Myanmar Pre-service Teacher Education Programme

Year 3 Semester 1

EDU3122
Curriculum and Pedagogy Studies: Biology

Middle School Specialisation Track

Student Teacher Textbook

PREFACE

The Pre-service Teacher Education Curriculum consists of several components: the curriculum framework, syllabi, Student Teacher Textbooks, and Teacher Educator Guides. This curriculum for the four-year Pre-service Teacher Education Programme was designed and structured to align with the Basic Education Curriculum and to equip student teachers with the competencies needed to teach effectively in Myanmar's primary and middle school classrooms. It is based on a Teacher Competency Standards Framework (TCSF) which articulates the expectations for what a teacher should know and be able to do in the classroom.

The curriculum follows a spiral curriculum approach which means that throughout the four years, student teachers return to familiar concepts, each time deepening their knowledge and understanding. To achieve this, the four-year Education Degree College programme is divided into two cycles. The first cycle (Years 1 and 2) is repeated at a deeper level in the second cycle (Years 3 and 4) to enable student teachers to return to ideas, experiment with them, and share with their peers a wider range of practices in the classroom, with the option to follow up on specific aspects of their teaching at a deeper level.

The curriculum structure provides an integrated approach where teaching of subject knowledge and understanding educational theories are learnt through a supportive learning process of relevant preparation and practical application and experience. The focus is, therefore, not just on subject content, but also on the skills and attitudes needed to effectively apply their knowledge, skills, and attitudes in teaching and learning situations, with specific age groups. As the focus is on all components of a 'competency' – knowledge, skills, attitudes and their effective application – it is referred to as a competency-based curriculum.

Accordingly, a competency-based curriculum is learner-centred and adaptive to the changing needs of students, teachers, and society. Where new concepts are learnt, they are then applied and reflected on:

1. Learn (plan what and how to teach);
2. Apply (practise teaching and learning behaviours); and
3. Reflect (evaluate teaching practice).

Beyond the Pre-service Teacher Education programme coursework, it is intended that student teacher graduates will be able to take and apply this cycle of 'learn, apply, and reflect' to their own teaching to effectively facilitate the learning and development of Myanmar's next generation.

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HOW TO USE THIS TEXTBOOK

Who will use this Biology Student Teacher Textbook?

This textbook has been designed to guide you, as a student teacher, through Year 3 of the Biology subject. In this textbook, you will find foundational information about Biology. The textbook also includes learning activities and additional resources to help you develop the knowledge, skills, and attitudes you need to be an effective teacher in Myanmar. You will use the textbook as a key resource in class; you can also use the textbook for independent self-study.

While the content in the textbook is addressed to you, as a student teacher, it is also a resource for your teacher educators, who will serve as your facilitators and mentors as you develop key competencies in Biology. Throughout this subject, you and your teacher educator will work together, using this textbook as a tool for learning.

When and where does Year 3 Biology take place?

A total of 60 teaching periods (Semester 1: 36 teaching periods; Semester 2: 24 teaching periods) are allotted for Year 3 Biology of the four-year Education Degree College programme. Classes will be held on the Education Degree College campus.

What is included in the Year 3 Biology Student Teacher Textbook?

The organisation and content of Biology Student Teacher Textbook align with Biology subject syllabus of the four-year Education Degree College programme.

Year 3 Biology contains the following topics:

- Methodology
- Living Things
- Ecology
- Environmental Biology
- Reproduction

For each unit, you will be working through learning activities, both individually and with your peers as well as teacher educators, to deepen your knowledge, skills, and attitudes on the topic. The content map below highlights the expected learning outcomes and time allocations for each unit in this textbook.

Table A. Year 3 Semester 1 Biology, Middle school specialisation track content map

Units	Sub-units	Lessons	Learning outcomes	TCSF		Periods
				Minimum requirements	Indicators	
1. Methodology	1.1. Overview of Middle School Biology	1.1.1. Introduction to Middle School Biology	• Identify the learning objectives and content focus of the Biology strand within the Lower Middle School Science curriculum • Understand how the EDC Year 3 Biology syllabus links to the Lower Middle School Science curriculum	A4.1	A4.1.1	1
	1.2. Working Scientifically	1.2.1. Intended skills in Middle School curriculum (Grades 6-7)	• Identify the scientific skills that need to be developed in the Lower Middle School Science curriculum • Identify the types of scientific investigations in the Lower Middle School Science curriculum • Explain how scientific investigations can support students to develop ways of working scientifically	A2.1 A4.1 A5.2 B1.2	A2.1.1 A4.1.1 A5.2.1 B1.2.3	2

Units	Sub-units	Lessons	Learning outcomes	TCSF		Periods
				Minimum requirements	Indicators	
		1.2.2. ITPR model	• Describe how the ITPR framework improves student learning and teaching quality • Identify ways of reflecting on teaching practice for continuing professional development as a teacher • Map the ITPR model to the Year 3 lesson plan template	D1.1	D1.1.1 D1.1.2	2
2. Living Things	2.1. Living Things	2.1.1. Classify microorganisms	• Categorise the variety of microorganisms according to size, structure, habitat, metabolism and reproduction • Understand the hierarchy of biological classification and identify the kingdoms to which microorganisms belong • Identify the types of non-cellular molecular parasite (viruses) and the diseases they cause • Identify single-celled organisms including amoeba through observation	A2.1 A5.1 B1.2 B3.1	A2.1.1 A5.1.1 A5.1.3 B1.2.1 B1.2.3 B3.1.3	3

Units	Sub-units	Lessons	Learning outcomes	TCSF		Periods
				Minimum requirements	Indicators	
		2.1.2. Classify types of plants (Flowering and non-flowering): Monocot/dicot	• Distinguish between flowering and non-flowering plants • Classify gymnosperms and angiosperms according to their characteristics • Compare monocotyledonous and dicotyledonous based on their characteristics	A2.1 A5.1 B1.2	A2.1.1 A2.1.2 A5.1.1 B1.2.3	2
		2.1.3. Classify types of animals (Vertebrates and invertebrates)	• Classify vertebrates and invertebrates • Design a learning activity for Grade 6/7 students which compares and contrasts vertebrates and invertebrates • Classify the structural and behavioural adaptations of living things	A5.1 B1.1 B1.2 B1.3	A5.1.1 A5.1.3 B1.1.1 B1.2.1 B1.3.3	2
		2.1.4. Life and the characteristics of living things: Plants and animals	• Explain in detail the seven life processes of living things • Develop a teaching resource for Grade 6/7 that explains the life processes of living things • Evaluate different habits including characteristics and the adaptations of plants and animals that allow them to survive in those habitats	A5.1 B1.1	A5.1.1 B1.1.1	2

Units	Sub-units	Lessons	Learning outcomes	TCSF		Periods
				Minimum requirements	Indicators	
	2.2. Structure and Function of Cells	2.2.1. Structure and function of plant cells	• Identify the structures that are found in plant cells using microscopes • Describe the functions of the main/major organelles found in plant cells	A2.1 A5.1 B3.1	A2.1.1 A5.1.1 B3.1.2 B3.1.3	2
		2.2.2. Structure and function of animal cells	• Describe animal cell structures and their functions using a model chart • Develop a teaching resource and assessment tool for Grade 6/7 students to label and identify illustrations of cell structures	A5.1 B3.1 D2.1	A5.1.1 B3.1.2 B3.1.3 D2.1.1	2
		2.2.3. Two types of cell division: Mitosis and meiosis	• Define mitosis and meiosis and identify the stages of each cell division • Develop a learning activity for Grade 6/7 which compares and contrasts mitosis and meiosis	A1.2 A2.1 A5.1	A1.2.2 A2.1.1 A2.1.2 A5.1.1	2
	2.3. Tissues	2.3.1. Plant tissues (Meristematic, simple, and complex)	• Identify different types of plant tissue • Explain meristematic cell division • Describe the components of simple tissue and their functions • Explain the components of complex tissue and their functions	A5.1 B1.2 B3.1	A5.1.1 B1.2.3 B3.1.2 B3.1.3	3

Units	Sub-units	Lessons	Learning outcomes	TCSF		Periods
				Minimum requirements	Indicators	
		2.3.2. Animal tissues	• Examine the different types of animal tissues • Develop a group activity for a Grade 6/7 class to classify the structure and function of each different type of animal tissue • Explain form and structure of epithelial tissue • Describe the different types of connective tissue • Describe the types of muscular tissues in the body • Explain the nervous tissue and identify a reflex arc	A1.1 A1.2 A2.1 A5.1	A1.1.2 A1.2.1 A2.1.1 A5.1.1	3
		2.3.3. Practical (Plant and animal tissue)	• Investigate the dicot stem of plants through dissection and identify parenchyma, collenchyma and sclerenchyma tissue • Identify the structures of epithelial tissue and muscular tissue in animals using microscopy • Collaboratively develop a learning activity for a Grade 6/7 class which focusses on scientific drawings of plant and animal tissues	A5.1 B3.1	A5.1.1 B3.1.3 B3.1.4	2

Units	Sub-units	Lessons	Learning outcomes	TCSF		Periods
				Minimum requirements	Indicators	
	2.4. Organ Systems	2.4.1. Cooperation among organ systems of plants	• Observe and classify the structure and functions of each organ of plants	A5.1 B3.1 B3.2	A5.1.1 B3.1.1 B3.1.2 B3.1.3 B3.2.2	1
		2.4.2. Organs and organ systems of the human body	• List the major organs and organ systems of animals including humans • Describe parts associated with each organ system of humans • Explain the function of each system	A5.1	A5.1.1 A5.1.3	2
		2.4.3. Structure of skin and nervous system of humans	• Collaboratively develop an investigation for a Grade 6/7 class which examines the structure and functions of human skin • Examine the structure and function of the human nervous system	A5.1 B1.1 B1.3	A5.1.1 A5.1.3 B1.1.2 B1.3.1 B1.3.2 B1.3.3 B1.3.4	1
		2.4.4. Interrelationship between systems of the human body	• Describe the importance of the human body systems to work together to maintain homeostasis	A5.1	A5.1.1	1
3. Ecology	3.1. Ecosystems	3.1.1. Ecology and ecosystems	• Define ecosystem and ecology • Describe types of ecosystems and distinguish the various types of ecosystems • Collaboratively develop a learning activity for a Grade 6/7 class which involves investigation of an ecosystem of the local area	A2.1 A5.1 B1.1 D2.1	A2.1.1 A5.1.1 A5.1.3 B1.1.1 D2.1.1	1

Units	Sub-units	Lessons	Learning outcomes	TCSF		Periods
				Minimum requirements	Indicators	
		3.1.2. Relationship between plants and animals in an ecosystem	• Illustrate the cycle/diagram for relationship between plants and animals in their respective area • Explain the relationship between plants and animals • Evaluate the benefits of the relationship between plants and animals	A5.1 B3.1	A5.1.1 B3.1.1 B3.1.3	1
		3.1.3. Energy flows in an ecosystem	• Interpret energy flows in an ecosystem • Discuss the advantages from energy flows in an ecosystem of the student teachers' local area	A5.1	A5.1.1 A5.1.3	1
Total number of periods						36

This course will prepare student teachers with the competencies required to teach the Science subject through modelling the values and attitudes promoted in the basic education curriculum for the types of citizens and society Myanmar envisions to create. Through this course, student teachers will develop essential skills such as science process skills, critical thinking skills, creative and problem-solving skills, questioning skills and collaborative skills. After attaining these skills, they will then be able to apply them with their middle school students in their classrooms and facilitate middle school students' interest and learning of Science. The student teachers will also be equipped with competencies to develop and implement well-designed lessons by linking them with daily life experiences. In addition, student teachers can plan and use various assessment practices integrated with learning activities to check middle school students' understanding and provide feedback. In this course, both subject and pedagogical content knowledge are integrated in the learning of various topics including living things, matter, energy, earth and space, and the environment. With reference to the Education Degree College Curriculum Framework, in Years 1 and 2, student teachers are expected to develop their fundamental knowledge of Science and basic pedagogical knowledge and competencies for teaching Science.

In Years 3 and 4, they will further strengthen deeper understanding of Science subject knowledge and gain a more systematic grasp of the effective implementation of Science curriculum, instruction and assessment.

Learning objectives for middle school students for Science subject

- To understand the fundamental of basic science, basic knowledge of science and explore the scientific philosophy in different levels.
- To develop the skills in scientific processes and apply them in real life situation.
- To understand the works of scientists and have inspiration to do scientific experiments.
- To have understanding about one's body and the environment and able to value and maintain them.
- To understand and appreciate the scientific findings and inventions.
- To increase the interest in science and develop enquiring mind.

The content of this textbook is based on the Myanmar Teacher Competency Standards Framework (TCSF) which articulates the expectations for what you should know and be able to do in the classroom. The teacher competencies in focus for the Biology subject include:

Table B. Teacher competencies in focus: Year 3 Biology, Middle school specialisation track

Competency standard	Minimum requirements	Indicators
A1: Know how students learn	A1.1 Demonstrate understanding of how students learn relevant to their age and developmental stage	A1.1.2 Prepare learning activities to align with students' level of cognitive, linguistic, social, and physical development
	A1.2 Demonstrate understanding of how different teaching methods can meet students' individual learning needs	A1.2.1 Identify various teaching methods to help students with different backgrounds (gender, ethnicity, culture) and abilities, including special learning needs, learn better A1.2.2 Identify focused and sequenced learning activities to assist students to link new concepts with their prior knowledge and experiences
A2: Know appropriate use of educational technologies	A2.1 Demonstrate understanding of appropriate use of a variety of teaching and learning strategies and resources	A2.1.1 Plan learning experiences that provide opportunities for student collaboration, inquiry, problem-solving and creativity A2.1.2 Use teaching methods, strategies and materials as specified in the textbooks and additional low cost support materials, to support student learning
A4: Know the curriculum	A4.1 Demonstrate understanding of the structure, content and expected learning outcomes of the basic education curriculum	A4.1.1 Describe key concepts, content, learning objectives and outcomes of the lower secondary curriculum for the subjects and grade level/s taught A4.1.2 Prepare lesson plans reflecting the requirements of the curriculum and include relevant teaching and learning activities and materials A4.1.3 Describe the assessment principles underpinning the Lower Secondary curriculum
A5: Know the subject content	A5.1 Demonstrate understanding of the subject matter to teach the assigned subject/s for the specified grade level/s	A5.1.1 Describe key concepts, skills, techniques and applications for the subjects covered in the grade levels taught A5.1.3 Link key concepts, principles and theories to real life applications to build discipline specific foundations and skills for different classes and grade levels taught
	A5.2 Demonstrate understanding of how to vary delivery of subject content to meet students' learning needs and the learning context	A5.2.1 Describe ways to contextualise learning activities for the age, language, ability and culture of students to develop understanding of subject related principles, ideas and concepts A5.2.3 Describe approaches to model the use of content specific language, technical terms and skills by providing examples of use in real life contexts

Competency standard	Minimum requirements	Indicators
B1: Teach curriculum content using various teaching strategies	B1.1 Demonstrate capacity to teach subject-related concepts clearly and engagingly	B1.1.1 Use different ways to explain the subject matter, related ideas and concepts to meet a range of learning abilities and intended learning outcomes B1.1.2 Select instructional material to link learning with students' prior knowledge, interests, daily life and local needs
	B1.2 Demonstrate capacity to apply educational technologies and different strategies for teaching and learning	B1.2.1 Use teaching methods and learning strategies appropriate for the class – culture, size and type B1.2.3 Create opportunities for students to investigate subject-related content and concepts through practical activities
	B1.3 Demonstrate good lesson planning and preparation in line with students' learning ability and experience	B1.3.1 Plan and structure lesson to ensure all the lesson time is used effectively B1.3.2 Provide lesson introductions to link new learning to prior learning, to engage students' interest and to motivate them in learning B1.3.3 Prepare focused and sequential learning experiences that integrate learning areas and are responsive to students' interests and experience B1.3.4 Use questioning techniques and examples, to introduce and illustrate concepts to be learnt
B2: Assess, monitor and report on students' learning	B2.1 Demonstrate capacity to monitor and assess student learning	B2.1.1 Use assessment techniques as part of lessons to support students to achieve learning outcomes
	B2.2 Demonstrate capacity to keep detailed assessment records and use the assessment information to guide students' learning progress	B2.2.2 Use varied assessment practices to monitor and record students' learning progress and inform further planning of the curriculum
B3: Create a supportive and safe learning environment for students	B3.1 Demonstrate capacity to create a safe and effective learning environment for all students	B3.1.1 Use space and classroom materials and resources to ensure involvement of all students in learning activities B3.1.2 Encourage students to interact with each other and to work both independently and in teams B3.1.3 Model and promote good health and safety practices to ensure students' wellbeing and safety within the classroom and school B3.1.4 Follow regulations regarding health and safety (administration of medication, CPR and First Aid training, fire and disaster drills, abuse and neglect, communicable disease)
	B3.2 Demonstrate strategies for managing student behaviour	B3.2.2 Encourage students to interact with each other with mutual respect and safety

Competency standard	Minimum requirements	Indicators
D1: Reflect on own teaching practice	D1.1 Regularly reflect on own teaching practice and its impact of student learning	D1.1.1 Use evidence of students learning to reflect on the impact of own teaching practice D1.1.2 Use information from a variety of sources to improve teaching practice and student learning
D2: Engage with colleagues in improving teaching practice	D2.1 Improve own teaching practice through learning from other teachers and professional development opportunities	D2.1.1 Discuss teaching practices with supervisors and colleagues, and willingly seek constructive feedback

Source: Myanmar Teacher Competency Standards Framework (TCSF) - Beginning Teachers, 2020, pp. 109 – 140

How do I use this textbook?

You can use this textbook both for your own self-study and as an in-class resource for learning activities facilitated by your teacher educator. Each unit in the textbook includes:

Expected learning outcomes: These are listed at the beginning of each unit and at the beginning of each lesson. The expected learning outcomes indicate what you should know and be able to do by the end of the lesson or unit.

Competencies gained: This list of the selected Teacher Competency Standards Framework (TCSF) competencies are what you should know and be able to do by the end of the lesson or unit as a beginning teacher.

Learning content: The learning content for each unit is broken down into sub-units and lessons that cover subject content knowledge that is important for teachers to know.

Learning activities: The learning activities included in the textbook are individual activities that you can do to help reinforce and deepen your knowledge and understanding of a topic. Your teacher educator will also facilitate learning activities during class. These may be individual, partner, small group, or whole class activities designed to help you achieve the learning outcomes for each lesson.

Review questions: You can use the unit review questions to test your own understanding of the unit content, or to help you study for an exam.

Key messages: At the end of the unit, under Unit Summary, there is a brief summary of the main points of the unit to help you review and remember the most important information.

Unit reflection: Taking the time to deliberately think about, or reflect, on what you have learnt will help you remember and apply that learning, and make connections with other subject areas and real-life. Each unit ends with some suggestions on how you can reflect and follow-up on what you have learnt in the unit.

Further reading: Each unit lists suggestions of additional resources on the topic. You can look these up in the library, on the internet, or in your Education Degree College's e-library to learn more about the topic.

Key terms: Important words or concepts from the Unit that are highlighted in the beginning of each Unit.

At the end of this textbook, you will find a **Glossary** with the definitions of these key words found throughout the textbook that might be new to you. These words are listed in alphabetical order. You will also find a list of all the **Bibliography**, which are the original sources of information used throughout the textbook.

Remember, your teacher educator is there to help facilitate your learning in this module. If there is material you do not understand in the textbook, be sure to ask your teacher educator, or your classmates, for help. As a student teacher, you are part of a community of collaborative learning within your Education Degree College as you work – together with your peers and guided by your teacher educators – to earn your teaching qualification.

