young people are taking steps to address climate change.

<https://www.youtube.com/watch?v=c2DA69vFbT4>

## Unit 22.2 Initiatives that address climate change and a green economy

### Content standard

- B9.5.4.2: Evaluate the effectiveness of initiatives that address the issue of climate change and green economy in Ghana and the world at large.

### Indicator

- B9.5.4.2.1: Assess data on climate change and green economy actions/activities globally including Ghana and other countries.

### Exemplars

- Research into climate change and green economy actions in Ghana.
- Access climate change and green economy actions in other countries.
- Compare and contrast climate change and green economy actions in Ghana and other countries.
- Identify and write the effective initiatives that address climate change and green economy issues in Ghana and other countries.
- Prescribe with reasons best practices to serve as possible solutions to address climate change and green economy issues in Ghana.

### Unit in a nutshell

- Ghana has launched various programmes to address the problem of climate change.
- There are two categories of actions in dealing with climate change, namely mitigation and adaptation.
- The NCCPF has three main objectives: low-carbon growth, effective adaptation to climate change, and social development.
- A number of agreements and partnerships have been created to address the global response to climate change.
- The United Nations endorsed the concept of a green economy.

#### ACTIVITY 22.2.1

#### Researching climate change and green economy actions in Ghana

LB page 390

(Groups)

CP6.3, DL5.1, CP6.4, CP5.1

### Guidelines

- The learners work in groups to research climate change actions taken in Ghana.
- They may use the internet, books, magazines or interviews with experts to do their research.
- Once completed, the groups should present their findings to the class.

### Assessment

Use the rubric for oral presentations on page 194 of this guide to assess the learners' presentations.



## INTERNET INTERACT

The video listed below gives information about an initiative in Ghana to address climate change and contribute to the green economy.

<https://www.youtube.com/watch?v=EK8KvX318IU>

### ACTIVITY 22.2.2

#### Investigating and comparing climate agreements and actions

LB page 392

(Groups)

CP6.3, DL5.1, CP6.4, CP6.3, CP5.1

### Guidelines

- The learners work in groups to research the goals of international climate change agreements and make a list.
- They may use the internet, books, magazines or interviews with experts to do their research.
- Once they have the goals listed, they should compare and contrast these international goals with those of Ghana's NCCPF.
- They should compile a list of differences, if any, between the goals of Ghana and those of the international community.

### ACTIVITY 22.2.3

#### Drawing a mind map of best practices to address climate change and green economy issues in Ghana

LB page 393

(Groups)

CP6.3, DL5.1, CP6.4, CP5.1

### Guidelines

- The learners work in groups to discuss the actions that they think the government, businesses and individuals in Ghana could take to address climate change and help to establish a green economy.
- They should summarise their ideas and create a mind map.
- Once completed, have a class discussion where the whole class discusses the ideas that the groups have come up with. Encourage critical thinking and constructive criticism of these ideas.

Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1. Climate change refers to long-term changes to the climate of a region, country or the whole world.
2. A green economy is an economy that provides a better quality of life for all, within the ecological limits of the planet. It involves three main aspects, namely the economy, the environment, and social equity existing in a balanced relationship to ensure sustainable development.
3. Any four: volcanic eruptions, ocean currents, Earth orbital changes, solar variations, internal variability
4. The dust and ash from volcanic eruptions block some sunlight from reaching the Earth, which causes the environment to cool down. The gases from a volcano include sulfur dioxide gas, which when combined with water vapour and dust in the atmosphere, forms aerosols that reflect sunlight away from the Earth.
5.
  - a) False. Earth's orbit around the Sun is not constant and can cause climate change.
  - b) True
  - c) True
6. During photosynthesis, trees absorb carbon dioxide and release oxygen.
7. Livestock, especially cattle, produce methane, which is 30 times more powerful than carbon dioxide as a greenhouse gas. The increasing demand for more livestock leads to overgrazing so less carbon dioxide is used by plants, and more is released into the atmosphere. Forests and other areas with trees are cleared for farming activities. Use of nitrogen fertilisers leads to increased nitrous oxide emissions into the atmosphere.
8. While climate change is a natural and cyclical occurrence, since the middle of the 20th century, the increase in the global temperature has changed much faster than it should have naturally. This is because the human influence on global warming is much greater than the natural influences.
9. Rising sea levels cause floods and erosion. In Ghana, coastal villages have been flooded and other areas along the coast are drastically affected by erosion, cutting some villages off from the mainland.  
Increased temperatures lead to extreme weather conditions and warmer water affects fish and other marine organisms. Ghana has experienced severe droughts and dead fish and dolphins washed up along the coast.  
Health problems: Climate change affects people's health and well-being in many ways. With more dry areas as a result of climate change, Ghana is facing an increase in meningitis cases.
10. Low-carbon growth, effective adaptation to climate change, social development.
11.
  - a) The upper half is a green economy because (any three): Lots of trees and plantlife, renewable energy, no pollution, clean air and water, animal life.
  - b) Any two: Polluted air, polluted water, dirty energy, burning of fossil fuels, no trees or plants, no animals.
12. Any three: The United Nations Framework Convention on Climate Change, The Kyoto Protocol, The International Carbon Action Partnership, The Muslim Seven Year Action Plan on Climate Change, The Paris Agreement.
13. Answers will vary. Ensure that the answers given are in accordance with best practices for minimising climate change.



## Check ...

Learners can:	Yes	No
1. Demonstrate an understanding of the natural and human factors that influence climate change and a green economy.		
2. Identify the natural factors that influence climate change.		
3. Identify human activities that contribute to climate change.		
4. Describe ways of minimising human activities that influence climate change.		
5. Compare natural and human factors that influence climate change and a green economy.		
6. Assess data on climate change and green economy actions/activities globally, including Ghana and other countries.		
7. Research into climate change and green economy actions in Ghana.		
8. Assess climate change and green economy actions in other countries.		
9. Compare and contrast climate change and green economy actions in Ghana and other countries.		
10. Identify and write the effective initiatives that address climate change and green economy issues in Ghana and other countries.		
11. Prescribe with reasons best practices to serve as possible solutions to address climate change and green economy issues in Ghana.		

# Topic 5: Understanding the environment

## Module 23 Uses of plant parts

### Unit 23.1 Uses of different plant parts

#### Content standard

- B9.5.5.1: Demonstrate knowledge and skills in the use of plant roots, stems, leaves, flowers, and fruits for agricultural and non-agricultural purposes.

#### Indicator

- B9.5.5.1.1: Show and list the uses of different plant parts for agricultural and non-agricultural purposes.

#### Exemplars

- Identify plant parts that are used for agricultural and non-agricultural purposes.
- Describe how plant parts are used for agricultural and non-agricultural purposes.
- List the uses of plant parts for agricultural purposes (such as planting, tools, animal housing, animal feed, soil improvement, pest and disease control, etc.).
- List the uses of plant parts for non-agricultural purposes (such as herbal medicine, construction of houses, bridges and furniture, artefacts, ceremonies, rituals, education, etc.).

#### Unit in a nutshell

- The main agricultural use of plant parts is propagation of the plant.
- Wood is used commonly to make the handles of agricultural tools.
- Bamboo is used in agriculture to make harvesting sticks and baskets.
- Wood and bamboo are often used to make animal housing.
- Straw, sawdust and wood shavings are used as bedding for animals.
- We can use some plant parts as feed for animals.
- Mulch, compost and green manure are used to improve soil fertility.
- Plant parts that are commonly used to control pests and diseases include leaves, stems, roots, barks, flowers and seeds.
- Plant parts are used to make herbal medicines.
- Wood, thatch, rope, rattan and cane are used for construction and to make furniture.
- People use a variety of plant parts as food.
- Plant material is used to make artefacts and items that we use in everyday life.
- Plant materials are used in material for ceremonies and rituals.
- Many objects and structures used in education are made from plant parts.
- Plant parts are often used as fuel.

**ACTIVITY 23.1.1****Plant parts for propagation**

LB page 398

(Individual)

CC7.3, CP5.5, CI5.3, DL5.5

**Guidelines**

The learners work on their own to answer the questions.