Unit 1

Methodology

In this unit, you will explore how the Education Degree College Year 3 Biology syllabus links to the Biology strand within the Basic Education Grades 6 and 7 Science curriculum. You will learn about ways of working scientifically and identify effective pedagogical practices that support students to learn Science in relevant ways connected to their daily life experiences. You will use the framework of Introduce-Teach-Practice-Repeat (ITPR) to develop effective strategies to improve student learning and teaching quality and reflect on your own teaching practice for ongoing professional development.

Expected learning outcomes

By the end of this unit, you will be able to:

- Identify the learning objectives and content focus of the Biology unit within the Lower Middle School Science curriculum;
- Understand how the EDC Year 3 Biology syllabus links to the Lower Middle School Science curriculum;
- Identify the scientific skills that need to be developed in the Lower Middle School Science curriculum;
- Identify the types of scientific investigations in the Lower Middle School Science curriculum;
- Explain how scientific investigations can support students to develop ways of working scientifically;
- Describe how the ITPR framework improves student learning and teaching quality;
- Identify ways of reflecting on teaching practice for continuing professional development as a teacher; and
- Map the ITPR model to the Year 3 lesson plan template.

Competencies gained

A2.1 Demonstrate understanding of appropriate use of a variety of teaching and learning strategies and resources

A4.1 Demonstrate understanding of the structure, content and expected learning outcomes of the basic education curriculum

A5.2 Demonstrate understanding of how to vary delivery of subject content to meet students' learning needs and learning context

B1.2 Demonstrate capacity to apply educational technologies and various strategies for teaching and learning

D1.1 Regularly reflect on own teaching practice and its impact on student learning

Key terms

Biology, concept map, critique, curriculum, inquiry, peer-reflection, self-reflection, syllabus

1.1. Overview of Middle School Biology

In this sub-unit, you will develop an understanding of how the Education Degree College Year 3 Biology syllabus links to the Basic Education Science curriculum.

1.1.1. Introduction to Middle School Biology

Expected learning outcomes

By the end of this lesson, you will be able to:

- Identify the learning objectives and content focus of the Biology strand within the Lower Middle School Science curriculum; and
- Understand how the EDC Year 3 Biology syllabus links to the Lower Middle School Science curriculum.

Learning activity 1. Think-pair-share: Teaching science

The purpose of this learning activity is to reflect on your motivation to become a teacher and the factors that influenced your choice of specialisation track.

Your teacher educator will ask you to reflect on your motivations.

You will be asked to join with another student teacher and share some of your reflection and motivations. The other student teacher will share their motivations with you.

You do not need to share personal or private information. Some of your **self-reflection**, you may choose not to share with others. Share only what you are comfortable with others knowing.

Consider using some, or all, of the following questions as prompts for your self-reflection:

What are your most important reasons for wanting to become a teacher?
Why did you choose a middle year specialisation track?
Why did you choose Biology as a specialist subject area?
What skills do you think are needed for this subject?
What are your personal strengths and how do they align with your subject choices?

Learning activity 2. Concept map: Biology

The purpose of this learning activity is for you to construct a **concept map** linking core themes from the Biology strand in the Grades 6 and 7 Science curriculum and from the Education Degree College Year 3 Biology syllabus.

A concept map is a way of organising information to show the relationships between concepts.

In this learning activity, you will work with a small group of student teachers to construct a concept map linking core themes from the:

- Biology strand/s in the Basic Education Grades 6 and 7 Science curriculum, and
- EDC Year 3 Biology syllabus.

Place "Biology" at the centre of your concept map. Refer to the Grades 6 and 7 Science curriculum documents to identify the areas of Biology that are taught within lower middle school Science. Add these areas to their concept map.

Consult the EDC Year 3 Biology content map and student teacher textbook to explore the topics in more detail.

As they explore the content of the textbook, add the topics and content to the concept map to show where they connect with the Grades 6 and 7 Science curriculum.

Add your own ideas of topics within an area of Biology to the concept map. This is an opportunity to show what you already know and understand about Biology in the Science curriculum.

Highlight these topics with illustrations, images and words that give specific examples. Where possible, these examples should be related to your lives and local area.

When you have finished the concept map with your group, you might want to take a photo to remember how the Year 3 Biology syllabus links to the lower middle Science curriculum.

Review questions

1. Why is it important to connect the topics of the Biology strand within the Grades 6 and 7 Science curriculum with real-life examples for students?
2. How do activities such as concept mapping support student learning?

1.2. Working Scientifically

In this sub-unit, you will explore the Middle School Science curriculum and identify the opportunities for developing students' ways of working scientifically. You will critique classroom scenarios to distinguish different types of scientific inquiry and identify opportunities within a lesson to develop students' scientific skills. You will explore the Introduce-Teach-Practice-Repeat (ITPR) framework and how the framework supports student learning and teacher capacity.

1.2.1. Intended skills in Middle School curriculum (Grades 6-7)

Expected learning outcomes

By the end of this lesson, you will be able to:

- Identify the scientific skills that need to be developed in the Lower Middle School Science curriculum;
- Identify the types of scientific investigations in the Lower Middle School Science curriculum; and
- Explain how scientific investigations can support students to develop ways of working scientifically.

Period 1

Introduction: What science can you see?

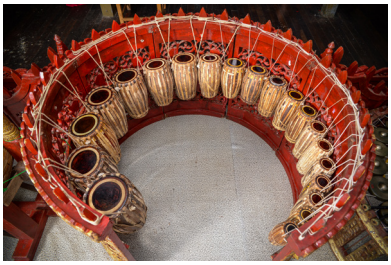
A barrier that can contribute to a student's lack of interest in science or lack of motivation to learn science is the perception that the science topic is not of relevance to them. If a student can see how a topic is of relevance to them and their future aspirations or even if they just consider it useful, they will be more motivated to learn. A teacher must consider the relevance of a topic to their learners and, if necessary, find an innovative way to make it relevant.

When your teacher educator asks: “Look at the images that are presented. What science is shown in the images?”, contribute your ideas to the discussion.

As a teacher, you will need to find ways to connect science with the everyday lives of students and their interests.

Use this activity as a challenge to think diversely about science and how it is represented.

Table 1.1. Science in everyday life

Activity	Science
 A player keeping the ball in the air in chinlone[1]	**What science can you see?**
 Pat waing	**What science can you see?**

1 https://www.flickr.com/photos/21160385@N02/11772806234 “Young men playing chin lone (Myanmar 2013)” by Paul Arps is licensed under CC BY 2.0. View license: https://creativecommons.org/licenses/by/2.0/

Activity	Science
 Rice paddy[2]	**What science can you see?**

Learning activity 1. Pairs: Scientific skills in the Middle School Science curriculum

The purpose of this learning activity is for you to identify the scientific skills in the middle school curriculum and map the skills to the process of **scientific inquiry**.

When your teacher educator instructs you to, use the Grades 6 and 7 Science curriculum to identify the scientific skills. Work with another student teacher to make a list of the skills (cognitive verbs) that you can identify.

Write these in the first column in the table.

Table 1.2. Scientific skills in the Grades 6 and 7 Science curriculum

Scientific skills	Stage of inquiry	Questions to build student capability to work scientifically

2 https://commons.wikimedia.org/wiki/File:Paddy_Planting.JPG "Paddy planting" by Skrissh2013 is licensed under CC Attribution-Share Alike 3.0 Unported license. View license: https://creativecommons.org/licenses/by-sa/3.0/

Scientific skills	Stage of inquiry	Questions to build student capability to work scientifically

Once you have constructed a list of scientific skills, look at the figure that shows a model for working scientifically.

This model shows a process of scientific inquiry that begins with a problem and requires scientific investigation to obtain answers. The model shows a general plan that can be followed, but it is not always a linear flow. This is important for students to understand. Scientific investigation may require refinement or further investigation when answers cannot be concluded. For example, a plan may need to be modified if the desired equipment is not available.

Look at your list of scientific skills. Can you use the model of working scientifically to determine where these skills can be developed?

Classify the skills into the planning, conducting, evaluating or processing stages of working scientifically and add this information to the second column in the table.

There may be more than one alignment of a skill in the working scientifically model.

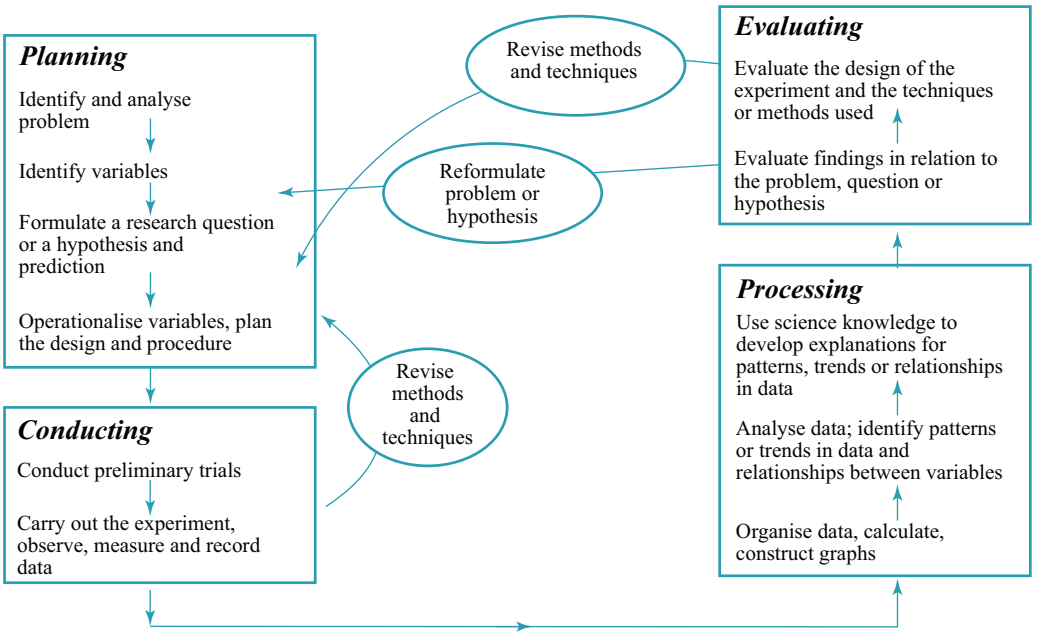


Figure 1. A model of science investigation processes (Hackling & Fairbrother, 1996)

Figure 1.1. Working scientifically[3]

After you have identified where the scientific skills can be developed, you will need to have open-ended questions that can guide students in a Grade 6/7 class to build their capability to work scientifically.

Your teacher educator will give you an example of questions aligned to the model of working scientifically.

You need to construct a list of open-ended scientific questions for each of the scientific skills that will be useful in helping students in a Grade 6/7 classroom to work scientifically.

3 Western Australia Department of Education and Training. (2005). *Working scientifically: Implementing and assessing open investigation work in Science*. http://www.watersciencelab.com.au/assets/working-scientifically_by-mark-hackling-2005.pdf

Period 2

Scientific investigations

Learning activity 2. Case study: Types of scientific investigations

The purpose of this lesson is for you to identify types of scientific investigations and explain how these can support students' capability to work scientifically.

You will work in a group to discuss a classroom scenario. Your group will be assigned one of the following scenarios to discuss and present to the class.

The scenarios are included in your textbook for you to read and consider in your development as a teacher. However, you will only discuss and present one scenario in this learning activity.

With your group, discuss and respond to the following:

- What is the content of the lesson?
- What role does the teacher have in the lesson?
- What role/s do the students have in the lesson?
- Is this a type of scientific inquiry?

You will present your discussion briefly to the class.

Scenario 1: Is it scientific inquiry?[4]

Scenario #1 A watering can is in a classroom. The can was almost full on Friday and almost empty on Monday. A student asked what happened to the water in the watering can. One student proposed that the pet hamster left his cage at night and drank the water. The teacher encouraged the students to find a way to test this idea. The students devised a test in which they covered the water so Willie the hamster could not drink it. Over several days, they observed that the water level did not drop. The teacher then challenged the students to think about other explanations. The students' questions resulted in a series of full investigations about the disappearance of water from the container.
Content/topic of lesson:
Teacher role:
Student role:
Is this scientific inquiry? Why/why not?

4 Biological Sciences Curriculum Study. (2006).

Scenario 2: Is it scientific inquiry?[5]

Scenario #2 Students investigated batteries and light bulbs to learn about electricity. The teacher gave teams of students a battery, a light bulb and a piece of wire. To begin, the teacher told the students to use the materials and "light the bulb". In time, the student teams lit the bulb and made observations about the arrangement of the battery, the wire and the bulb. The teacher then provided more batteries, wires, small buzzers and other materials and asked the students to explore various arrangements and see what they could learn. As the students continued their activity, the teacher pointed out certain results of their battery, bulb, wire and buzzer systems. After several days of exploration with the materials, the teacher introduced the ideas about electrical circuits and transfer of energy.
Content/topic of lesson:
Teacher role:
Student role:
Is this scientific inquiry? Why/why not?

5 Biological Sciences Curriculum Study. (2006).

Scenario 3: Is it scientific inquiry?[6]

Scenario #3 Students were provided with several short stories about scientists and their work. Over a three-week period, every student read one of the stories as homework. Then, in groups of three, all student groups discussed and answered the same questions: "What questions did the scientist ask?", "What type of investigations did the scientist conduct?", "What instruments and equipment did the scientist use?" and "How did the scientist use observations to answer his or her questions?". After reading the stories and completing the discussion questions, the teacher had the groups prepare oral reports on the topic: "How scientists do their investigations".
Content/topic of lesson:
Teacher role:
Student role:
Is this scientific inquiry? Why/why not?

6 Biological Sciences Curriculum Study. (2006).

Scenario 4: Is it scientific inquiry?[7]

Scenario #4 A student asked why the plants on the windowsill all seemed to be facing the window. The plants had been pointing toward the classroom on Friday, but by Monday, all the leaves and flowers were facing away from the classroom. One student proposed that the teacher had turned all the plants around on Monday morning. The teacher indicated that this had not been done and encouraged the students to ask other questions that they could test. Eventually, the students decided to find out if the plants could follow the light. The students devised a test in which they covered half the plants for several days and turned the other half back toward the classroom. Over several days, they observed that the uncovered plants turned back to the window, but the covered plants did not.
Content/topic of lesson:
Teacher role:
Student role:
Is this scientific inquiry? Why/why not?

7 Biological Sciences Curriculum Study. (2006).

Scenario 5: Is it scientific inquiry?[8]

Scenario #5 Students investigated fossils to learn about biological evolution. The teacher distributed two similar but slightly different moulds with dozens of brachiopod fossils. The students measured the lengths and widths of the two populations of brachiopods. The teacher asked if the differences in length and width might represent evolutionary change. As the students responded, the teacher asked, "How do you know?", "How could you support your answer?", "What evidence would you need?", "What if the fossils were in the same rock formation?", "Are the variations in length and width just normal variations in the species?" and "How would a difference in length or width help a brachiopod adapt better?". Students learnt about changes in the variations of characteristics in a population: biological evolution.
Content/topic of lesson:
Teacher role:
Student role:
Is this scientific inquiry? Why/why not?

8 Biological Sciences Curriculum Study. (2006).

Learning activity 3. Group work: Modify a learning activity

The purpose of this learning activity is to analyse a lesson and suggest modifications that would better support students to develop ways of working scientifically.

Table 1.3 shows some shifts in the classroom towards an inquiry-based learning approach.

Table 1.3. Scientific inquiry in the classroom[9]

Scientific inquiry in the classroom	
Less emphasis on …	**More emphasis on …**
Activities in which the aim/hypothesis, method and data to be collected are clearly prescribed	Context meaningful to students' experience and interest
Activities that demonstrate and verify science content	Activities in which students pose questions to be answered, design investigative procedures and decide on data to be collected, plus student-devised explanations based on evidence
Guided interpretation of expected results	Open-ended activities that investigate relevant questions and student-devised explanations based on evidence
Teachers presenting science by talk, text and demonstration	Students choosing how to represent data and communicate findings
Assessment of recall of terms and facts	Assessment based on elements of the inquiry-based activities
End-of-topic tests for grading and reporting	Ongoing assessment of student work for diagnostic, formative and summative purposes

You will work in a small group to **critique** the lesson about organisms in pond water. A table with some criteria will help with your analysis.

Then, you need to suggest modifications to the lesson that will better support students to develop ways of working scientifically, using the lesson about organisms in pond water.

9 Science by Doing. (2021).

Table 1.4. Lesson: Organisms in pond water

Organisms in pond water	
Learning objectives	• Use microscopes to observe organisms in pond water • Observe and draw the organisms found in pond water
Materials	• Pre-prepared, labelled slides of pond organisms • Microscopes • Science books • Pencils and erasers
Lesson	• Ask students to work in pairs • Direct students to collect and set up a microscope • Give each student pair a set of pre-prepared, labelled slides • Give students time to observe the organisms on the slides • Ask students to draw a labelled diagram of what they see on each slide

Table 1.5. Analysis and modifications

	Yes/ No	Suggested modification
Is the context relevant to the students?		
Are students likely to become engaged in the lesson and ask questions to be explored?		
Is there the opportunity for data collection?		
Are students given the opportunity to discuss findings or ideas?		
Does the lesson help students develop an understanding of the scientific content?		
Do students have opportunities to communicate/present their ideas?		
Is there the opportunity to provide students with feedback?		
Is the lesson likely to stimulate new ideas or questions about the topic?		
Will the lesson identify any scientific misconceptions?		

1.2.2. ITPR model

Expected learning outcomes

By the end of this lesson, you will be able to:

- Describe how the ITPR framework improves student learning and teaching quality;
- Identify ways of reflecting on teaching practice for continuing professional development as a teacher; and
- Map the ITPR model to the Year 3 lesson plan template.

Period 1

Mapping the lesson plan to the ITPR framework

Introduction

The next two periods will focus on lesson structure and reflection tools.

To do this effectively, you need to develop a lesson that can be evaluated using these tools.

You have already analysed a classroom lesson about pond organisms and identified modifications that could be made to make the lesson more aligned with ways of working scientifically.

Use this analysis as the basis for a lesson.

Use the lesson plan template in Annex 1 to develop a lesson.

Learning activity 1. Directed learning and pairs: Evaluate a learning activity

The purpose of this learning activity is to evaluate and map your lesson plan to the ITPR framework.

Your teacher educator will facilitate a discussion about the ITPR framework. Contribute to the discussion by sharing what you remember or what you know about the framework.

After the discussion, review the lesson you have developed. Identify aspects of the lesson and align the structure to the ITPR framework. You might need to make additional notes about where opportunities exist to refine the lesson, based on the ITPR framework.

Brainstorm with a partner to identify how the ITPR framework improves:

- student learning, and
- teaching quality.

Table 1.6. ITPR framework

Impact on student learning	Impact on teaching quality

Period 2

Reflection on teaching practices

Teacher Competency Standards Framework (TCSF)

This period will focus on ways of reflecting on teaching practice for continuing professional development as a teacher.

The importance of reflective practice for teachers:

- Reflective practice develops a teacher's ability to understand how their students learn and the best ways to teach them.
- By reflecting on their teaching, teachers will identify any barriers to learning that students have.
- Teachers can then create lessons which reteach any content which students have not been able to access, to allow them to overcome any obstacles and develop.
- Being reflective will make sure teachers develop a wider range of skills as they find new ways to teach.
- This will develop confidence in the classroom as teachers find the best ways to deliver knowledge of a subject.

Reflection is an important part of the TCSF.