**Answers**

- |               |               |            |
|---------------|---------------|------------|
| a) root tuber | b) root tuber | c) rhizome |
| d) root tuber | e) rhizome    | f) bulb    |
- A tuber is an underground modified stem or root that stores the plant's food reserves.

**ACTIVITY 23.1.2****Using parts of plants on a cattle farm**

LB page 401

(Groups)

CC7.3, CP5.5, CI5.3, DL5.5

**Guidelines**

- The learners work in groups to discuss ways in which a cattle farmer could use parts of plants on his or her farm.
- Guide the discussion to include parts of plants that can be used for cattle feed, shelter and enclosures.
- Encourage the learners to think creatively and to see if they can come up with innovative solutions for practical problems.
- Remind the learners that they should respect each other's suggestions. Give learners an opportunity to comment on suggestions and give reasons why the suggestions would work or would not work. Make sure that they give constructive criticism and not revert to personal attacks or nastiness.

**Answers**

Learners' own answers.

**ACTIVITY 23.1.3****Everyday uses of plant parts**

LB page 404

(Groups)

CC7.3, CP5.5, CI5.3, DL5.5

**Guidelines**

- The learners work in groups to discuss products made of plant parts, and how they are used in everyday life.
- Guide the learners to do some research at home and among the community before the discussion.
- They may also use books or the internet for research.

- Guide the discussion to ensure that it includes foodstuffs, cloth and medicines, as well as functional items such as furniture and tools.
- The learners should also discuss synthetic alternatives to plant products, which can include human-made fabrics, fertilisers, plastics, etc. They should also try to identify advantages and disadvantages of these synthetic materials such as durability and pollution.

## Answers

Learners' own answers.

### ACTIVITY 23.1.4

### Discussing the case study

LB page 407

(Pairs)

DL5.1

## Guidelines

- Read the case study with the learners. Ask them to describe what they see in the photographs.
- You can either divide the class into groups or let the whole class discuss the photographs and answer the questions.
- Guide the learners to make the necessary links between raw materials and the products that are manufactured from them.

## Answers

- A. Food, herbs, spices, wooden spoons, cloths
  - B. pineapples, rubber tyres, cloth bag
  - C. fruit, cloth bag, 'paper' money (note that 'paper' money is actually made from linen), wooden crates
  - D. cardboard, wood stall
  - E. bread, wicker basket, cloths
  - F. grass brushes, garlic, onions
  - Answers will vary, but should include the following: fruits, roots, sap (rubber), fibres (linen), cloth, wood pulp (cardboard), stems and leaves (baskets).
- Food, shelter, bedding.
- Answers will vary. Accept any non-agricultural wooden or cardboard products.
- Onions. Bulb.
  - Bulb
  - Any three: seed, bulb, corm, rhizome, tuber, runners. Accept any suitable examples given.

## Unit 23.2 Create materials from plant parts

### Content standard

- B9.5.5.1: Demonstrate knowledge and skills in the use of plant roots, stems, leaves, flowers, and fruits for agricultural and non-agricultural purposes.

### Indicator

- B9.5.5.1.2: Demonstrate the use of different plant parts for agricultural and non-agricultural purposes.

### Exemplars

- Create agricultural materials from different plant parts that are used to carry out agricultural activities.
- Create non-agricultural materials from different plant parts to carry out non-agricultural activities.

### Unit in a nutshell

- Compost is an example of an agricultural material made from plant parts.
- Composting is the process of recycling organic materials and organic waste.
- Compost is used to improve the condition of the soil.
- There is a huge variety of non-agricultural materials or objects that can be made from plant parts.
- A broom can be made with natural material such as palm leaves or grass.

#### ACTIVITY 23.2.1 Talking about materials used to make fences LB page 408

(Pairs)

DL5.5, CC8.2, CC8.3, CC7.3, CC8.2, CC8.3

### Guidelines

- Ask the learners to work in pairs and look at photos A–D.
- If they are struggling to identify the photos, ask them to describe what they see, for example: 'The pieces are uneven.' or 'The pieces are very thin.' Guide them to deduce the correct answers.

#### Answers

- a) branches
- b) reeds
- c) bamboo
- d) wooden poles

#### ACTIVITY 23.2.2 Making a fence LB page 409

(Groups)

DL5.5, CC8.2, CC8.3, CC7.3, CC8.2, CC8.3

## Guidelines

- Make sure that materials and tools needed are available for the groups. You can ask the learners beforehand to gather sticks and thin branches. If you know of somebody in the community who has been trimming their trees, you could try to arrange to collect some branches from them.
- Read the instructions in the Learner's Book with the learners and make sure that they understand what they should do.
- Make sure that the learners follow the correct safety precautions while they are working. Keep a first-aid kit at hand in case any learners hurt themselves.
- Guide the learners while they are working and assist where needed.

### ACTIVITY 23.2.3

### Making a broom

LB page 411

(Pairs)

CC9.1, CP5.6, CI5.3

## Guidelines

- This is a practical activity where learners work in pairs to make a broom.
- The learners should follow the instructions given in the Learner's Book to make the brooms.
- Make sure that materials and tools needed are available for the groups.
- The instructions on pages 410–411 of the Learner's Book are comprehensive. Make sure that the learners follow the instructions closely.
- Supervise the use of tools, emphasising safety.
- Have safety equipment and a first-aid kit on hand.

### PROJECT

### Making an agricultural or a non-agricultural object

LB page 411

(Groups)

CC 9.1, CP 5.6, CI 5.3

## Guidelines

- This is a practical activity where learners work in groups to make an agricultural object.
- Guide the learners to do research online to find information on how to make various objects. They could, for example, type "make a chicken coop" into the search box, and then follow different links until they find a suitable example.
- Make sure that materials and tools needed are available for the groups.
- Give guidance while the learners are making their objects and supervise the use of tools.
- Have safety equipment and a first-aid kit on hand.

### ACTIVITY 23.2.4

### Your quiz about humans and the environment

LB page 411

(Groups)

CP5.1, CC 9.1

## Answers

1. Recycling. Recycling refers to the collection and processing of waste material to convert it into new products. These new products can be household items, clothing, or art and craft objects that are made by hand. Recycling also includes scientific processes such as converting waste into raw material that can be used to manufacture new products, and using waste as fuel to generate energy.
2. Non-communicable diseases are often caused by people's lifestyles and bad habits, for example tobacco smoking, an unhealthy diet, lack of physical exercise, and drinking too much alcohol.
3. Advantages (any three):
  - Work can be done faster.
  - Newer forms of technology will, in general, be more accurate for mixing, measuring and cutting substances.
  - Machines can run for hours without getting tired or needing breaks.
  - There is greater consistency when work is done by a machine.
  - Instead of spending long hours doing tiring or boring labour, workers can concentrate on jobs that are more stimulating.
  - Information technology (IT) makes communication easier and faster, and makes it possible to find and share information efficiently.Disadvantages (any three):
  - New forms of equipment can be very expensive.
  - Additional training is often needed to show workers how to use new machines or tools.
  - The equipment must be maintained properly to make sure that it works effectively.
  - In some cases, machines can take over the work of humans and lead to unemployment.
  - The constant availability of the internet and modern communication technology on devices such as Smartphones can make employees feel that they are always on duty, without a break from the demands of their work.
4. The term green economy refers to the way in which a country or region develops and maintains its economy and standards of living. A green economy is an economy that provides a better quality of life for all, within the ecological limits of the planet. A green economy involves three main aspects, namely the economy, the environment, and social equity. Those three aspects must exist in a balanced relationship to ensure sustainable development.
5. (Any five plant parts, and any two examples. Accept any other correct examples.)

Roots. Examples: carrot, beetroot, turnip and radish

Stems. Examples: asparagus, celery, yams, cocoyam, onions, ginger

Fruits. Examples: banana, plantain, pineapples, pawpaw, mango, oranges, aluquintuguin (soursop), noni fruit

Leaves. Examples: sweet potato, cassava, cowpea, cocoyam, spinach, amaranth, lettuce, cabbage

Flowers. Examples: broccoli and cauliflower flowers, nasturtium, pansy, hibiscus

Seeds. Examples: rice, maize, millet, cowpea, wheat, cocoa, coffee

Learners should answer the questions in their exercise books to assess their understanding of the Topic. Learners should aim for at least 60%.