Table 1.7. Domain D: Professional growth and development

This domain deals with teachers' continuing professional growth and development. It incorporates teachers' habits, motivation and actions related to their ongoing learning and professional improvement. It advocates the importance of all teachers being aware of their role as leaders within the community and highlights the need for active research to support teachers' classroom performance and continuing professional development.	
Competency standard D1: Reflect on own teaching practice	
Minimum requirements	**Indicators**
D1.1 Regularly reflect on own teaching practice and its impact on student learning	D1.1.1 Use evidence of students learning to reflect on the impact of own teaching practice D1.1.2 Use information from a variety of sources to improve teaching practice and student learning D1.1.3 Regularly reflect on a wide range of actions and experiences to identify areas for own continuous professional development as a teacher
Competency standard D2: Engage with colleagues in improving teaching practice	
Minimum requirements	**Indicators**
D2.1 Improve own teaching practice through learning from other teachers and professional development opportunities	D2.1.1 Discuss teaching practices with supervisors and colleagues, and willingly seek constructive feedback D2.1.2 Participate in professional development activities relating to identified goals for improving practice D2.1.3 Establish goals for own professional development as a teacher D2.1.4 Participate in professional activities conducted by school clusters and recognised professional associations
Competency standard D3: Participate in professional learning to improve teaching practice	
Minimum requirements	**Indicators**
D3.1 Demonstrate understanding of the importance of inquiry and research-based learning to improve teaching practice	D3.1.1 Identify relevant professional learning material to improve own practice D3.1.2 Search and analyse online or offline information on current trends and research based practices in lower secondary education and for specific subjects taught to improve own content knowledge and teaching practice

Learning activity 2. Directed learning and pairs: Reflection of learning activity

The purpose of this learning activity is to have the opportunity for **self-** and **peer-reflection** on your lesson plan.

After you have completed the self-reflection, consider student-reflection. Write some ideas in Table 1.8 that would provide you with feedback from a student perspective.

Table 1.8. Lesson reflection

Self-reflection	
How have you addressed prior learning? How will you identify misconceptions? Have you provided student-centred opportunities? What do you think will work well? What might be challenging? How have you addressed students with special needs? How have you differentiated learning activities for various student abilities? How have you connected with students' everyday life or experiences? Do the learning outcomes align with the activities? Do you think students will find this engaging? How will you assess student learning? How will you provide feedback to students?	
Student-reflection	
Identify some questions or activities that you could use to obtain student feedback.	
Peer-reflection	
Can you make suggestions to improve the teaching or learning opportunities? What do you think is done well in the lesson? Where do you think the challenges might exist in delivering this lesson? How could those challenges be overcome? Do you think students will find this engaging and relevant to their lives? Provide other comments as necessary.	

Review questions

1. How does inquiry-based learning help students develop scientific skills?
2. What is the purpose of the TCSF?
3. How do self- and peer-reflection improve teaching practice?

Unit Summary

Key messages

- Working scientifically is an active process of questioning, planning, and performing investigations, then analysing and communicating findings.
- Scientific inquiry can take many forms, including research, practical activities and observation.
- Introduce-Teach-Practice-Review is a framework to improve student learning and teacher practice but is not always a linear process.
- The Teacher Competency Standards Framework describes key attributes of good teaching and what is expected of teachers' professional practice.
- The TCSF is a tool for teachers in their continuing professional development and achievement of quality in professional practice.
- Peer- and self-reflection are important aspects of ongoing teacher professional development.

Unit reflection

Construct a concept map showing the links between the lower middle school Science curriculum, opportunities to work scientifically, and the Teacher Competency Standards that can be developed through these teaching and learning practices.

Further reading

1.1. Overview of Middle School Biology

Australian Council for Educational Leaders. (2016). *Authentic learning: What, why and how?* http://www.acel.org.au/acel/ACEL_docs/Publications/e-Teaching/2016/e-Teaching_2016_10.pdf

1.2. Working Scientifically

Biological Sciences Curriculum Study. (2006). *Why does inquiry matter? Because that's what Science is all about!* Iowa, US: Kendall/Hunt Publishing Company. http://www2.virginia.edu/blandy/blandy_web/education/Bay/Why_Inquiry_Matters_BSCS.pdf

Hackling, M. W., Smith, P., & Murcia, K. (2010). Talking Science: Developing a discourse of inquiry. *Teaching Science*, *56*(1), 17–22.

Kang, J., & Keinonen, T. (2018). The effect of student-centered approaches on students' interest and achievement in Science: Relevant topic-based, open and guided inquiry-based, and discussion-based approaches. *Research in Science Education*, *48*(4), 865–885.

Western Australia Department of Education and Training. (2005). *Working scientifically: Implementing and assessing open investigation work in Science.* http://www.watersciencelab.com.au/assets/working-scientifically_by-mark-hackling-2005.pdf

Unit 2

Living Things

In this unit, you will explore the biology of living things. You will investigate microorganisms, plants and animals and how living things are classified by their relatedness. You will develop skills in microscopy as they examine the structures of plant and animal tissues, and build your capacity to develop learning activities for these concepts suitable for Grade 6 and 7 students. You will have the opportunity to participate in hands-on scientific investigations to identify the structures of plant and animal cells and tissues and connect the structures with functions and life processes. You will work from cells to tissues to organs to organ systems, developing an understanding of how these systems function together and how homeostasis is maintained.

Expected learning outcomes

By the end of this unit, you will be able to:

- Categorise the variety of microorganisms according to size, structure, habitat, metabolism and reproduction;
- Understand the hierarchy of biological classification and identify the kingdoms to which microorganisms belong;
- Identify the types of non-cellular molecular parasite (viruses) and the diseases they cause;
- Identify single-celled organisms including amoeba through observation;
- Distinguish between flowering and non-flowering plants;
- Classify gymnosperms and angiosperms according to their characteristics;
- Compare monocotyledonous and dicotyledonous based on their characteristics;
- Classify vertebrates and invertebrates;
- Design a learning activity for Grade 6/7 students which compares and contrasts vertebrates and invertebrates;

- Classify the structural and behavioural adaptations of living things;
- Explain in detail the seven life processes of living things;
- Develop a teaching resource for Grade 6/7 that explains the life processes of living things;
- Evaluate different habits including characteristics and the adaptations of plants and animals that allow them to survive in those habitats;
- Identify the structures that are found in plant cells using microscopes;
- Describe the functions of the main/major organelles found in plant cells;
- Describe animal cell structures and their functions using a model chart;
- Develop a teaching resource and assessment tool for Grade 6/7 students to label and identify illustrations of cell structures;
- Define mitosis and meiosis and identify the stages of each cell division;
- Develop a learning activity for Grade 6/7 which compares and contrasts mitosis and meiosis;
- Identify different types of plant tissue;
- Explain meristematic cell division;
- Describe the components of simple tissue and their functions;
- Explain the components of complex tissue and their functions;
- Examine the different types of animal tissues;
- Develop a group activity for a Grade 6/7 class to classify the structure and function of each different type of animal tissue;
- Explain form and structure of epithelial tissue;
- Describe the different types of connective tissue;
- Describe the types of muscular tissues in the body;
- Explain the nervous tissue and identify a reflex arc;
- Investigate the dicot stem of plants through dissection and identify parenchyma, collenchyma and sclerenchyma tissue;
- Identify using microscopy the structures of epithelial tissue and muscular tissue in animals;
- Collaboratively develop a learning activity for a Grade 6/7 class which focusses on scientific drawings of plant and animal tissues;
- Observe and classify the structure and functions of each organ of plants;
- List the major organs and organ systems of animals including humans;
- Describe parts associated with each organ system of humans;
- Explain the function of each system;
- Collaboratively develop an investigation for a Grade 6/7 class which examines the structure and functions of human skin;

- Examine the structure and function of the human nervous system; and
- Describe the importance of the human body systems to work together to maintain homeostasis.

Competencies gained

A1.1 Demonstrate understanding of how students learn relevant to their age and developmental stage

A1.2 Demonstrate understanding of how different teaching methods can meet students' individual learning needs

A2.1 Demonstrate understanding of appropriate use of a variety of teaching and learning strategies and resources

A5.1 Demonstrate understanding of the subject matter to teach the assigned subject/s for the specified grade level/s

B1.1 Demonstrate capacity to teach subject-related concepts clearly and engagingly

B1.2 Demonstrate capacity to apply educational technologies and different strategies for teaching and learning

B1.3 Demonstrate good lesson planning and preparation in line with students' learning ability and experience

B3.1 Demonstrate capacity to create a safe and effective learning environment for all students

B3.2 Demonstrate strategies for managing student behaviour

D2.1 Improve own teaching practice through learning from other teachers and professional development opportunities

Key terms

Algae, anaphase, angiosperms, amoeba, amyloplast, archaea, bacteria, behavioural adaptations , cell membrane, cell wall, chloroplast, collenchyma, connective tissue, cytokinesis, cytoplasm, dicotyledonous, endoplasmic reticulum, epidermis, epithelial tissue, eukaryotes, fungi, Golgi apparatus, gymnosperms, habitat, helminth, homeostasis, interphase, invertebrates, living, meiosis, metaphase, metabolism, microorganisms, microscope, mitochondria, mitosis, monocotyledonous, muscular tissues, non-living, nucleolus, nucleus, organ, organelle, parasites, parenchyma, peroxisome, phloem, prometaphase, prophase, protozoa, reflex, ribosomes, sclerenchyma, structural adaptations, telophase, tissue, vacuole, vertebrates, viruses, xylem, yeast

2.1. Living Things

In this sub-unit, you will explore living organisms including microorganisms, plants and animals. You will investigate ways that living things are classified and grouped. You will have the opportunity to deepen your knowledge and skills in working scientifically through inquiry activities including research tasks and practical investigations. You will work collaboratively to design and evaluate learning activities suitable for use in a Grade 6/7 classroom.

2.1.1. Classify microorganisms

Expected learning outcomes

By the end of this lesson, you will be able to:

- Categorise the variety of microorganisms according to size, structure, habitat, metabolism and reproduction;
- Understand the hierarchy of biological classification and identify the kingdoms to which microorganisms belong;
- Identify the types of non-cellular molecular parasite (viruses) and the diseases they cause; and
- Identify single-celled organisms including amoeba through observation.

Period 1

Microorganisms

Microorganisms are classified into seven main types: **bacteria, archaea, protozoa, algae, fungi, viruses** and **helminths** (multicellular parasites). Each type has features including cellular composition, morphology, motion and reproduction that are characteristic to that type. The term "microorganism" technically refers to organisms that are too small to be seen by the naked eye. However, exceptions exist, including some organisms that can be seen without magnification but are classified as microorganisms due to their relationship with other microorganisms.

Bacteria are found in many **habitats** on Earth and differ widely in their shape, metabolic activities and nutritional requirements. Bacteria are **unicellular, prokaryotic** organisms that lack a nucleus.

Bacteria can be divided into two sub-groups: **gram-positive** and **gram-negative**. The distinction is based on the differences in cell-wall structure, with gram-positive bacteria having cell walls composed of thick layers of **peptidoglycan** and gram-negative bacteria having only a thin layer of peptidoglycan. This difference produces various results on a Gram stain reaction. Many bacteria are harmless or helpful, but some are pathogens which cause disease.

Archaea are also unicellular, prokaryotic organisms but differ from bacteria in their evolutionary history, genetics, metabolism and cell-wall composition. Archaea are found in a wide range of habitats, but none are known to be pathogens.

Protozoa are unicellular, aerobic eukaryotes with cell walls composed of cellulose. They are found in moist habitats including freshwater and saltwater environments. In dry conditions, they can become dormant and survive for long periods of time until they have access to water again. They are motile and have various means of locomotion, depending on their cellular structures.

Algae are unicellular or multicellular organisms found in aquatic environments. Their cells are surrounded by cell walls made of cellulose. Algae contain chlorophyll that allows them to make their own food by photosynthesis.

Fungi include **yeasts**, moulds and mushrooms. They are eukaryotic cells with a true nucleus that can be multicellular (mushrooms and moulds) or unicellular (yeasts). Fungi have a cell wall that contains chitin. The fungi are classified as a kingdom that is separate to other eukaryotic kingdoms. Fungi have varied ecologies, morphologies and life cycles and acquire food by absorbing dissolved molecules.

Viruses are not considered to be living organisms. They are non-cellular and consist of a nucleic acid core surrounded by a protective coat called a capsid. Viruses are only active inside a living cell (called a host cell). They are not able to reproduce and are not metabolically active outside a host cell.

Helminths can be seen without microscopy at some stages of their life cycles but are

classified as microorganisms as part of their life cycle involves microscopic eggs and larvae. Helminths are multicellular, parasitic worms that survive by obtaining nourishment and protection from a living host.

Learning activity 1. Gallery walk: Types of microorganisms

The purpose of this learning activity is to build your understanding about the different types of microorganisms through collaborative research and knowledge sharing. Your teacher educator will give you a topic to research – bacteria, viruses, fungi or parasites (protozoa and helminths).

With your group, produce a poster detailing information about the type of microorganism you have been given. Include in your poster information about:

- Morphology (appearance) including size
- Cellular composition
- Locomotion
- Metabolism
- Reproduction
- Any advantages
- Any disadvantages
- Include an interesting example

Display your group's poster and conduct a gallery walk to learn about the research findings on other types of microorganisms from the different groups.

Learning activity 2. Group work: Planning scientific inquiry

The purpose of this learning activity is to plan a scientific inquiry to investigate yeast **metabolism.** This is an example of an activity that could be carried out with middle school students.

Background information

Yeast are fungi that are used in the manufacture of many food products, such as bread. In the presence of oxygen, yeast undergo aerobic respiration and convert sugars into carbon dioxide gas and water. The production of carbon dioxide gas is what causes bread to rise.

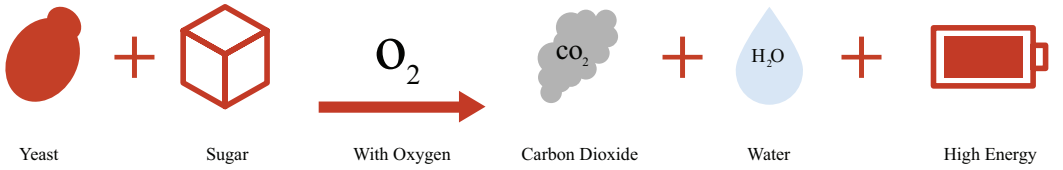


Figure 2.1. Aerobic respiration of yeast

In the next period, you will conduct the practical investigation to observe the metabolism of sugar by yeast. You will use different combinations of yeast, sugar and water to investigate yeast metabolism.

As the investigation takes at least 40 minutes to complete, the scientific planning will be done in this period, and the practical will be done next period.

Use the science-inquiry template (Table 2.1) to help prepare for the practical and to consider any safety risks.

The instructions for the investigation are given in the template. In your group, complete the template points from 1 to 5.

Table 2.1. Science-inquiry template: Yeast metabolism

1. Question In this investigation, I am trying to find out …
2. Prediction I predict that … This is because …
3. Variables Things that will affect this investigation include … The variable/s that I will *change* to answer the question is … The variables that I will keep the *same* are … I will *measure* …

4. Equipment and method

Equipment (per group):

- 4 small plastic bottles (~300 ml), all the same size
- 4 balloons
- 1 funnel
- tape
- labelling pen
- 3 x 2g active dry yeast
- 3 x 100g sugar
- 3 x 125ml warm water
- kitchen scales
- measuring cup

Method:

1. Label the bottles with your group name and the following details:

    Bottle 1: water + yeast

    Bottle 2: water + yeast + sugar

    Bottle 3: water + sugar

    Bottle 4: yeast + sugar

2. Place the funnel in the mouth of the bottle and add the following ingredients:

    Bottle 1: 125ml warm water + 2g active dry yeast

    Bottle 2: 125ml warm water + 2g active dry yeast + 100g sugar

    Bottle 3: 125ml warm water + 100g sugar

    Bottle 4: 2g active dry yeast + 100g sugar

3. Immediately after the ingredients are added to each bottle, place a balloon over the mouth of the bottle. Make sure the stem of the balloon covers the mouth and stick the balloon down with tape.

4. Swirl the contents of the bottles gently to mix the ingredients.

5. Leave the bottles in a warm place for 40 minutes (or overnight if possible).

6. Record your observations.

5. Safety

The risks in doing this investigation are …

I will manage these risks by …

6. Observations

This is what I observed …

7. Results

In the investigation, I found out that …

The observations that support this are …

My prediction was (correct/incorrect) because …

8. Discussion

Was this a fair test? Why/why not?

If I could do the investigation again, I would …

This would improve the investigation because …

Period 2

Classify the microorganisms

Learning activity 3. Practical: Investigating yeast metabolism

The purpose of this learning activity is to conduct a scientific inquiry to investigate yeast metabolism. Collect the materials that you need for the investigation from your teacher educator.

Work with your group to set up the investigation and leave the metabolic process to proceed until near the end of the period. At the end of the period, record your observations in the science-inquiry template (Table 2.1). In the next period, you will evaluate your results and discuss the investigation.

Biological classification

Domains are the highest taxonomic rank of organisms. The three-domain system of classifying living organisms consists of **bacteria, archaea,** and **eukaryota.** Bacteria and archaea are both prokaryotic organisms, while eukaryote are eukaryotic organisms.

Under the three domains of life, organisms are further classified into kingdoms. All organisms in the domain bacteria belong to the kingdom bacterium. All organisms in the domain archaea belong to the kingdom archaeabacteria.

Organisms in the domain eukaryota belong to the animal, plant, fungi or protist kingdoms. Organisms are then further classified into phylum, class, order, family, genus and species.

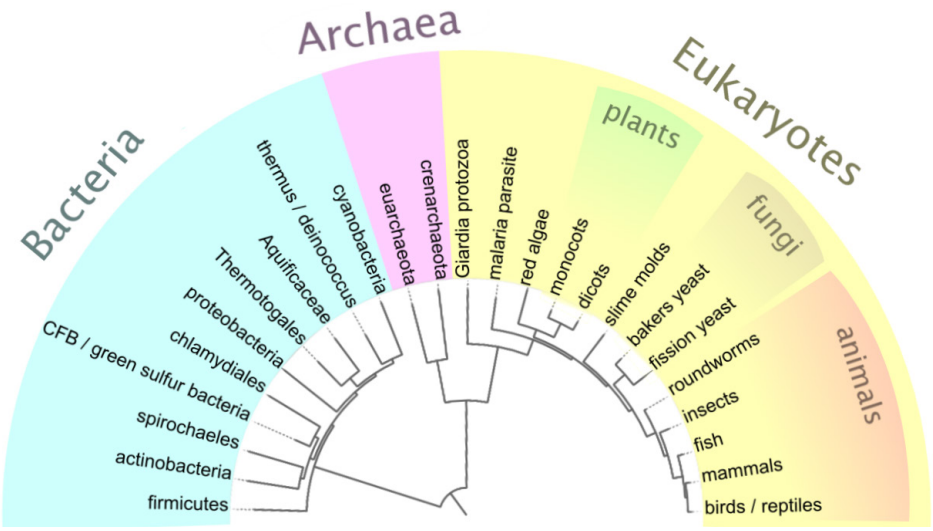


Figure 2.2. Simplified phylogenetic tree of life[10]

Some information about the three domains is provided in Table 2.2.