1.
  - a) Mulch can be placed around the stem of a plant to prevent the soil from drying out, maintain soil temperature and protect the plant from pests and diseases. Compost can be applied to agricultural fields as a fertiliser or added to improve soil structure. Green manure consists of crops that are planted to improve the condition of the soil, as cover crops, and to help to prevent erosion.
  - b) The tuber
  - c) De-oiled cakes of neem, groundnut and sesame control pests such as fungi and insect larvae that live in the soil
2. Wood and bamboo
3. As food, as animal feed, to propagate more yams.
4. Any two: The root of Ghana quinine (yellow-dye root, *Cyptolepsis sanguinoleta*). The stem-bark of Neem (*Azadirachta indica*). The bark of mahogany (*Khaya senegalensis*)
5. Thatch is dried grass or reeds. It is used for roofs and fences.
6. Any five: Thatch is used to make roofs for school buildings. Wood is used to make tables and chairs, pencils, rulers, set squares and paper. Rubber is used to make erasers.
7. *Nyanya* leaves are believed to ward off evil. Priests wear the leaves around their neck for spiritual protection. *Nyanya* leaves are placed on the head of a new chief when he is installed, and chiefs also often wear *nyanya* leaves on their body during durbars. At funerals, mourners may wear a wreath of *nyanya* leaves around their head to protect them against evil spirits. During some ceremonies, a wreath of palm leaves is worn around the head to appease the bush spirits. Libations made from plant parts are used during various ceremonies, for example the official naming ceremony of infants.
8.
  - a) Any one: corn, sugarcane or sorghum
  - b) To power cars and other machines

### Check ...

Learners can:	Yes	No
1. Show and list the uses of different plant parts for agricultural and non-agricultural purposes.		
2. Identify plant parts that are used for agricultural and non-agricultural purposes.		
3. Describe how plant parts are used for agricultural and non-agricultural purposes.		
4. List the uses of plant parts for agricultural purposes.		
5. List the uses of plant parts for non-agricultural purposes.		
6. Demonstrate the use of different plant parts for agricultural and non-agricultural purposes.		
7. Create agricultural materials from different plant parts that are used to carry out agricultural activities.		
8. Create non-agricultural materials from different plant parts to carry out non-agricultural activities.		



**Activity 1: Multiple choice**

1. A the burning of waste at very high temperatures
2. A methane
3. C cannot be transmitted from person to person
4. B insulin
5. D calcination
6. C production of liquefied petroleum gas
7. A sustainable
8. B burning of fossil fuels
9. A bulbs
10. D a fermented green plant product

**Activity 2: Short questions**

1. Waste management refers to all the steps involved in handling waste to ensure a clean and healthy environment. It entails a series of activities such as collection, transport, treatment and final disposal.
2. Collection of waste  
Sorting and bundling  
Washing  
Shredding and separation  
Melting and reorganisation  
Manufacture of pellets
3. heart diseases, diabetes, respiratory diseases, cancer
4. Cancer is characterised by the uncontrolled growth of abnormal cells, which can spread throughout the body. Cancer cells usually stick together to form a growth known as tumours. Unlike benign tumours, cancer tumours can invade tissues other than the one in which the cancerous cells have formed. In some types of cancer, cells from the original tumour can break away and move to other body parts. This process is called metastasis.
5. **a)** It is a fungal infection.  
**b)** Ringworm is caused by a group of fungi called dermatophytes, which grow on skin.  
**c)** Ringworm affects the skin and scalp.
6. Limestone, clay and sand
7. **a)** The production of fufu is based on the pounding properties of starch. When cooked starch is pounded, it softens and swells.  
**b)** Soapmaking is a chemical reaction between fatty acids and an alkali. Oils contain the fatty acids and the liquid extract of the ashes are alkaline. The chemical reaction is called saponification.
8. carbon dioxide, methane, nitrogen oxide
9. During photosynthesis, trees absorb carbon dioxide and release oxygen. When trees are cut down, less carbon dioxide is absorbed and the carbon dioxide level in the atmosphere rises.
10. **a)** Melting ice sheets and glaciers cause the sea level to rise.  
**b)** Coastal cities and towns are in danger of being flooded.