Table 2.2. Traits of bacteria, archaea and eukaryota

Trait	Bacteria	Archaea	Eukaryota
Organism structure	Unicellular	Unicellular	Unicellular or multicellular
Nucleus	No	No	Yes
Mitochondria	No	No	Yes
Chloroplasts	No	No	Yes (plant and some protists)
Histones	No	Have proteins similar to histones	Yes
Ribosome size	70S ribosomes	70S ribosomes	80S ribosomes
Cell-wall composition	Peptidoglycan	Protein but lack peptidoglycan	Not always present Plants: cellulose Fungi: chitin
Cell membrane	Straight chain	Branched chain	Straight chain
Chromosome shape	Mostly circular	Circular	Linear
Carbon linkage of lipids	Ester	Ether	Ester
DNA replication	Bacterial	Bacterial-like	Eukaryotic

10 "File:Simplified tree.png" by Madprime is licensed with CC BY-SA 3.0. To view a copy of this license, visit https://simple.m.wikipedia.org/wiki/File:Simplified_tree.png

Learning activity 4. Venn diagram: Comparing the three domains of life

The purpose of this learning activity is to identify the similarities and differences between the three domains of life. Use information from the table and what you have learnt about microorganisms to identify similarities and differences between the domains.

Use the Venn diagram to identify:

- traits that are common to all domains,
- traits unique to each domain, and
- traits shared by two domains.

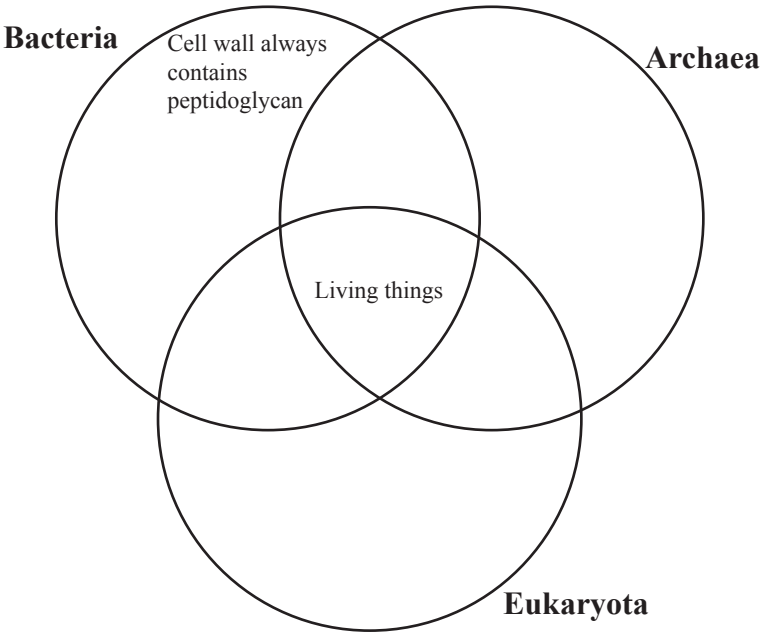


Figure 2.3. A Venn diagram to compare and contrast traits of organisms in the three domains of life

Your teacher educator will ask the following questions to check your understanding. You can record your answers and the responses of other student teachers in this textbook.

1. Do all microorganisms belong to the same domain?
2. Can you give an example of a type of microorganism and the domain and/or kingdom it belongs to?
3. Why are viruses not included in the tree of life?

Period 3

Evaluation on investigation of yeast metabolism

Learning activity 5. Group work and class discussion: Investigating yeast metabolism

The purpose of this learning activity is to draw conclusions and evaluate the investigation of yeast metabolism.

In the previous period, you conducted a practical to investigate yeast metabolism. You recorded your observations from the investigation at point 6 in the science-inquiry template in your textbook.

Work with your group to complete points 7 and 8 in the template. Your teacher educator will ask you to share your responses with the class.

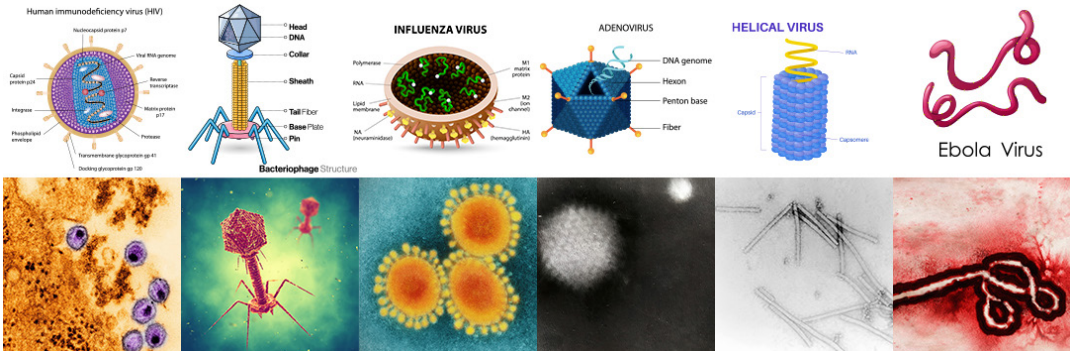
Remember that this practical is a good way to use microorganisms safely in a middle school classroom activity. In a middle school classroom, this investigation can demonstrate to students that microorganisms are living and metabolically active.

If students are engaged and interested, other variables also can be investigated, such as whether the type of sugar or the temperature of the water affects yeast metabolism.

Learning activity 6. Active teaching: Viruses and amoeba

The purpose of this learning activity is to identify the types of viruses and amoeba and the diseases they cause. Your teacher educator will share some further information about viruses and amoeba.

Virus Classification on the basis of morphology and replication

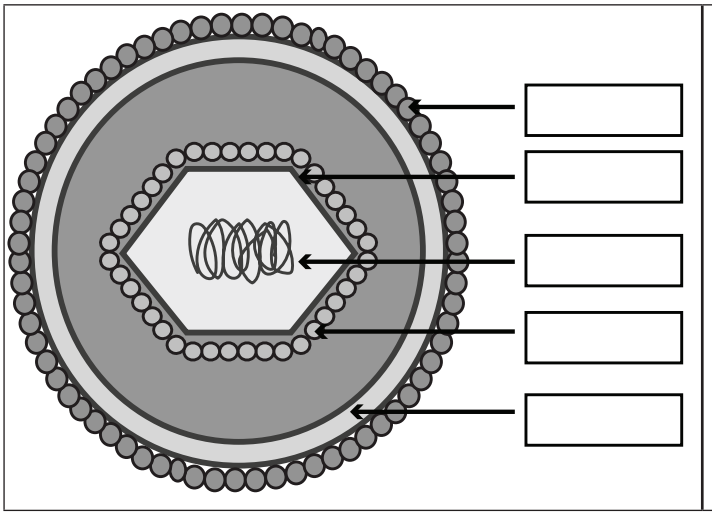


Human immudeficiency virus | Bacteriophage | Influenza virus | Adenovirus | Tobacco mosaic virus | Ebola virus

Figure 2.4. Classification of viruses[11]

11 The Biology Notes. (2020, January 18).

Use the information from your teacher educator to complete the following table and label the diagrams.



Function of components:

Figure 2.5. Basic structure of a virus

Complete the table to add information about the diseases caused by these common pathogenic viruses.

Table 2.3. Common pathogenic viruses

Genome	Family	Example	Disease
dsDNA, enveloped	Herpesviridae	Simplexvirus	Cold sores, herpes
dsDNA, naked	Reoviridae	Reovirus	Gastroenteritis (stomach flu)
ssDNA, naked	Parvoviridae	Adeno-associated dependoparvovirus A	Respiratory tract infection
dsRNA, naked	Picornaviridae	Enterovirus C	
+ssRNA, naked	Picornaviridae	Rhinovirus	
	Picornaviridae	Hepatovirus	
+ssRNA, enveloped	Togaviridae	Rubivirus	
	Retroviridae	Lentivirus	
	Filoviridae	Zaire Ebolavirus	
	Coronaviridae	Betacoronavirus	
-ssRNA, enveloped	Orthomyxoviridae	Influenzavirus A, B, C	

An amoeba is a type of unicellular organism that can change its shape. They are eukaryotic organisms that are found in many kingdoms of life. Label the diagram in Figure 2.6 to identify the structures of an amoeba.

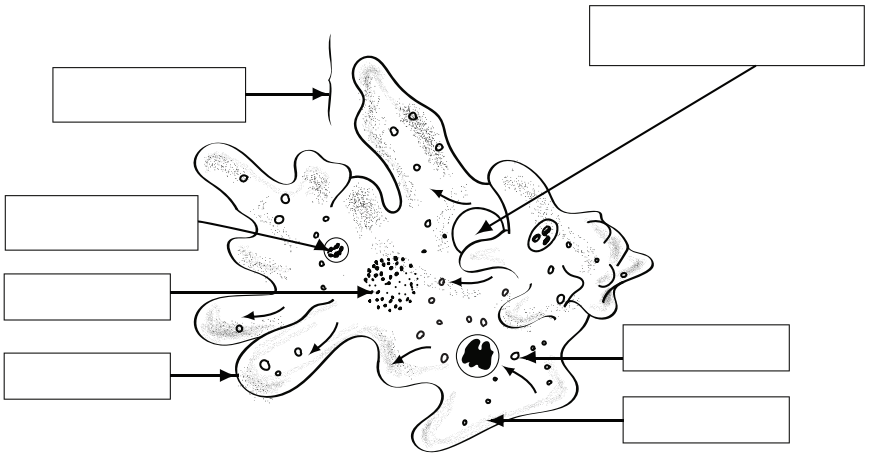


Figure 2.6. Structure of an amoeba[12]

Which diseases are caused by amoeba?

12 No copyright restrictions: by User: Kupirijo de la traducción Ortisa, CC BY-SA 4.0.

2.1.2. Classify types of plants (Flowering and non-flowering): Monocot/dicot

Expected learning outcomes

By the end of this lesson, you will be able to:

- Distinguish between flowering and non-flowering plants;
- Classify gymnosperms and angiosperms according to their characteristics; and
- Compare monocotyledonous and dicotyledonous based on their characteristics.

Period 1

Classifying types of plants

Learning activity 1. Brainstorm: Classification systems

The purpose of this learning activity is to consider the diversity of plants and how they could be classified.

1. Your teacher educator will write the names of some common plants on the board.
2. What other plants can you think of? When your teacher educator tells you to, write the names of as many different plants as you can in the box.

Box 2.1. Brainstorming types of plants

1. Your teacher educator will ask you to share the names of some of the plants that you wrote down. In the box, also record the plants that other students thought of.
2. How could these plants be grouped (classified)? What things do they have in common? What are the differences?
3. Join with two other student teachers and come up with a way of classifying the plants into groups.
4. Record the way you have classified the plants in the diagram. You do not have to use five categories. You may choose to use fewer or more.
5. Give each category a heading. Do all the plants fit into these categories?

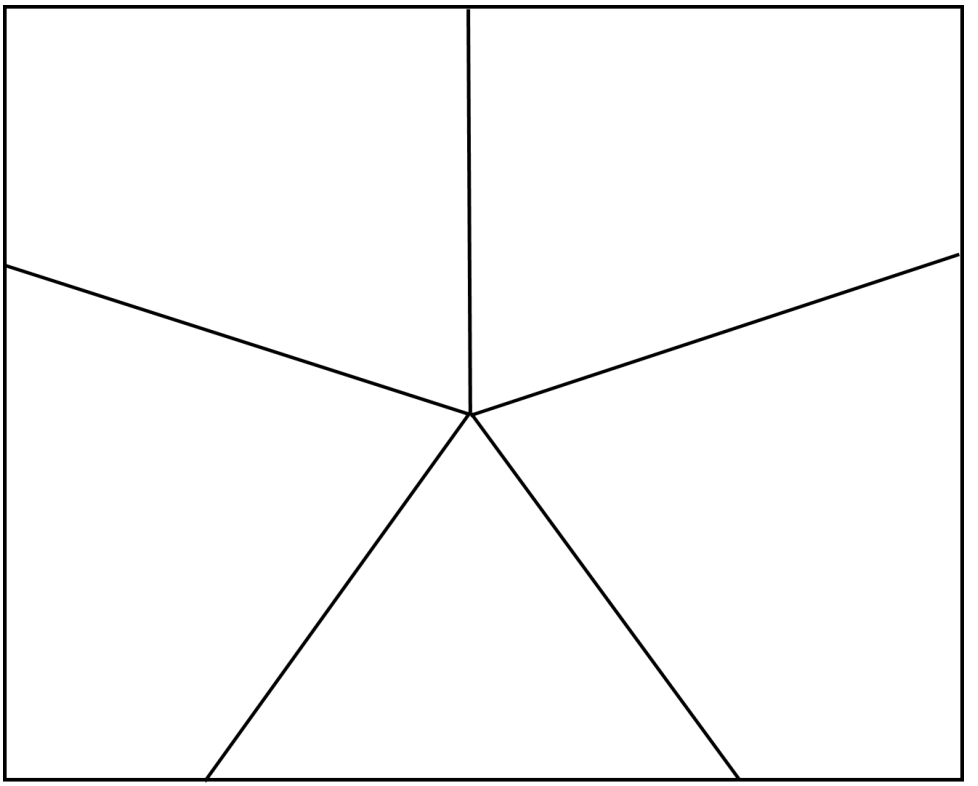


Figure 2.7. Classifying types of plants

Learning activity 2. Active teaching: Classifying plants

Background information

Flowering plants are the most diverse group of land plants with more than 300,000 known species. They are plants that produce flowers at some stage of their life cycle. Flowering plants are also known as **angiosperms.** Angiosperms are vascular plants with stems, roots and leaves.

Non-flowering plants are those that never produce a flower. Non-flowering plants reproduce by seeds or spores. Non-flowering plants that use seeds to reproduce are called **gymnosperms.**

The seeds of gymnosperms do not have a covering. The table shows some differences between angiosperms and gymnosperms.

Table 2.4. Comparison of angiosperms and gymnosperms

Angiosperms	Gymnosperms
Produce flowers and fruit	Do not produce flowers and fruit
Life cycle is seasonal	Evergreen
Seeds are enclosed within an ovary	Seeds have no covering
Leaves are flat in shape	Leaves are scalelike and needle-like in shape
Pollination occurs mostly by insects	Pollination occurs mostly by wind dispersal
Hardwood	Softwood
Do not produce cones	Produce male and female cones

The ovule is the part of the female reproductive organ in seed plants. It is the place where female reproductive cells are made and contained. It consists of three parts:

- the integument – a protective layer of cells surrounding the ovule,
- the nucellus – the inner structure of the ovule that contains the megasporocyte, and
- the megagametophyte – produces an egg cell for fertilisation.

The different ovules for angiosperms and gymnosperms are shown in the figure.

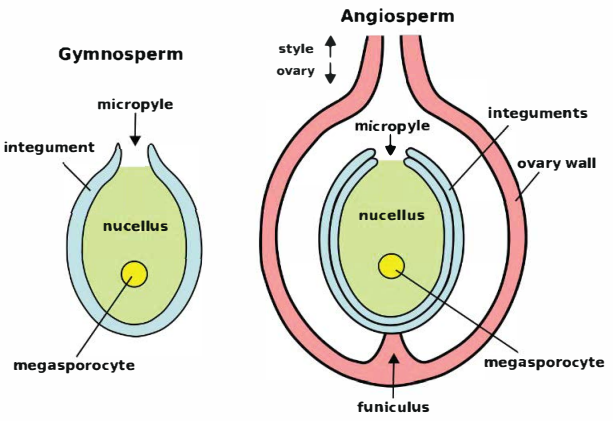


Figure 2.8. Ovules of angiosperms and gymnosperms[13]

13 Image available in the public domain at: https://commons.wikimedia.org/wiki/File:Ovule-Gymno-Angio-en.svg

Angiosperms are further separated into two main categories. These are the **monocotyledonous** (monocots) and **dicotyledonous** (dicots). Monocots are grass and grass-like flowering plants. The seeds of monocots contain only one cotyledon (mono = one). Dicots make up the other category of flowering plants.

The seeds of dicots contain two cotyledons (di = two). A number of features can be used to separate monocots and dicots.

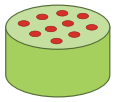
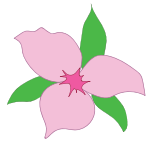
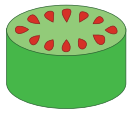
	Seed	Root	Vascular	Leaf	Flower
Monocot					
	One cotyledon	**Fibrous roots**	**Scattered**	**Parallel veins**	**Multiples of 3**
Dicot					
	Two cotyledon	**Tap roots**	**Ringed**	**Net-like veins**	**4 or 5**

Figure 2.9. Features that distinguish monocots and dicots

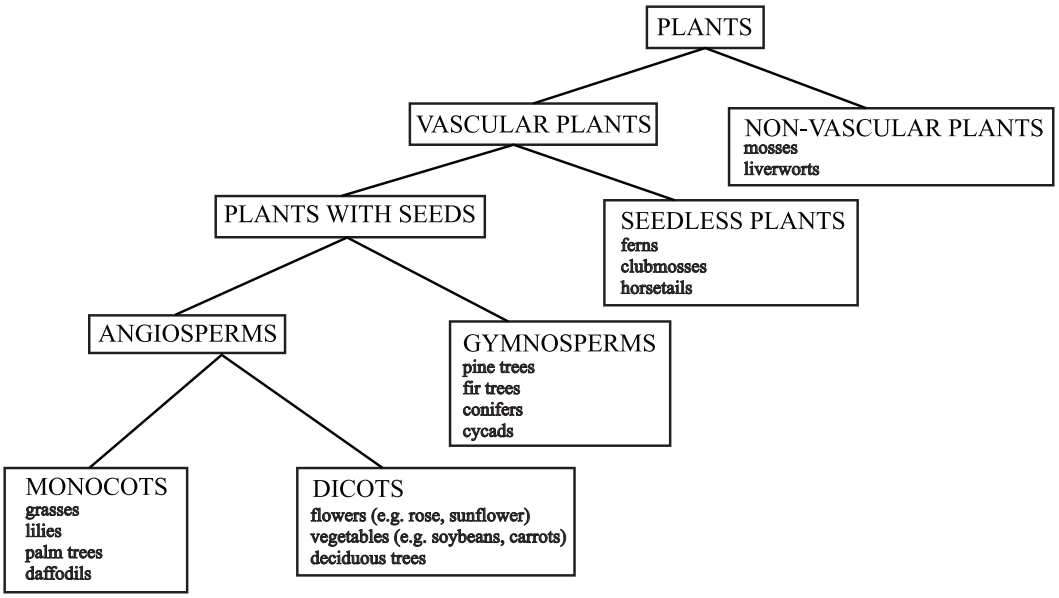


Figure 2.10. Dichotomous key to classify plants

Complete the following table to identify the plants.

What type of plant is shown?

Which features help you to classify this plant?

Table 2.5. Classification of various plants

Classification	Examples	Features
 Orchid[14]	• Flowering plant • Grows in a variety of habitats but mostly in tropical regions • Vascular • Simple leaves with parallel veins • Can grow anchored to trees • Three petals and three sepals (leaf-like supporting structure)	What features helped you classify the plant?
 Bryophyta[15]	• Reproduces through spores • Grows in moist habitats • Does not produce flowers or seeds • Lacks vascular tissue	What features helped you classify the plant?
 Bryophyta[16]	• Needle-like leaves • Native to South-East Asia • Produces cones • Seeds dispersed by wind • Grows up to 45m tall	What features helped you classify the plant?
 Athyrium niponicum[17]	• Consists of stem, roots and leaves • Fronds (leaf-like structures) generally 30-75cm • No seeds or flowers • Vascular • Reproduces by spores	What features helped you classify the plant?

14 "Orchid" by Brett Levin Photography is licensed under CC BY 2.0. View license: https://creativecommons.org/licenses/by/2.0/
15 "Moss covered coastline" by Creativity103 is licensed under CC BY 2.0. View license: https://creativecommons.org/licenses/by/2.0/
16 "Pinus latteri Mason" by yetunminn is licensed under CC BY 2.0. View license: https://creativecommons.org/licenses/by/2.0/
17 "Ghost Fern" by L'eau Bleue is licensed with CC BY-SA 2.0. View license: https://creativecommons.org/licenses/by-sa/2.0/

Classification	Examples	Features
 Potato plant[18]	• Leaves with net-like veins • Native to the Americas • Five-petal flowers • More than 5000 varieties • Vascular • Tap roots that produce tubers	What features helped you classify the plant?

Period 2

Plants in the local environment

Learning activity 3. Observation: Plants in the local environment

The purpose of this learning activity is to identify and classify plants in the local environment. You need to identify, draw and classify three or four different plant types from the Education Degree College environment.

Table 2.6 has space for drawings, plus guiding questions to help you identify and classify the plants. You should try to choose different types of plants from diverse environments.

Table 2.6. Local plant identification

Sketch of a plant: draw as many details of the plant as you can see. Consider:	Can you classify the plant?
• Leaf shape, veins, size, arrangement on the stem • Flower structures • Plant stem • Seeds	Do you know the identification of the plant? What are the observable features of the plant? What type of habitat does this plant grow in? Do you know anything else about the plant (for example: When does it flower? Does it lose/grow leaves?)

18 "Potato plant" by Eamonn_Sullivan is licensed with CC BY-SA 2.0. View license: https://creativecommons.org/licenses/by-sa/2.0/

Sketch of a plant: draw as many details of the plant as you can see. Consider: • Leaf shape, veins, size, arrangement on the stem • Flower structures • Plant stem • Seeds	Can you classify the plant? Do you know the identification of the plant? What are the observable features of the plant? What type of habitat does this plant grow in? Do you know anything else about the plant (for example: When does it flower? Does it lose/grow leaves?)
Sketch of a plant: draw as many details of the plant as you can see. Consider: • Leaf shape, veins, size, arrangement on the stem • Flower structures • Plant stem • Seeds	Can you classify the plant? Do you know the identification of the plant? What are the observable features of the plant? What type of habitat does this plant grow in? Do you know anything else about the plant (for example: When does it flower? Does it lose/grow leaves?)
Sketch of a plant: draw as many details of the plant as you can see. Consider: • Leaf shape, veins, size, arrangement on the stem • Flower structures • Plant stem • Seeds	Can you classify the plant? Do you know the identification of the plant? What are the observable features of the plant? What type of habitat does this plant grow in? Do you know anything else about the plant (for example: When does it flower? Does it lose/grow leaves?)

2.1.3. Classify types of animals (Vertebrates and invertebrates)

Expected learning outcomes

By the end of this lesson, you will be able to:

- Classify vertebrates and invertebrates;
- Design a learning activity for Grade 6/7 students which compares and contrasts vertebrates and invertebrates; and
- Classify the structural and behavioural adaptations of living things.

Period 1

Vertebrates and invertebrates

A **vertebrate** is an animal that has a spinal cord surrounded by cartilage or bone. The vertebrate skeleton consists of four parts.

1. The **braincase** is a hard structure, like the cranium in humans that protects the brain.
2. The **vertebrae** are a series of short bones that make up the spinal column and function to protect the spinal cord.
3. **Bones** support and protect the soft tissues of the body and provide points for muscle attachment.
4. **Gill arches** are the support structures for the gills of fish and some amphibians. In most vertebrates, some of the arches have evolved into other structures such as the jaw.

An **invertebrate** is an animal that does not have a backbone or bony skeleton. Invertebrates are the largest group in the animal kingdom. It has been estimated that 97% of all animals are invertebrates. Invertebrates are generally soft-bodied animals that lack a rigid internal skeleton for the attachment of muscles. Invertebrates may possess a hard outer skeleton that protects the soft tissues of the body.

Learning activity 1. Group work: Vertebrates and invertebrates

The purpose of this learning activity is to identify and classify vertebrate and invertebrate animals.

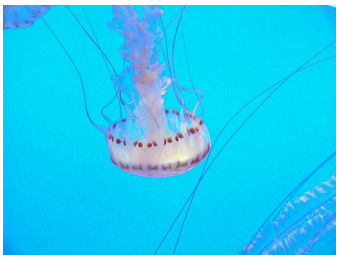
Table 2.7 shows the classification of some invertebrates based on their similar features.

Table 2.7. Classification of some invertebrates

Classification	Examples	Features
Echinoderms  Mosaic sea star[19]	Sea stars Sea cucumbers Sea urchins	• An exterior of spiny plates • Radial symmetry • A fluid-filled vascular system • Tube feet with suction cups • All marine animals
Arthropods  Mud flat crab[20]	Insects Crabs Shrimp Centipedes	• Segmented body • Exoskeleton • Legs with joints

19 https://commons.wikimedia.org/wiki/File:Fromia_indica_Landaagiraavaru.JPG "Indian Red Sea Star" by Frédéric Ducarme is licensed under CC BY-SA 4.0. View license: https://creativecommons.org/licenses/by-sa/4.0/

20 https://commons.wikimedia.org/wiki/File:Mud-Flat_Crab_(Chasmagnathus_convexus)_(5780853050).jpg "Mud Flat Crab" by Thomas Brown is licensed under CC BY 2.0. View license: https://creativecommons.org/licenses/by/2.0/

Classification	Examples	Features
Cnidarians  Jellyfish[21]	Jellyfish Sea anemone	• Soft bodies • No heads • Many tentacles
Molluscs  Snail[22]	Snail Scallop Limpet	• Most have an internal or external shell • Soft-bodied • Have gills, jaws and a circulatory system
Annelid  Bristle worm[23]	earthworm leech	• One or more body segments with rings • Projecting bristles • Soft-bodied

Vertebrates can also be classified based on similar features.

Work with another student teacher to complete the table.

21 https://commons.wikimedia.org/wiki/File:Jelly_Fish_(8113912393).jpg "Jelly Fish" available in the public domain under CC0 1.0. View license: https://creativecommons.org/publicdomain/zero/1.0/
22 "Snail" by Ilweranta is licensed under CC BY 2.0. View license: https://creativecommons.org/licenses/by/2.0/
23 https://commons.wikimedia.org/wiki/File:A_polychaete_(bristle_worm)_-_geograph.org.uk_-_1087795.jpg "Bristle Worm" by Lairich Rig is licensed under CC BY-SA 2.0. View license: https://creativecommons.org/licenses/by-sa/2.0/

Consider the features that animals in each group have in common, such as:

- Body temperature
- Life cycle
- Reproduction
- Body covering

Table 2.8. Classification of some vertebrates

Classification	Examples	Features
Mammals  Myanmar snub-nosed monkey[24]		
Birds  Whiskered yuhina[25]		
Amphibians  Frilled tree frog[26]		

24 https://commons.wikimedia.org/wiki/File:Black_Snub-nosed_Monkeys.jpg "Black snub-nosed monkeys" by Rod Waddington is licensed under CC BY-SA 2.0. View license here: https://creativecommons.org/licenses/by-sa/2.0/

25 https://commons.wikimedia.org/wiki/File:Whiskered_Yuhina_(34618039801).jpg "Whiskered Yuhina" available in the public domain under CC0 1.0. View license: https://creativecommons.org/publicdomain/zero/1.0/

26 "Frilled Tree Frog (Rhacophorus appendiculatus)" by berniedup is licensed under CC BY-SA 2.0. View license here: https://creativecommons.org/licenses/by-sa/2.0/

Classification	Examples	Features
Reptiles  Burmese star tortoise[27]		
Fish  Hilsa[28]		

Learning activity 2. Group work: Design a learning activity

The purpose of this learning activity is to design a learning activity suitable for students in Grade 6/7 that classifies vertebrate and invertebrate animals.

Table 2.9 is part of the Year 3 lesson plan template that you should use to develop your own classroom lessons.

You will be developing an activity that could be part of a complete lesson. The section of the template is copied here for you to use as a guide.

Work with a partner to develop a learning activity that would be suitable for a Grade 6/7 class. You will share your ideas with your class at the end of the lesson.

27 https://commons.wikimedia.org/wiki/File:Geochelone_platynota_-Toronto_Zoo,_Ontario,_Canada-8a.jpg "Burmese Star Tortoise" by Kevin Ho is licensed under CC BY-SA 2.0. View license: https://creativecommons.org/licenses/by-sa/2.0/

28 https://commons.wikimedia.org/wiki/File:Hilsa_fish.jpg "Hilsa fish" by Rajeeb is licensed under CC BY-SA 4.0. View license here: https://creativecommons.org/licenses/by-sa/4.0/

As you develop the learning activity, consider the following:

- Is the activity suitable for the age group?
- Is the activity aligned with the syllabus?
- Does the activity have a clear purpose and objective?
- Can the activity be done safely in the classroom or school grounds?

Table 2.9. Learning activity planner

Stage	**Timing**	**Teacher activity** *(What are you doing?)*	**Student activity** *(What are students doing?)*	**Differentiation** *(How will you differentiate teaching and learning to respond to students' needs?)*
At what stage of a lesson would this activity be used?				

Period 2

Adaptations and features of living things

Learning activity 3. Case study and gallery walk: Structural and behavioural adaptations of living things in Myanmar

The purpose of this learning activity is to research the **structural** and **behavioural adaptations** of living things found in Myanmar and explain how these features help it in its habitat.

Structural adaptations are the physical features of an organism that help it live in its habitat. For example, many animals have teeth that help them capture and consume prey or grind and process vegetation. Plants may have deep roots that help it access water.

Behavioural adaptations are things the organism does to live in its habitat. Bird calls and migrations are behavioural adaptations. Plants that climb on others to reach sunlight are an example of a behavioural adaptation of plants. The table shows some information about the Asian elephant.

Table 2.10. Structural and behavioural adaptations of the Asian elephant

Animal	 Asian elephant[29]
Habitat	Grasslands and forests in tropical and subtropical regions
Diet	Herbivorous – grass, bark, roots and leaves
Locomotion	Walking and swimming

29 Photo by ACER. Used with permission.

Structural features and how they help it live in its habitat	• Fatty tissue on feet – distributes weight and spreads pressure • Trunk – smell, transferring food and water, spraying water and dust, acts as a snorkel when swimming • Large ears – hearing, large surface area for cooling • New teeth through their lifetime – old teeth are replaced so the elephant can continue to break down tough, fibrous plant material • Tusks – dig for water, move branches, defence • Grey skin – camouflage • Folded skin – increased surface area for heat dissipation
Behavioural adaptations and how they help it live in its habitat	1. Flapping ears, spraying water, rolling in mud – all help to keep the elephant cool 2. Walking on toes – distributes pressure 3. Spraying water and dust – protects from sunburn and insect bites 4. Swishing tail – brushes away biting insects 5. Low-pitched sounds – communication including to warn other elephants of predators

You will work with another student teacher to research a living organism from Myanmar.

You will produce a poster detailing information about the organism you have chosen. Include in your poster information about:

- Habitat
- Diet
- Locomotion (how it moves)
- Structural features
- Behavioural adaptations
- How the structural and behavioural adaptations help the organism in its habitat

Display your group's poster and conduct a gallery walk to learn the research findings about other organisms from the various groups.

Information about other organisms can be noted in the table.

Table 2.11. Structural and behavioural adaptations of living things in Myanmar

Organism	Structural and behavioural adaptations

2.1.4. Life and the characteristics of living things: Plants and animals

Expected learning outcomes

By the end of this lesson, you will be able to:

- Explain in detail the seven life processes of living things;
- Develop a teaching resource for Grade 6/7 that explains the life processes of living things; and
- Evaluate different habits including characteristics and the adaptations of plants and animals that allow them to survive in those habitats.

Period 1

Seven life processes of living things

Movement: Both plants and animals have the ability to move. Many plants are rooted in the ground and move slowly as they grow. Roots grow downwards into the earth and stems grow upwards towards the light. Some plants will turn their leaves to face the light or curl leaves to prevent water loss. Animals can move in many ways and can move their entire body.

Respiration: This is the process of extracting energy from food. All living things respire to obtain energy to grow and move. Respiration occurs in the mitochondria of a cell. Aerobic respiration uses glucose and oxygen to release energy, water and carbon dioxide. Plant respiration is aerobic. Plants use the sugars and oxygen produced from photosynthesis as a source of energy. Anaerobic respiration occurs without oxygen. Some microorganisms use anaerobic respiration. Anaerobic respiration breaks down glucose into ethanol and carbon dioxide. Humans use anaerobic respiration during hard exercise when not enough oxygen reaches the muscles. In this reaction, glucose is broken down into lactic acid.

Sensitivity: Sensitivity refers to the ability of living things to detect changes in their environment. Animals respond to sensations such as temperature, light, heat, touch and taste. Plants respond to light. For example, flowers often open in the morning in response to light and close at night when the light fades.

Nutrition: Plants and animals take in and use food. Nutrition is needed for growth and energy. Plants make their own food through photosynthesis. Photosynthesis uses energy from the sun to convert carbon dioxide and water into sugars and oxygen. Animals cannot make their own food. Animals consume plants and other animals for their nutrition. Complex molecules in the food animals consume are broken down into simple molecules in the body that are used for energy and growth.

Excretion: Excretion is the process of removing waste products, toxic materials and excess substances. Plants excrete excess carbon dioxide and oxygen through the stomata (small holes) in their leaves. Animals excrete materials through their lungs (carbon dioxide and water), kidneys and skin (water, salts and urea).

Reproduction: All living things produce offspring. Plants produce seeds that create new plants of the same species. Animals lay eggs or give birth to live young.

Growth: All living things grow. Plants grow as long as they remain living. Animals stop growing when they reach a defined stage in their life cycle. However, cells within an animal's body continue to be replaced.

Learning activity 1. Think-pair-share: Seven life processes of living things

The purpose of this learning activity is to explain and provide examples of the seven life processes of **living** things.

Reflect on the poster that you created in the previous period. Your teacher educator will give you your poster or it may still be displayed in the classroom.

Work with the same student teachers you developed the poster with. Complete the table to show how the organism you researched displays the processes of living things.

Table 2.12. Processes of living things in Myanmar

	Organism	
M	How does it move?	
R	Type of respiration?	
S	What senses does the organism use? What features help it to detect changes in the environment?	
N	What does the organism consume to obtain energy?	
E	How does the organism excrete unwanted materials?	
R	How does the organism reproduce? Describe the life-cycle stages of the organism.	
G	How does the organism grow? Does it grow throughout its life cycle?	

Students often have misconceptions about whether a thing is living or not.

Work with another student teacher to complete the table.

Decide which life processes the things in the table show. Is this a **living** or a **non-living** thing?

You will share your decisions and explanation with the class.

Table 2.13. Living or non-living?

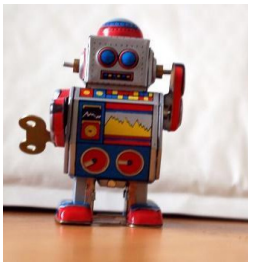
	What life processes does this show?	Living or non-living?	Explain your decision
 Rock[30]			
 Clouds[31]			
 Aircraft[32]			
 Mushroom[33]			

30 "Rocks" by stebulus is licensed with CC BY 2.0. View license here: https://creativecommons.org/licenses/by/2.0/

31 https://search.creativecommons.org/photos/d7b8d0b7-fe2a-48ec-b98b-d8cb584743ed "Clouds on Blue Sky" by leolintang is licensed under CC BY 2.0 View license here: https://creativecommons.org/licenses/by/2.0/

32 https://search.creativecommons.org/photos/9aaed530-41fe-47df-a421-29db4694e3e9 "A Plane" by oatsy40 is licensed under CC BY 2.0. View license here: https://creativecommons.org/licenses/by/2.0/

33 https://search.creativecommons.org/photos/19d2a27f-9564-4854-89cb-350248f65431 "Magic Mushrooms? NOT" by jmv is licensed under CC BY 2.0. View license here: https://creativecommons.org/licenses/by/2.0/

	What life processes does this show?	Living or non-living?	Explain your decision
 Apple (picked from a tree)[34]			
 Robot[35]			

Learning activity 2. Group work: Develop a teaching resource

The purpose of this learning activity is to develop a teaching resource for Grade 6/7 students that explains the seven life processes of living things.

You will work with a small group of student teachers to develop a teaching resource that could be used in a Grade 6/7 classroom to explain the seven life processes.

Use the space on the next page to detail your ideas.

As you develop your resource, consider the following questions:

- When would this resource be used in a lesson?
- How does this resource help student learning?
- Who would use this resource?
- What are the learning objectives that relate to this resource?
- How will this resource help students understand the concepts of life processes?

34 "Discovery apples" by Nick Saltmarsh is licensed under CC BY 2.0. View license here: https://creativecommons.org/licenses/by/2.0/
35 "Robot" by andreavallejos is licensed under CC BY-ND 2.0. View license here: https://creativecommons.org/licenses/by-nd/2.0/

- How much will it cost to make and use the resource?
- Can you use recycled materials?
- How long will the learning activity take in a classroom?
- Is the resource engaging for Grade 6/7 students?

Box 2.2. Teaching resource for seven life processes

Teaching resource: Seven life processes

Period 2

Characteristics and adaptations of plants and animals

Learning activity 3. Think-pair-share: Habitats

The purpose of this learning activity is to evaluate various habits including characteristics and the adaptations of plants and animals that allow them to survive in those habitats.

In this learning activity, you will work individually to complete the table. Some information about the habitats is given. Some information is missing.

Add any extra information about these habitats that you can think of.

Look at the information about the organisms in these environments. Complete the information where it is missing in the table. Use the images to help understand the features of these habitats.

Think about these habitats and add another organism to one. Add information about a feature this organism has and how that helps it live in that habitat. When your teacher educator tells you, join with another student teacher and share your answers. Add any information you may have missed to your table. You will then join with another pair to share information again. Add any further details to your table.