11. It is a plan that the government of Ghana drew up that maps out actions that will allow Ghana's economy to continue to grow without adding to climate change (mitigation). It also plans to minimise and respond to the adverse effects of climate change that will impact its citizens in the years to come (adaptation).
12. mulch, compost, green manure
13. Timber is used to make furniture, beds, roofing beams, boats, canoes and many other objects for human use. Many buildings in Ghana are built using wattle and daub. Thatch is used for roofs and fences. Palm leaves are used for roofing. Rope is made of fibres from plants such as sisal, and it is used to tie planks or bamboo culms together. Rattan and cane are used to make furniture such as tables and chairs.

## Activity 2: Essay

Guide the students to choose a topic and write an essay.

Use the rubric for essays on page 195 of this Teacher's Guide to help you assess the learners' essays.

# General/generic assessment tools

- These rubrics can be used for formal or informal assessment. They serve only as a guideline; feel free to adapt them for your purpose.
- For formal assessment, write the relevant rubric up on the board beforehand so that learners know how they will be assessed.
- For informal assessment, you may prefer to remove mark allocations and use them as checklists. Learners can use the rubrics themselves for self-assessment or peer assessment.

## Rubric for drawings

Criteria for drawing	Marks
1. Accurate	4
2. Correct labels for features or parts	4
3. Drawn with single, unbroken lines	4
4. Large and clear	3
5. Includes a scale bar or scale factor	2
6. Straight label lines	1
7. Has a heading/title	1
8. Not shaded or coloured in	1
<b>Total</b>	<b>20</b>

## Rubric for graphs

Criteria for graph	
1. Data points are correctly plotted, in other words: <ul style="list-style-type: none"><li>• graph covers the full range of data from minimum value to maximum value</li><li>• scale is correct</li><li>• values are correct.</li></ul>	10
2. Graph is easy to 'read', in other words it includes, where necessary: <ul style="list-style-type: none"><li>• a title</li><li>• a key to decode lines or bars of a different colour or pattern</li><li>• a labelled horizontal x-axis</li><li>• a labelled vertical y-axis</li><li>• tick intervals/sub-divisions along the axes.</li></ul>	10
<b>Total</b>	<b>20</b>

**Note:** If choice of graph (e.g. line graph versus bar graph) is inappropriate, subtract 7 marks.

## Rubric for posters

Criteria for poster	Marks
1. Concise with relevant and interesting information/fact-packed/conveys message well	5
2. Well-structured with effective use of headings	5
3. Written in learner's own words	5
4. Presented in an eye-catching/attractive/creative/lively way	5
<b>Total</b>	<b>20</b>

## Rubric for reports (for a practical activity or investigation) or essays

Criteria for report	Marks
1. Clearly states aim or purpose	3
2. Briefly describes method (and materials, where necessary)	3
3. Details results (or observations)	6
4. Follows a logical order or sequence, e.g. aim, method, observation/results, conclusion	3
5. Learner has engaged fully with the task and demonstrates a clear understanding, in other words they know what is important and relevant, they have applied their mind, and they have arrived at the correct conclusion(s)	5
<b>Total</b>	<b>20</b>

## Rubric for models

Criteria for model	Marks
1. A reasonable or accurate representation	4
2. Includes all the key parts or key mechanisms	4
3. Has labelled parts/legends or keys/explanations	4
4. Is well constructed/put together	4
5. Is inventive/original	4
<b>Total</b>	<b>20</b>

## Rubric for oral presentation

Criteria for oral presentation	Marks
1. The presentation is built upon appropriate/relevant content	5
2. Well structured, in other words, the presentation has an introduction and a conclusion and is easy to follow	5
3. Follows an interesting/creative/thoughtful/engaging approach	5
4. Is fluent/confident delivery	5
<b>Total</b>	<b>20</b>

## Rubric for projects

Criteria for project	Marks
1. Do necessary preparation	4
2. Plan and allocate tasks	2
3. Work together as a group	2
3. Follow instructions	5
4. Apply knowledge to do practical work	5
5. Give or receive feedback	2
<b>Total</b>	<b>20</b>