Table 2.14. Features of organisms in selected habitats

Desert[36]

Description:

- Hot and dry
- Low rainfall, scarce water sources
- Plenty of direct sunlight
-
-

Organism	Features	How it helps the organism live
Cactus	Spines	Stops animals eating the plant for water
Plants	Thick, spongy leaves	
Lizards	Burrow underground	
Kangaroo rats	Nocturnal	Active at night when it is cooler

36 "Simpson Desert" by tensaibuta is licensed under CC BY 2.0. View license here: https://creativecommons.org/licenses/by/2.0/

Tropical rainforest[37]

Description: • Hot and wet • Thick canopy • • •		
Organism	**Features**	**How it helps the organism live**
Lianas	Climbs on other plants	
Many plants	Drop tip and waxy surface	Allow excess water to run off
Spider monkey	Prehensile tail and strong limbs	
Chameleon	Colour-changing scales	

Grassland[38]

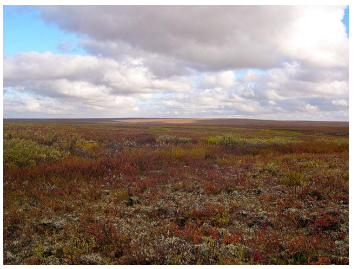
Description:

- Hot summers prone to wildfires
- Generally low rainfall
- Windy
-
-

37 Taman Negara, Malaysia, Primary tropical rainforest.jpg by Vyacheslav Argenberg. Licensed under CC BY 4.0. View license here: https://creativecommons.org/licenses/by/4.0/

38 "Marfa Grasslands" by AnEyeForTexas is licensed under CC BY-NC 2.0. View license here: https://creativecommons.org/licenses/by-nc/2.0/

Organism	Features	How it helps the organism live
Many trees	Thick bark	Protects from wildfires
Many plants	Deep roots	
Gazelle and antelope	Light-coloured skin	
Zebra	Live in herds	



Tundra[39]

Description:

- Cold all-year round
- Sublayer of soil is permanently frozen
-
-

Organism	Features	How it helps the organism live
Some plants	Dark-coloured leaves	Absorb heat from the sun
Birds	Two coats of feathers	For warmth, to trap heat and insulation
Polar bear	Thick, white fur and fat layers	
Plant	Fuzzy, hair-like structures on leaves	

Freshwater aquatic[40]

39 https://commons.wikimedia.org/w/index.php?curid=2770717 "File:Bolshezemelskaja tundra 1.JPG" by APL is licensed under CC BY-SA 3.0. View license here: https://creativecommons.org/licenses/by-sa/3.0/

40 "Nymphaea capensis plant3" by Macleay Grass Man is licensed under CC BY 2.0. View license here: https://creativecommons.org/licenses/by/2.0/

Description:

- Lakes, ponds, rivers and springs
- Conditions vary, depending on geographical location

Organism	Features	How it helps the organism live
Lilies	Long, flexible stems	Move with water currents
Hawaiian freshwater fish	Sucking discs on pelvis and mouth	Allow travel upstream through strong currents by attaching to hard surfaces
Water hyacinth	Air pockets in plant tissue	

Learning activity 4. Directed activity: Create a creature

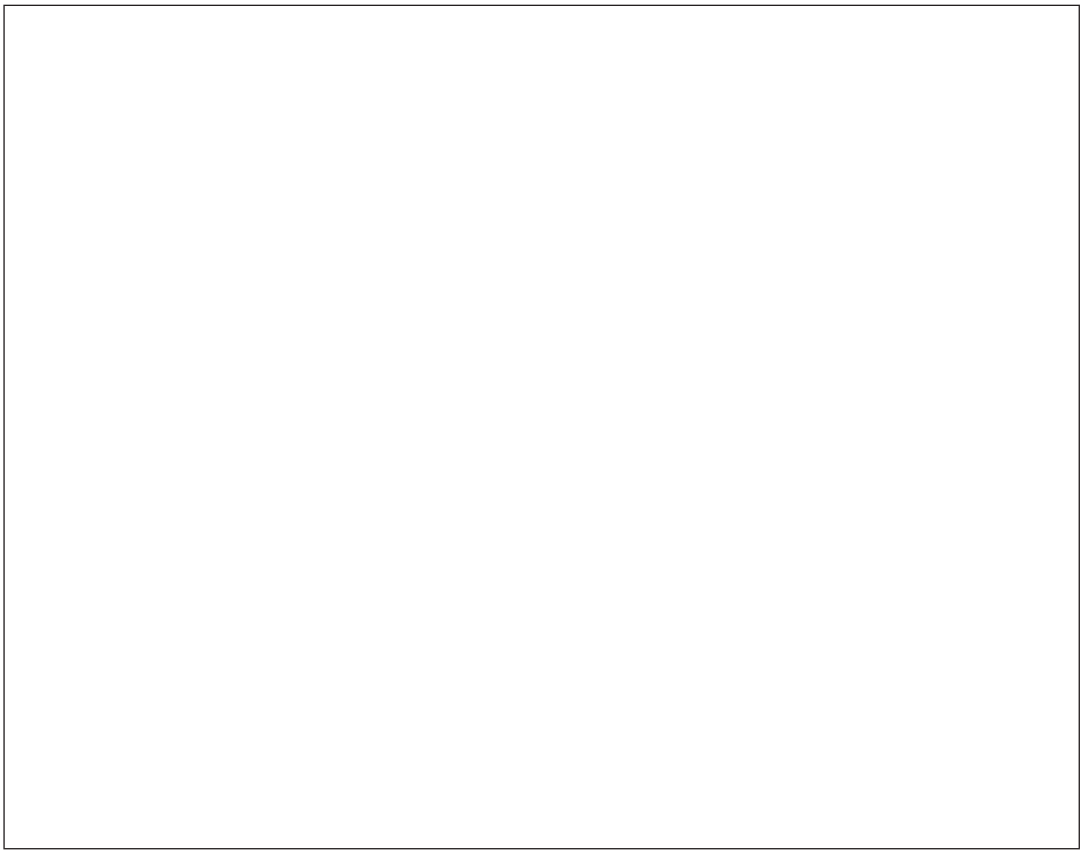
The purpose of this learning activity is to demonstrate understanding of the features and adaptations that help an organism live in a given habitat. In this activity, you will act as a scientist who has discovered a new type of organism. You need to document the information about the organism as a scientist would. You can create a creature from an ecoregion of Myanmar or you can imagine a unique habitat, such as what features an organism on Mars or in a volcanic habitat might have. Draw and describe your creature in its habitat in Box 2.3.

Include the following information:

- A drawing of the organism
- Give the organism a name
- Describe the habitat
- Explain the basic needs of the organism
- Detail the structural and behavioural features of the organism that help it live in that habitat

Your information sheet might include labels, maps and captions to illustrate this information.

Box 2.3. Create a creature



Review questions

1. Explain the three domains of life-giving examples of each.
2. Draw a Venn diagram showing the similarities and differences between angiosperms and gymnosperms.
3. List and explain the seven processes of living things.

2.2. Structure and Function of Cells

In this sub-unit, you will identify and describe living things at a cellular level. You will examine the structures of plant and animal cells and identify the functions. You will learn about and model the mechanisms of cell division and develop resources to support Grade 6/7 students in learning about these concepts. You will gain further experience in working scientifically, using microscopes to identify cellular organelles.

2.2.1. Structure and function of plant cells

Expected learning outcomes

By the end of this lesson, you will be able to:

- Identify the structures that are found in plant cells using microscopes; and
- Describe the functions of the main/major organelles found in plant cells.

Period 1

Structure and function of plant cells

In Year 2, you learnt to identify the structures of plant cells and their functions, and you learnt about some of the organelles. Using Figure 2.11, label any structures that you recognise. You will also use Table 2.15 in this introductory exercise.

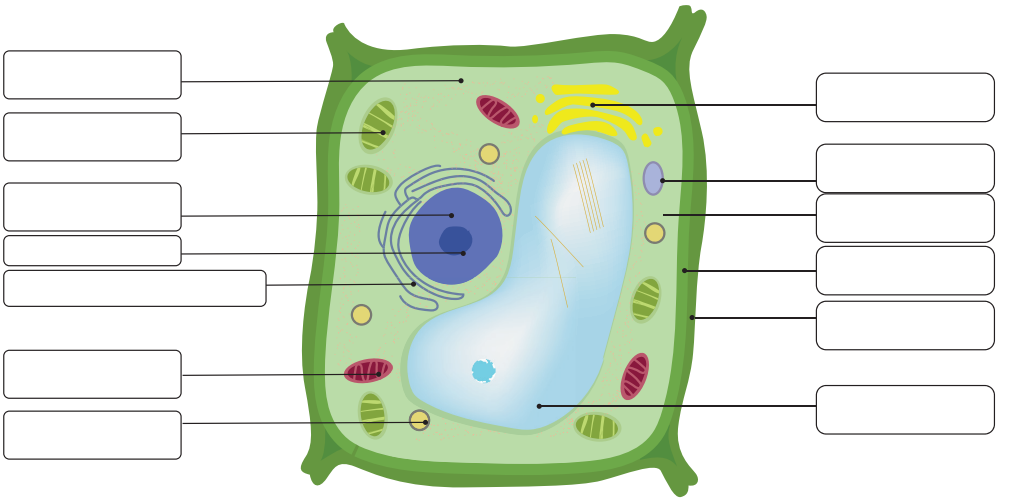


Figure 2.11. Organelles of a plant cell

Table 2.15. Structure and function of plant parts

Plant cell part	Structure and function
Cell membrane	
Cell wall	
Cytoplasm	
Nucleus	
Nucleolus	
Mitochondria	

Plant cell part	Structure and function
Endoplasmic reticulum	
Golgi apparatus	
Ribosomes	
Chloroplast	
Vacuole	
Amyloplast	
Peroxisome	

These resources are from the Year 2 Student Teacher Textbook.

Learning activity 1. Practical: Microscopy

The purpose of this learning activity is to safely use a microscope to magnify structures.

Table 2.16. Parts and functions of a light microscope

Part	Description and function
Diaphragm	This controls the amount of light that comes into the slide.
Eyepiece lens	This is the lens closest to the eye.
Stage clips	These hold the slide in place.
Stage	The slide is put on this.
Fine focus	This is used to finely adjust the focus so that it is sharp and clear.
Mirror	This directs light from the source through the microscope.
Objective lens	This is the lens closest to the slide.

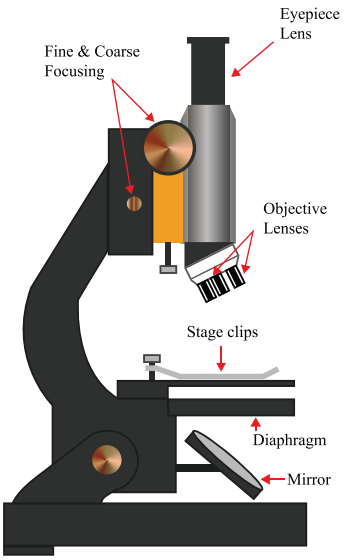


Figure 2.12. Features of a light microscope[41]

41 EDC Year 2 Biology Textbook.

Setting up a microscope:

1. Always use both hands to pick up and carry a microscope. Use one hand to hold the arm with of the microscope and place the other hand under the base for support.
2. Plug the power cord into the socket. Turn on the power and turn on the light.
3. Turn the revolving nosepiece so that the lowest power objective lens (the shortest objective lens) is fixed into position.

Look at the microscope. Do you recall the parts and their functions?

In this learning activity, your teacher educator will give you a glass slide, coverslip and newspaper. Cut a small square of newspaper and look at it under the microscope. Follow the instructions to use the microscope correctly.

1. Place the glass slide on the **microscope stage** and fasten it with the **stage clips**.
2. Look from the side of the microscope and use the **coarse focus** to wind the stage all the way to the top. Make sure the objective lens is not wound through the glass slide.
3. Look through the **eyepiece** and adjust the **mirror** and **diaphragm** to maximise the amount of light.
4. Look down the eyepiece and turn the coarse focus gently until the image becomes focussed.

You should be able to see the text on the newspaper. Move the newspaper around.

- Which direction is the text moving?
- What orientation are the letters in?

Period 2

Observing structure of plant cells

Learning activity 2. Practical: Observing structures of plant cells

The purpose of this learning activity is to use a microscope to observe the structures of plant cells.

In this learning activity, you will prepare slides to observe the cells of three different plants:

- Onion
- Banana
- Pond weed

In Year 2, you observed or prepared a slide to visualise onion cells. The method is given again here for you to follow.

Methods to prepare slides of banana cells and pond weed cells also are given.

In your group, prepare a slide of each plant material.

Observe the plant cells under the microscope.

Draw and label what you see. Make sure you:

- give each drawing a title,
- label the structures you can see, and
- record the magnification you are using to observe the cells.

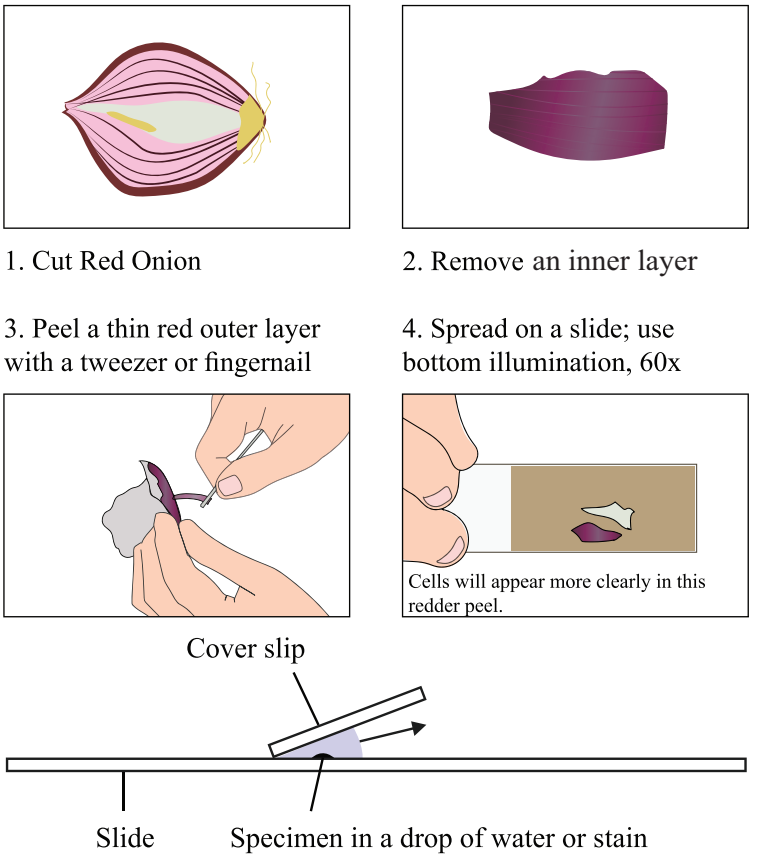


Figure 2.13. Preparing a slide of onion cells[42]

Once the onion cells have been obtained, they can be stained. This will make the cells easier to see. Cover with a coverslip.

Making a slide of banana cells

1. Take a small piece of the banana and smear it across a clean glass slide.
2. Place a small drop of iodine on a thin section of the smear.
3. Cover with a coverslip.
4. Examine the slide and locate a single banana cell.
5. Draw the cell in your textbook.

42 Year 2 Biology Textbook, Figure 3.9.

Making a slide of pond weed cells

1. Pick off an entire, healthy-looking leaf with your fingers or small scissors.
2. Place the leaf on the microscope slide.
3. Add a drop of water and a coverslip.
4. Examine the slide.
5. Draw the cells and their arrangement with each other in your textbook.

Table 2.17. Observations of plant cells

2.2.2. Structure and function of animal cells

Expected learning outcomes

By the end of this lesson, you will be able to:

- Describe animal cell structures and their functions using a model chart; and
- Develop a teaching resource and assessment tool for Grade 6/7 students to label and identify illustrations of cell structures.

Period 1

Structure and function of animal cells

Learning activity 1. Practical: Observe, identify and label structures of animal cells

The purpose of this learning activity is to use a microscope to observe, identify and label the structures of animal cells.

In the previous lessons, you have been using a microscope to visualise plant cell structures.

In this period, you will visualise animal cell structures and compare them with the plant cells that you observed.

Follow the method to make a slide of your own cheek cells.

Draw a diagram of the cheek cells and their arrangement in your textbook.

On your diagram, make sure you:

- give each drawing a title,
- label the structures you can see, and
- record the magnification you are using to observe the cells.

Making a slide of cheek cells

1. Swab the inside of your cheek with a small clean spoon or toothpick. It should not hurt. Just apply gentle pressure as you scrape the inside of your cheek. This will remove some cells from the inner surface of your cheek.
2. Put one drop of a dilute salt solution on a slide. Add the sample to the drop of weak salt solution. Add a stain such as methylene blue. This will make the cells easier to see.
3. Cover the sample with a coverslip. Make sure no bubbles are trapped underneath the coverslip. Lower the coverslip with a needle (Figure 2.14).
4. Examine the slide using a microscope and draw a labelled diagram of what you can see.

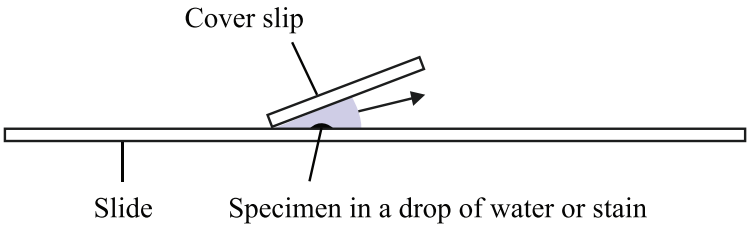


Figure 2.14. Lowering a coverslip on to a specimen[43]

Box 2.4. Observations of cheek (animal) cells

43 Year 2 Biology Textbook, Figure 3.8.

Learning activity 2. Modelling: Identification of animal cell structures

In this learning activity, you will identify the structures of an animal cell, and you will complete Figure 2.15 by labelling the parts of the animal cell.

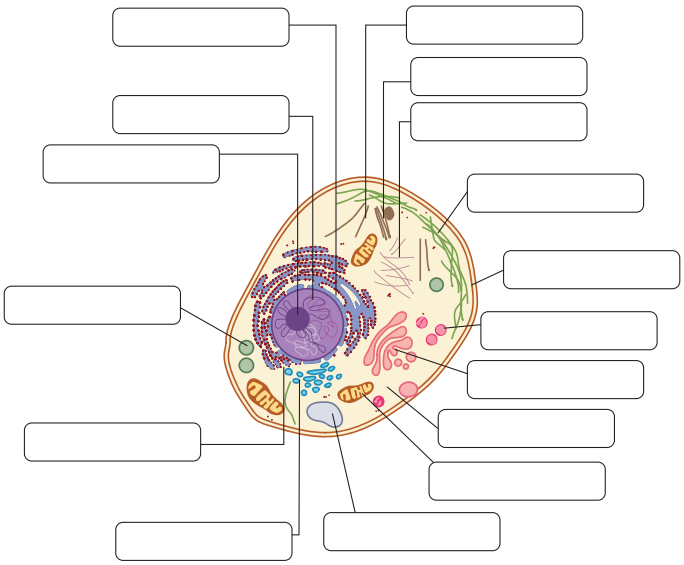


Figure 2.15. Structures of animal cells

You should be able to identify the following structures:

- Nucleus
- Nucleolus
- Endoplasmic reticulum
- Peroxisome
- Cell membrane – sometimes called the plasma membrane for animal cells
- Golgi apparatus
- Cytoplasm
- Mitochondria
- Vacuole

Period 2

Designing a teaching resource and assessment tool for Grade 6/7 students

Learning activity 3. Pair work: Design a learning resource for Grade 6/7 students to identify and label plant and/or animal cell structures

The purpose of this learning activity is to develop a teaching resource for Grade 6/7 students to use to identify and label cell structures.

Begin by reviewing the Grade 6/7 curriculum. Identify what students need to know about plant and animal cells. Use the curriculum as a guide to develop your resource.

Work with another student teacher to develop a teaching resource to help the students understand and identify cell structures. Your resource may be about plant cells, animal cells or both. Develop the resource in the space in your textbook. As you develop the resource, consider:

- When would this resource be used in a lesson?
- How does this resource help student learning?
- Who would use this resource?
- What are the learning objectives that relate to this resource?
- How will this resource help students understand the structures of cells?
- How much will the resource cost?
- Can you use recycled materials?
- Is the resource user-friendly?

Box 2.5. Grade 6/7 cell structures resource

Learning activity 4. Pair work: Develop a self- or peer-assessment tool for Grade 6/7 students

The purpose of this learning activity is to develop an assessment tool for student self- or peer-assessment of the learning resource student teachers have designed.

In Year 2 of Educational Studies, you reviewed a peer-assessment tool to evaluate a student's ability to draw and label parts of an insect. You may have identified strengths and limitations with this assessment tool. Recall:

Table 2.18. Checklist for formative task

Learning outcome: *Draw and label the parts of an insect*			
Success criteria	**Yes**	**No**	**If no, provide feedback**
1. Antennae, head, thorax, abdomen and legs are drawn correctly (see exemplar).			
2. All body parts are labelled correctly.			
3. All labels are spelt correctly.			
4. Arrows link all labels to body parts.			
5. A figure title is at the bottom.			