## Rubric for essays

Criteria for essay	Marks
1. Content is accurate, with relevant fact presented clearly	2
2. Includes relevant examples	1
3. Essay reflects understanding and critical thinking skills	1
4. Clear structure with logical flow and coherence	2
5. Used online resources, libraries and science journals for research	2
6. Presentation is neat and readable, and correct length	1
7. Correct grammar, spelling and use of terminology	1
<b>Total</b>	<b>10</b>

# The Periodic Table of Elements

1 <b>H</b> Hydrogen 1																
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4															
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12	3	4	5	6	7	8	9								
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	45 <b>Sc</b> Scandium 21	48 <b>Ti</b> Titanium 22	51 <b>V</b> Vanadium 23	52 <b>Cr</b> Chromium 24	55 <b>Mn</b> Manganese 25	56 <b>Fe</b> Iron 26	59 <b>Co</b> Cobalt 27	63 <b>Ni</b> Nickel 28	65 <b>Cu</b> Copper 29	74 <b>Zn</b> Zinc 30	78 <b>Pd</b> Palladium 46	80 <b>Ag</b> Silver 47	81 <b>Cd</b> Cadmium 48	82 <b>Hg</b> Mercury 80	101 <b>Pb</b> Lead 82
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	89 <b>Y</b> Yttrium 39	91 <b>Zr</b> Zirconium 40	93 <b>Nb</b> Niobium 41	96 <b>Mo</b> Molybdenum 42	98 <b>Tc</b> Technetium 43	101 <b>Ru</b> Ruthenium 44	103 <b>Rh</b> Rhodium 45	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	110 <b>Cd</b> Cadmium 48	112 <b>Hg</b> Mercury 80	115 <b>In</b> Indium 49	117 <b>Tl</b> Thallium 81	120 <b>Pb</b> Lead 82	127 <b>Bi</b> Bismuth 83
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	lanthanoids 57–71	178 <b>Hf</b> Hafnium 72	181 <b>Ta</b> Tantalum 73	184 <b>W</b> Tungsten 74	186 <b>Re</b> Rhenium 75	190 <b>Os</b> Osmium 76	192 <b>Ir</b> Iridium 77	195 <b>Pt</b> Platinum 78	200 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	209 <b>Pb</b> Lead 82	210 <b>Bi</b> Bismuth 83	216 <b>Po</b> Polonium 84	217 <b>At</b> Astatine 85	218 <b>Rn</b> Radon 86
– <b>Fr</b> Francium 87	– <b>Ra</b> Radium 88	Actinoids 89–103	– <b>Rf</b> Rutherfordium 104	– <b>Db</b> Dubnium 105	– <b>Sg</b> Seaborgium 106	– <b>Bh</b> Bohrium 107	– <b>Hs</b> Hassium 108	– <b>Mt</b> Meitnerium 109	– <b>Ds</b> Darmstadtium 110	– <b>Uu</b> Ununennium 111	– <b>Uub</b> Unbibium 112	– <b>Uut</b> Untrium 113	– <b>Uuq</b> Unquadrium 114	– <b>Uup</b> Unpentium 115	– <b>Uuh</b> Unhexium 116	– <b>Uus</b> Unseptium 117

## KEY

A
<b>X</b>
Name
Z

A = relative atomic mass

**X = atomic symbol**

Name of element

Z = proton (atomic) number

lanthanoids

Actinoids

138.9 <b>La</b> Lanthanum 57	140.1 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	<b>Pm</b> Promethium 61	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	162 <b>Tb</b> Terbium 65	167 <b>Dy</b> Dysprosium 66	172 <b>Ho</b> Holmium 67	175 <b>Er</b> Erbium 68	180 <b>Tm</b> Thulium 69	184 <b>Yb</b> Ytterbium 70	189 <b>Lu</b> Lutetium 71
– <b>Ac</b> Actinium 89	232 <b>Th</b> Thorium 90	– <b>Pa</b> Protactinium 91	– <b>U</b> Uranium 92	– <b>Np</b> Neptunium 93	– <b>Pu</b> Plutonium 94	239 <b>Am</b> Americium 95	243 <b>Cm</b> Curium 96	247 <b>Bk</b> Berkelium 97	251 <b>Cf</b> Californium 98	255 <b>Es</b> Einsteinium 99	259 <b>Fm</b> Fermium 100	263 <b>Mn</b> Mendelevium 101	267 <b>Lr</b> Lawrencium 102	271 <b>Rf</b> Rutherfordium 104