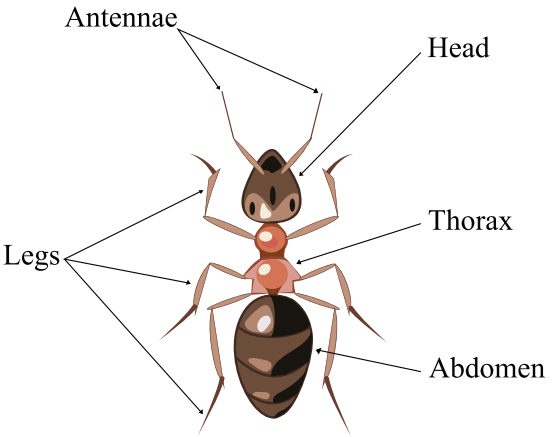


Figure 1. Parts of an Insect

Figure 2.16. Exemplar for formative task

You will develop an assessment tool that students could use for self-assessment or that a peer in the classroom could use to assess a student's work.

Write this assessment tool in Box 2.6.

As you develop the assessment tool, consider:

- What do you expect students to be able to do?
- How will you know whether a student has done the task successfully?
- Has the learning outcome been achieved?

Box 2.6. Assessment tool for cell structure resource

2.2.3. Two types of cell division: Mitosis and meiosis

Expected learning outcomes

By the end of this lesson, you will be able to:

- Define mitosis and meiosis and identify the stages of each cell division; and
- Develop a learning activity for Grade 6/7 which compares and contrasts mitosis and meiosis.

Period 1

Types of cell division: Mitosis and meiosis

Learning activity 1. Developing understanding: Meiosis and mitosis

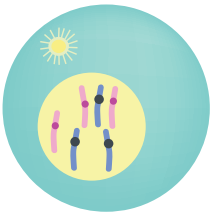
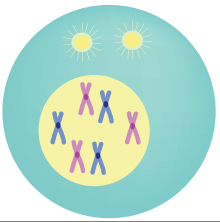
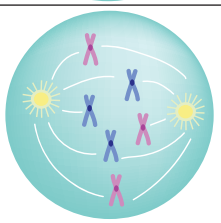
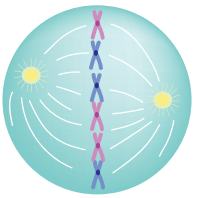
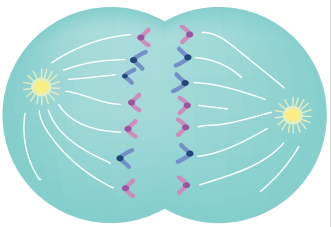
The purpose of this learning activity is to develop an understanding of the types of cell division – **meiosis** and **mitosis**.

Watch videos that explain the process of meiosis and mitosis. Suggestions are as follows:

	Video: Meiosis | Genetics | Biology | FuseSchool URL: https://www.youtube.com/watch?v=5pvwIsDE6eg Scan QR Code using your mobile device to watch the video on YouTube. This video has captions that enable you to read the text while viewing the video. Turn on where you see CC.
Video: Mitosis URL: https://qrgo.page.link/jGVZh Scan QR Code using your mobile device to visit KhanAcademy.org and watch videos on this website. The videos have captions and transcripts that enable you and your student teachers to read the text while viewing the video. Turn on where you see CC.	

As you listen to the information, make notes in Tables 2.19 and 2.20.

Table 2.19. Mitosis[44]

What is mitosis?	
	**Interphase**
	**Prophase**
	**Prometaphase**
	**Metaphase**
	**Anaphase**

44 Vidyasagar, A. (2018, August 14). *What is mitosis?* Live Science. https://www.livescience.com/52512-mitosis.html

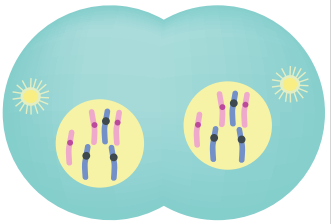
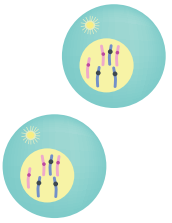
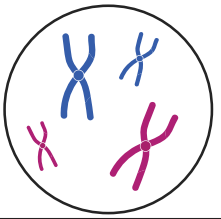
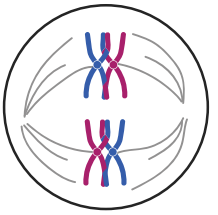
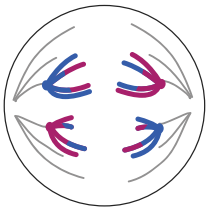
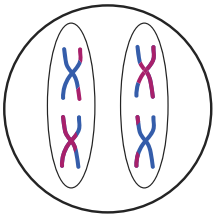
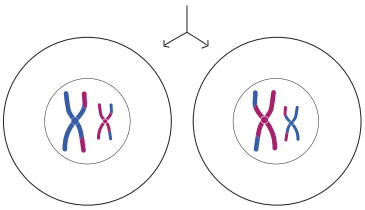
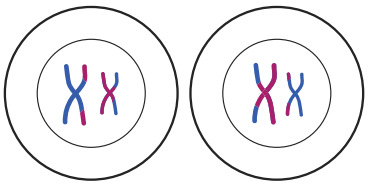
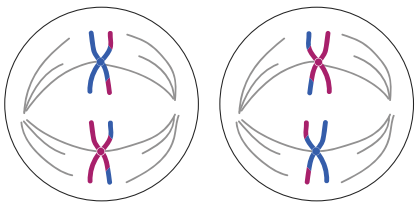
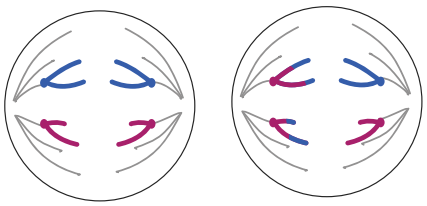
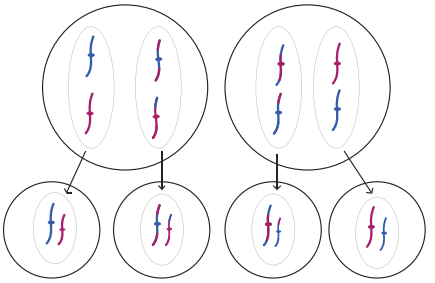
	**Telophase**
	**Cytokinesis**

Table 2.20. Meiosis[45]

What is meiosis?	
	Interphase
	**Prophase I**
	**Metaphase I**

45 Life Sciences Cyberbridge. (n.d.). *Meiosis II*. http://cyberbridge.mcb.harvard.edu/mitosis_7.html

	**Anaphase I**
	**Telophase I**
	**Cytokinesis**
	**Prophase II**
	**Metaphase II**
	**Anaphase II**

	**Telophase II**
	Cytokinesis

Learning activity 2. Pairs: Comparing meiosis and mitosis

The purpose of this learning activity is to compare and contrast the types of cell division – meiosis and mitosis.

Use the information in Table 2.21, as well as the information from the videos, to complete a Venn diagram. Work with another student teacher to complete the Venn diagram to show:

- the things that only happen in meiosis,
- the things that only happen in mitosis, and
- the things that are common to both meiosis and mitosis.

Table 2.21. Comparison of features of meiosis and mitosis

Feature	Meiosis	Mitosis
Function	Genetic diversity through reproduction	Cellular reproduction for general growth and repair
Organisms that use this type of cell division	Humans, animals, plants, fungi	All organisms
Genetics of daughter cells	Genetically different	Genetically identical
Crossing over of chromosomes	Yes, mixing of chromosomes can occur	No, crossing over does not occur
Number of divisions	2	1

Feature	Meiosis	Mitosis
Number of daughter cells produced	4 cells each containing one set of chromosomes	2 cells each containing two complete sets of chromosomes
Steps	Prophase I, metaphase I, anaphase I, telophase I, cytokinesis, prophase II, metaphase II, anaphase II and telophase II, cytokinesis	Prophase, metaphase, anaphase, telophase, cytokinesis
Resulting cells	Sex cells only (female egg or male sperm cells)	All cells except for sex cells

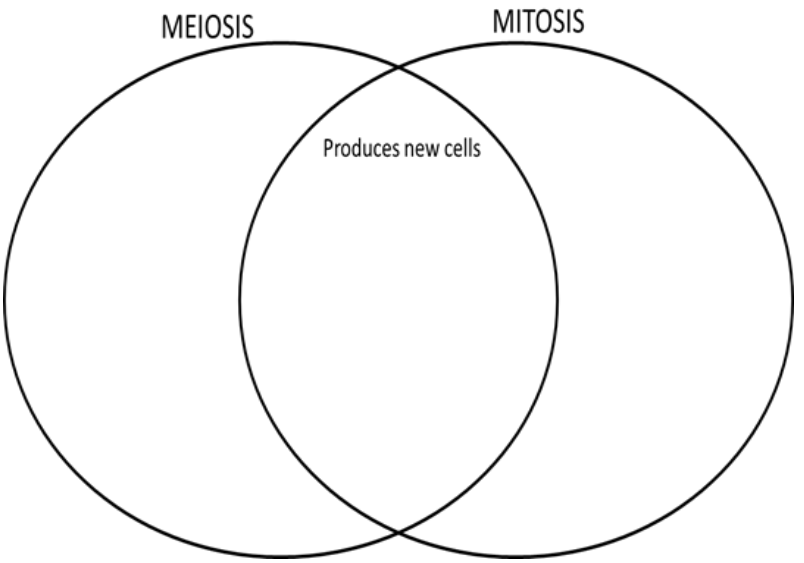


Figure 2.17. Venn diagram comparing meiosis and mitosis

Period 2

Stages of cell division

Learning activity 3. Flowchart: Developing a model of meiosis and mitosis

The purpose of this learning activity is to demonstrate the stages of cell division by creating a model flow chart.

Scientific models are a representation of ideas, events or processes that can be valuable to aid student learning in the classroom.

Some scientific concepts such as cell division cannot be easily observed and so models are a useful tool to represent, describe, explain and reason about these concepts. Models encourage students to think deeply and creatively about scientific ideas.

In this learning activity, you will work with a small group of student teachers to model the processes of meiosis and mitosis using common materials such as pipe cleaners and wool.

Your teacher educator will provide materials such as wool, pipe cleaners, beads or other commonly accessible materials. Your teacher educator will demonstrate how you can use these materials to model the process of cell division. For example, a model of interphase before DNA replication might look like Figure 2.18.

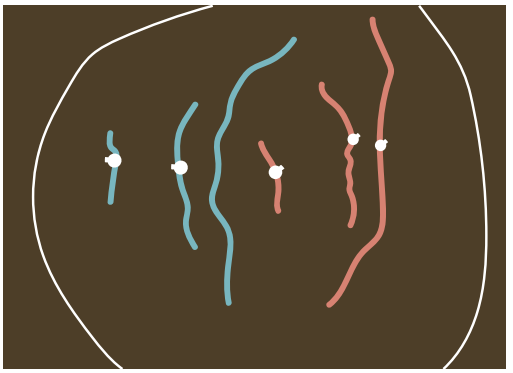


Figure 2.18. Model of interphase before DNA replication

Work with your group to model the stages of meiosis and mitosis. As you work, make sure you include the following information for each stage:

- The type of cell division
- The stage of cell division
- A very brief description of what is occurring at that stage.

Take photographs of your work to record the model that you have created.

Review questions

1. Draw a Venn diagram to compare the organelles of plant and animal cells.
2. Define and briefly explain meiosis and mitosis.

2.3. Tissues

In this sub-unit, you will investigate different types of plant and animal tissues, including their structures and functions. You will continue to develop your capabilities in working scientifically through practical and research-based learning activities. You will work collaboratively to develop learning activities about plant and/or animal tissues that are suitable for use in a Grade 6/7 classroom.

2.3.1. Plant tissues (Meristematic, simple and complex)

Expected learning outcomes

By the end of this lesson, you will be able to:

- Identify different types of plant tissue;
- Explain meristematic cell division;
- Describe the components of simple tissue and their functions; and
- Explain the components of complex tissue and their functions.

Period 1

Simple plant tissues

The **epidermis** is a single layer of cells that covers the leaves, flowers, roots and stems of plants. It is the outermost layer of the plant body and functions primarily to protect the plant by acting as a barrier to microorganisms and pathogens. The epidermis is thin and transparent, which allows for light to pass through and photosynthesis to colour the tissues underneath. Epidermal tissue has trichomes which are small hairs on the surface of the leaf. These act to trap water and prevent water loss. Epidermal tissue is covered with a waxy substance that also helps prevent water loss. Guard cells are another type of cell in the epidermis that contains the chloroplasts.

The guard cells control the opening and closing of the stomata (small holes in the leaves that control gas exchange), allowing oxygen, carbon dioxide and water vapour to enter and leave the leaf.

The **parenchyma** forms the majority of stems and roots, as well as soft fruits such as grapes and tomatoes. It functions mainly to store nutrients for the plant. The parenchyma has thin walls to allow for rapid diffusion between cells. The cells of the parenchyma have large central vacuoles that store and regulate ions, waste products and water. Vacuoles also help to make the cell firm and give support to the whole plant. Special cells in the parenchyma, called chlorenchyma, contain chloroplasts. This allows them to carry out photosynthesis and store starch.

The **collenchyma** is usually found in the shoots and leaves of plants. It functions to give strength and structural support to the leaves and shoots. The cells are thin-walled which allows for flexibility, for example, when the plant bends in the wind. The cells are tightly packed together to provide structural support. The corners of the cell walls are thickened and contain cellulose for mechanical strength.

The **sclerenchyma** tissue is the supporting tissue in plants that makes them hard and stiff. Sclerenchyma fibres are long and narrow and have thick, lignified (woody) cell walls. The fibres provide mechanical strength and allow for the conduction of water. Sclerids are specialised cells in the sclerenchyma tissue that have strong, thickened, lignified (woody) cell walls. They protect other cells and give fruits, such as apple cores and pears, their hardness.

Learning activity 1. Flowchart: Structure and function of simple plant tissues

The purpose of this learning activity is to understand the organisation of plant tissues and the structure and function of simple plant tissues.

Your teacher educator will introduce the different types of plant tissues. As the types of plant tissues are explained, fill in the flowchart in Figure 2.19 to show how the tissues are classified.

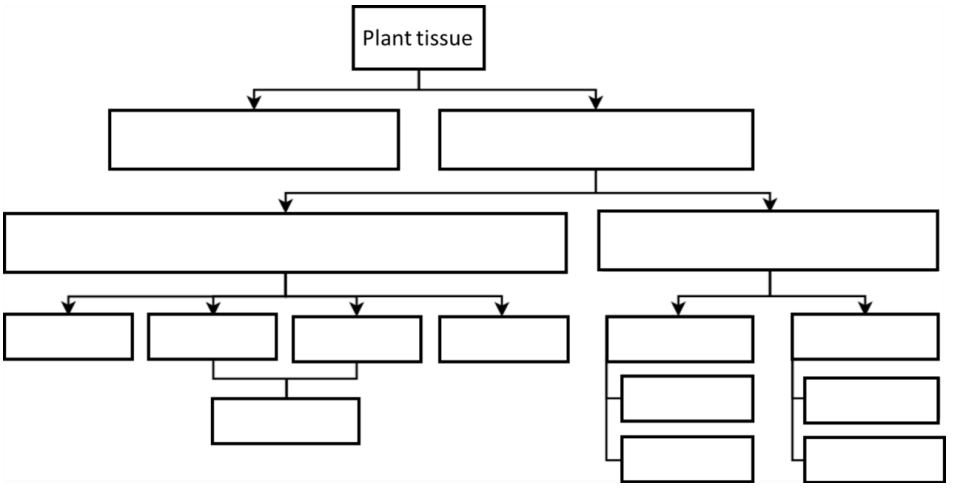
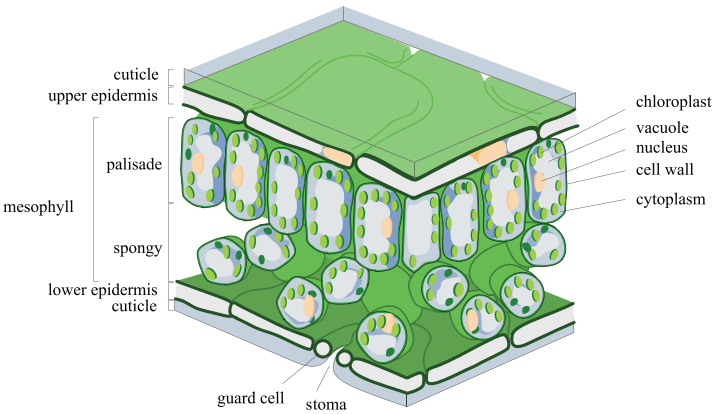


Figure 2.19. Types of plant tissue[46]

You will then form pairs and complete Table 2.22.

Table 2.22. Structure and function of simple plant tissues

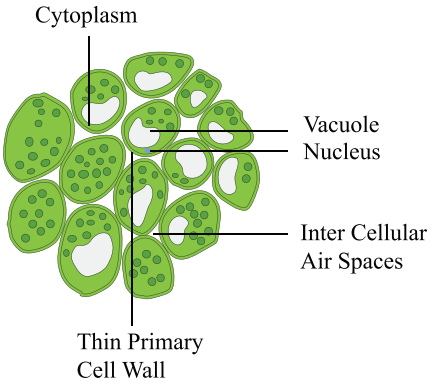
Epidermis



Structure	Function
Epidermis	(Overall function)
Trichromes	
Guard cells	

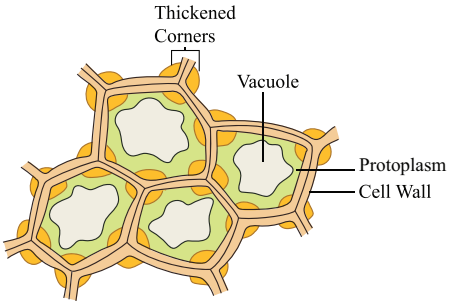
46 https://intl.siyavula.com/read/science/grade-10-lifesciences/plant-and-animal-tissues/04-plant-and-animal-tissues-03

Parenchyma



Structure	Function
Parenchyma	(Overall function)
Vacuoles	
Chlorenchyma	

Collenchyma



Structure	Function
Collenchyma	(Overall function)
Thin-walled cells	
Thickened corners	
Tightly packed cells	

Sclerenchyma

Structure	Function
Sclerenchyma	(Overall function)
Sclerenchyma fibres	
Sclerids	

Learning activity 2. Observation and analysis: Meristematic cell division

The purpose of this learning activity is to observe and analyse the stages of cell division in the meristematic tissue of plants.

Meristematic tissue contains undifferentiated (unspecialised) cells that are capable of cell division. As the cells in this tissue replicate, they develop into the specialised tissues and organs of the plant.

Apical meristem tissue causes primary growth (lengthening) of the plant. This occurs at the tips of shoots and roots.

Lateral meristem tissue causes secondary growth (widening) of the plant – for example, bark on trees.

Meristematic cells replicate by mitosis.

The cells of an onion bulb divide rapidly, and the stages of mitosis can often be seen by microscopy.

The image shows the stained cells of an onion bulb, similar to the observations you made in Lesson 2.2.1.

Observe this image closely. Can you identify the stages of mitosis in the highlighted boxes? What observations led to that decision?

How many cells can you see in each stage of mitosis? Review Figure 2.20 and record your answers in Table 2.23.