										18
										4 <b>He</b> Helium 2
										13
										14
										15
										16
										17
										20 <b>Ne</b> Neon 10
										11 <b>B</b> Boron 5
										12 <b>C</b> Carbon 6
										14 <b>N</b> Nitrogen 7
										16 <b>O</b> Oxygen 8
										19 <b>F</b> Fluorine 9
										27 <b>Al</b> Aluminium 13
										28 <b>Si</b> Silicon 14
										31 <b>P</b> Phosphorus 15
										32 <b>S</b> Sulphur 16
										35.5 <b>Cl</b> Chlorine 17
										40 <b>Ar</b> Argon 18
10	11	12	70 <b>Ga</b> Gallium 31	73 <b>Ge</b> Germanium 32	75 <b>As</b> Arsenic 33	79 <b>Se</b> Selenium 34	80 <b>Br</b> Bromine 35	84 <b>Kr</b> Krypton 36		
59 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	70 <b>Ga</b> Gallium 31	73 <b>Ge</b> Germanium 32	75 <b>As</b> Arsenic 33	79 <b>Se</b> Selenium 34	80 <b>Br</b> Bromine 35	84 <b>Kr</b> Krypton 36		
106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	128 <b>Te</b> Tellurium 52	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54		
195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Bi</b> Bismuth 83	<b>Po</b> Polonium 84	<b>At</b> Astatine 85	<b>Rn</b> Radon 86		
– <b>Ds</b> Darmstadtium 110	– <b>Rg</b> Roentgenium 111	– <b>Cn</b> Copernicium 112	– <b>Nh</b> Nihonium 113	– <b>Fl</b> Flerovium 114	– <b>Mc</b> Moscovium 115	– <b>Lv</b> Livermorium 116	– <b>Ts</b> Tennessine 117	– <b>Og</b> Oganesson 118		

152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	159 <b>Tb</b> Terbium 65	163 <b>Dy</b> Dysprosium 66	165 <b>Ho</b> Holmium 67	167 <b>Er</b> Erbium 68	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71
– <b>Am</b> Americium 95	– <b>Cm</b> Curium 96	– <b>Bk</b> Berkelium 97	– <b>Cf</b> Californium 98	– <b>Es</b> Einsteinium 99	– <b>Fm</b> Fermium 100	– <b>Md</b> Mendelevium 101	– <b>No</b> Nobelium 102	– <b>Lr</b> Lawrencium 103







# ESSENTIAL Science Basic 9

## Facilitator's Guide

**ESSENTIAL** **Science** offers you a premium course in Science. The material has been developed to meet the full requirements of the Common Core curriculum for JHS, as developed by the National Council for Curriculum and Assessment (NaCCA), carefully addressing all Strands, Sub-strands, Content Standards, Indicators and Core Competencies. Throughout the series, attitudes, values and skills as prescribed by the curriculum, are addressed.

**ESSENTIAL** **Science** encourages learners to be responsible and competent citizens who are scientifically literate, creative thinkers, problem-solvers and self-confident communicators that are fully engaged in solving local and global issues experienced in the world around them.

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- practical activities and projects to do at home that allow the learners to apply the theory that they have learnt
- assessment sections that can be used to evaluate progress and achievement.

Each Learner's Book comes with a FREE digital edition of the book. The code for the digital edition appears on the inside front cover of the book and provides access for one year.



The **ESSENTIAL** **Science Basic 9 Facilitator's Guide** supports you to teach the new curriculum with confidence and offers:

- step-by-step teaching guidelines
- answers to activities in the Learner's Book
- assessment rubrics and checklists that can be used to assess learners formally or informally
- memos that can be used to assess learners' understanding of the concepts learned
- activities that can be used for diagnostic assessment
- suggestions for how to include local materials and ICT in the learning process
- curriculum coverage tables at the start of each Strand indicating how Content Standards and Core Competencies are covered in the course
- remedial and extension activities to support multi-ability learning.

**Learning is Essential!**



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