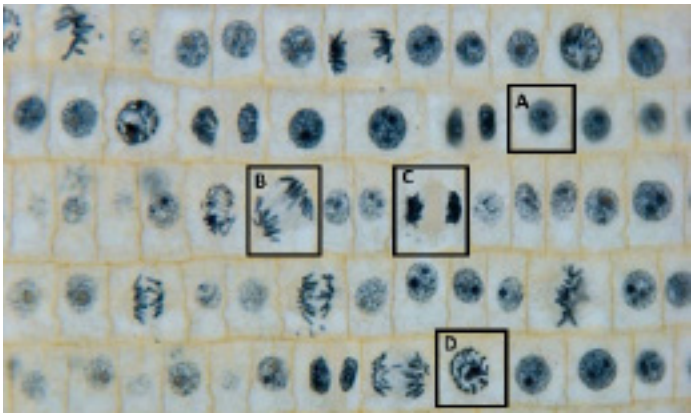


Figure 2.20. Cell division in onion bulb[47]

Table 2.23. Stages of mitosis in onion bulb cells

	Stage of mitosis	Evidence
A		
B		
C		
D		
E		

Period 2

Complex plant tissues structure and function

Xylem is the tissue in plants that provides support and transports water and dissolved minerals from the roots to the stem and leaves. It is made up of vessels, tracheids, fibres and parenchyma cells that are interconnected to form a continuous system of water-conducting channels. Xylem **vessels** are composed of a long chain of straight, tough, non-living cells arranged to form a hollow tube. Vessels have regions where primary and secondary cell walls are absent, known as perforations. Water flows through these perforations from vessel to vessel. The vessels function to transport water from roots to leaves.

47 https://drive.google.com/file/d/175y9Eo9rmiWVhME6BJju6UkhCtsQn4RL/view

Tracheids are elongated cells with a thick, lignified cell wall for structural support. The ends of the tracheid cells overlap with each other, creating pits. This formation allows water to pass horizontally from cell to cell. **Fibre** cells provide support to the xylem and the **parenchyma** tissue functions as storage for the various substances.

Phloem is the living tissue that transports the nutrients produced during photosynthesis. Phloem transports the nutrients to the parts of the plant where the nutrients are required. Phloem tissue is composed of sieve elements, parenchyma cells, companion cells and fibres.

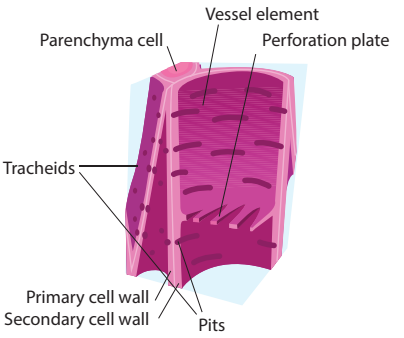
Sieve elements, also called conducting cells, are a type of cell that transports sugars throughout the plant. They do not have a nucleus and lack many other cellular organelles. This allows for more space for transportation. They are long cells arranged in columns to form channels that the nutrients move through. As they lack many organelles, sieve elements rely on companion cells for their metabolic requirements. The companion cells and sieve elements are connected by plasmodesmata: microscopic channels that allow transport and communication between cells. Parenchyma cells store the food for transport in the phloem. The fibres provide structural support for the tissue.

Learning activity 3. Tabulation: Structure and function of complex plant tissues

The purpose of this learning activity is to help you understand the structure and function of complex plant tissues. Read through the information about complex plant tissues and work in pairs to complete Table 2.24.

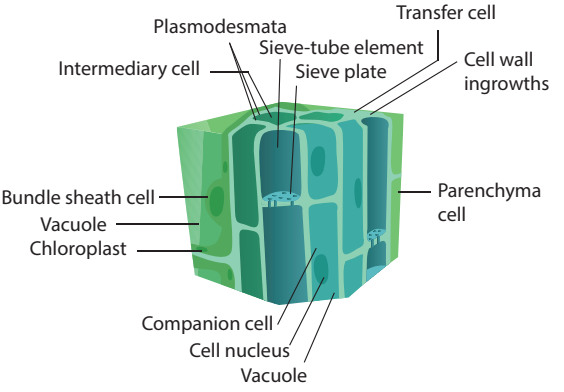
Table 2.24. Structure and function of complex plant tissues

Xylem



Structure	Function
Long cells, straight cell arrangement	
Thick, lignified cell walls of tracheids	
Pits of tracheids	
Fibre	
Parenchyma	

Phloem



Structure	Function
Sieve elements	
Companion cells	
Parenchyma cells	
Fibres	

Learning activity 4. Practical: Experimental design to observe water transport in plants

The purpose of this learning activity is to design an experiment to observe the transport of water in plants and identify the tissues involved in water transport.

Transport of water can be demonstrated using celery. In this experiment, you will investigate the role of leaves in the transport of water in celery stalks. You will investigate the difference in water transport between a celery stalk with leaves and one without leaves.

Before you set up the experiment, use the science-inquiry template (Table 2.25) to help prepare for the practical and to consider any safety risks.

Use your knowledge of plant cell and tissue structure and function to make a prediction about what you might observe. Record this in point 2 of the template.

The instructions for the investigation are given in the template.

In your group, complete the template points from 1-5.

When you have completed those points in the template, you can collect the materials needed from your teacher educator and set up the experiment.

You will make observations and draw conclusions in the next period.

Table 2.25. Science-inquiry template: Water transport in plants

1. Question In this investigation, I am trying to find out …
2. Prediction I predict that … This is because …

3. Variables
Things that will affect this investigation include …

The variable/s that I will *change* to answer the question is …

The variables that I will keep the *same* are …

I will *measure* …

4. Equipment and method
Equipment (per group):

- 2 sticks of celery with leaves on
- sharp knife
- 2 cups (same size)
- measuring cylinder
- water
- food dye
- ruler

Method:

1. Take each stick of celery and cut off the wide base (about 2cm).
2. Measure the length of each stick of celery and cut from the base to make sure the sticks are of equal length. Make sure the celery is not too long that it will tip the cup over.
3. Remove the leaves from one stick of celery.
4. Measure 400ml of water and add this volume to each cup.
5. Add an equal amount of food colouring to each cup (make the colour quite dark).
6. Put the cut end of each celery stalk into a cup of coloured water.
7. Leave the celery stalks in the cup of coloured water overnight.
8. Observe the bottom of the celery stalk. Record your observations.
9. Cut the celery stalk lengthways down the middle. Measure how far the coloured water travelled up the stalk. Record your observations.

5. Safety
The risks in doing this investigation are …

I will manage these risks by …

6. Observations
This is what I observed …

7. Results In the investigation, I found out that … The observations that support this are … My prediction was (correct/incorrect) because …
8. Discussion Was this a fair test? Why/why not? If I could do the investigation again, I would … This would improve the investigation because …

Period 3

Observing water transport in plants

Learning activity 5. Practical: Observing water transport in plants

The purpose of this learning activity is to observe the transport of water in plants and identify the tissues involved in water transport.

When your teacher educator tells you to, collect your celery stalks from the previous period.

Blot the stalks dry and remove any excess water with a paper towel.

First, observe the base of the stalks and record what you can see in the science-inquiry template (Table 2.25).

After you have made this observation, cut along the length of the stalk to measure how far the water has travelled.

At each step, record your observations in the template.

Include a labelled diagram of the plant tissue, labelling any structures you can identify.

Cut through a section of the stalks to observe the xylem. Record what you can see using a labelled diagram.

Complete points 6-8 in the science-inquiry template.

As you work, consider the following questions:

- What did you observe?
- How did this relate to what you predicted?
- Was it a fair test?
- What could you not control?
- What would you do differently if you could do the experiment again?
- How does this experiment demonstrate water transport in plants?

Consider hands-on science inquiry in a middle school classroom context.

- Why is it important to do practical/hands-on investigations with students?
- How does hands-on learning facilitate student learning?
- Did this practical help your understanding of transport in plants?

Your teacher educator will ask you to contribute to a discussion of these questions.

2.3.2. Animal tissues

Expected learning outcomes

By the end of this lesson, you will be able to:

- Examine the different types of animal tissues;
- Develop a group activity for a Grade 6/7 class to classify the structure and function of each different type of animal tissue;
- Explain form and structure of epithelial tissue;
- Describe the different types of connective tissue;
- Describe the types of muscular tissues in the body; and
- Explain the nervous tissue and identify a reflex arc.

Period 1

Types of animal tissues and their functions

Learning activity 1. Research and poster presentation: Tissue types

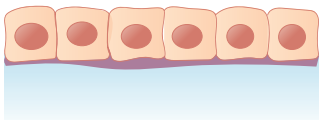
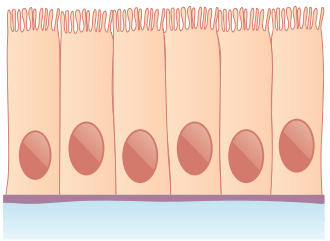
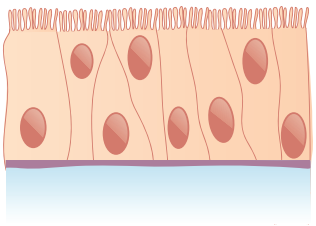
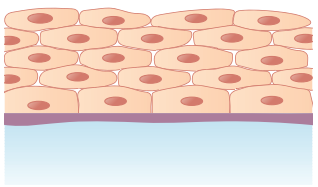
The purpose of this learning activity is to understand the types of animal tissues and their functions.

This period will focus on three types of animal tissue:

1. **Epithelial**
2. **Connective**
3. **Muscular**

You will work with a group of student teachers to research one of these types of tissues. Your group will prepare a poster and present the information about the tissue type to the other student teachers.

Table 2.26. Epithelial tissue

Characteristics of epithelial tissue:			
Type of epithelial tissue	**Cell shape and arrangement**	**Locations**	**Function**
 Simple squamous			
 Simple cuboidal			
 Simple columnar			
 Pseudostratified columnar			
 Stratified squamous			

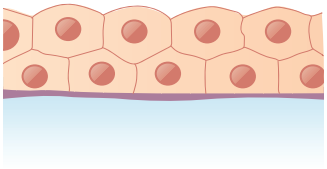
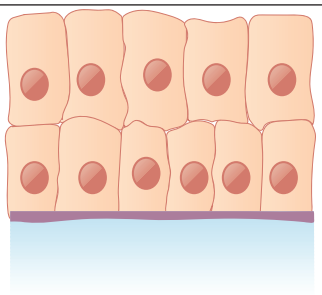
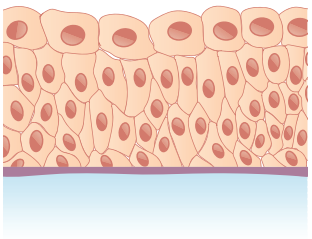
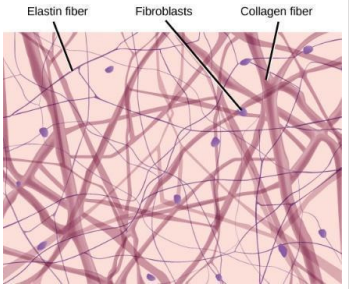
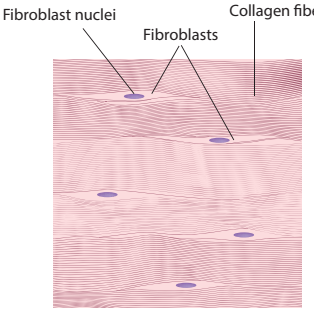
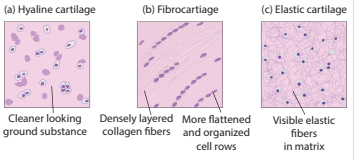
Type of epithelial tissue	Cell shape and arrangement	Locations	Function
 Stratified cuboidal			
 Stratified columnar			
 Transitional			

Table 2.27. Connective tissue

Components of connective tissue:			
Type of connective tissue	**Composition**	**Locations**	**Function**
 Connective proper – loose connective			
 Connective proper – dense connective			
 Cartilage			

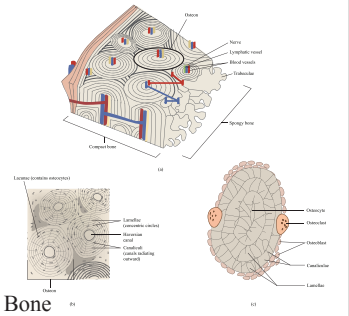
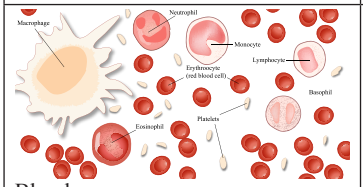
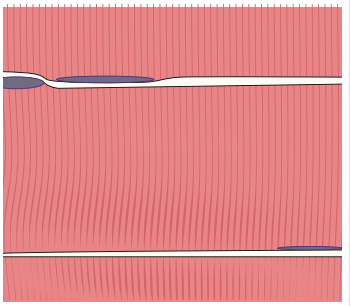
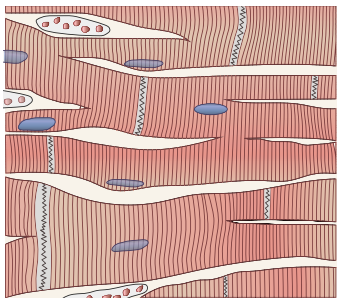
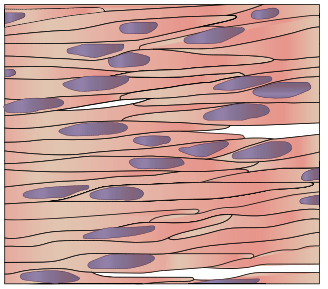
Type of connective tissue	Composition	Locations	Function
 Bone			
 Blood			

Table 2.28. Muscle tissues

Components of muscle tissue:			
Type of muscle tissue	**Composition**	**Locations**	**Function**
 Skeletal muscle			

Type of muscle tissue	Composition	Locations	Function
 Cardiac muscle			
 Smooth muscle			

Period 2

Nervous tissue

Nervous tissue is the main component of the nervous system. The nervous system includes the brain, spinal cord and nerves. The main functions of the nervous system are communication and control of the body. The nervous system consists of two categories of cells: neurons (nerve cells) and neuroglia (glial cells). Neurons are highly specialised nerve cells that generate and conduct nerve impulses. Neuroglial cells do not transmit electrical signals but function to support and protect neurons.

The nervous system consists of the central nervous system (CNS) and the peripheral nervous system (PNS). The CNS is composed of the brain and spinal cord that coordinates information from all parts of the body and sends signals to control body movements. The PNS consists of peripheral nerves that branch throughout the body. It connects the CNS to the rest of the body and controls movements of particular parts of the body.

The structure of a neuron is shown in Figure 2.21. Each component of a neuron has specific functions. The dendrites are thin, branching projections that receive the incoming information from other neurons and synapses. The cell body consists of a nucleus and other cellular organelles. The cell body is responsible for the synthesis of proteins and other chemicals. Axons are long projections that carry the signal away from the cell body to the next neuron. Signals are released from the ends of the axon terminals and travel across the synapse to receptors on the dendrites of other neurons.[48]

The axon can be surrounded by a whitish, fatty layer called the myelin sheath that provides electrical insulation. Nodes of Ranvier are gaps in the myelin sheath coating that allow ions to diffuse in and out of the neuron.

Glial cells are cells that support the neurons, supply them with nutrients and remove dead cells and debris.

There are several types of glial cells: **Eukaryote**

- Astroglial cells are found in the brain and spinal cord and provide nutrients to neurons, maintain ion balance, and remove unneeded excess neurotransmitters from the synaptic cleft.
- Oligodendrocytes are found in the CNS and provide physical support to neurons. They form a myelin sheath around some neurons in the CNS.
- Microglial cells are small cells in the CNS that protect against disease by engulfing and removing pathogens. They can also destroy infected neurons and promote the regrowth of neurons.
- Schwann cells form myelin sheaths around some neurons in the PNS. Neurons that are myelinated can conduct electrical impulses faster than non-myelinated neurons.

48 Lumen Boundless Anatomy and Physiology. (n.d.).

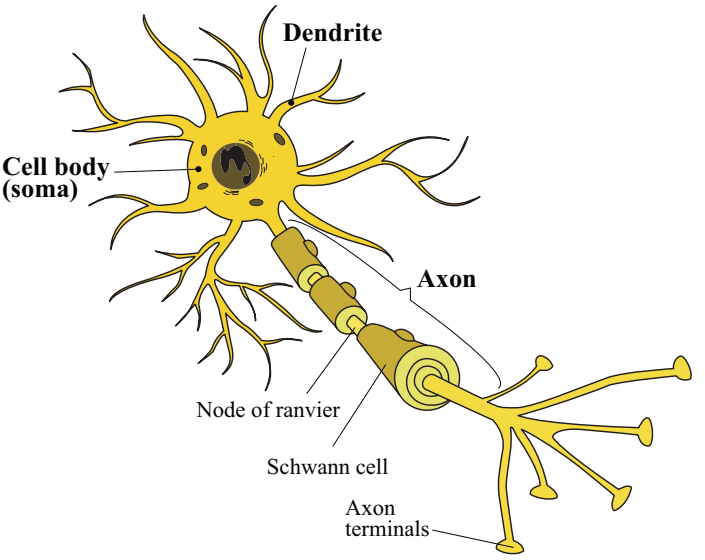


Figure 2.21. Diagram of a neuron[49]

Reflex arc

A **reflex** is an automatic response to a stimulus (something that causes an action). A reflex arc is the nervous system pathway that controls the reflex. The steps in a reflex arc are sensor, sensory neuron, control centre, motor neuron and muscle. Reflexes start in the sensors: structures, including neurons, that detect a stimulus (for example, sound, heat, pain, light and touch). The sensor signals the sensory neuron to take the message to the spinal cord or the brain. Neurons in the brain and spinal cord control reflex actions by combining information and responding. The nerve impulse travels to motor neurons: the neurons that control muscles and glands. The muscles or glands then respond to the signal and produce a reaction, such as muscle contraction or hormone secretion.

Learning activity 2. Practical: Investigating a reflex arc

The purpose of this learning activity is to understand a reflex arc and investigate the effect of noise on reflex actions.

In this learning activity, you will be investigating a reflex arc using the ruler drop test.

49 Medical News Today. (n.d.).

The investigation will study the effect of background noise on reaction speed.

You will work with another student teacher, and you will both do the ruler drop test with 10 replicates.

You will conduct the test twice – firstly in silence, then with background noise.

When your teacher educator instructs you, work with another student teacher to complete points 1-5 of the science-inquiry template. The method is given in the template. Ensure you read the method before you begin the inquiry.

Once you have recorded the data for each condition, complete points 6-8 of the inquiry template.

Table 2.29. Science-inquiry template: Effect of background noise on a reflex arc

1. Question In this investigation, I am trying to find out …
2. Prediction I predict that … This is because …
3. Variables Things that will affect this investigation include … The variable/s that I will *change* to answer the question is … The variables that I will keep the *same* are … I will *measure* …

4. Equipment and method

Equipment (per group):

- ruler with centimetre graduations
- table
- chair

Method:

1. Decide who will drop the ruler and who will catch it.
2. The person catching the ruler should sit comfortably in a chair with the arm resting on the table.
3. The person catching the ruler should place their thumb and forefinger on either side of the ruler, ready to catch it.
4. The person dropping the ruler should hold the ruler vertically with the 0cm marking in line with the thumb and forefinger of the person catching.
5. Check that the catcher is ready.
6. Wait for the class to be ready and be as silent as possible.
7. The person dropping the ruler should release the ruler without telling the person catching.
8. The person catching should try to grab the ruler as quickly as possible.
9. Record the number on the ruler where it was caught.
10. Repeat the ruler drop for the first person until 10 measurements have been recorded.
11. Swap places and repeat for the second person.
12. Once the class has finished the collection with low background noise, your teacher educator will instruct you to repeat the experiment with background noise.
13. Collect 10 measurements for each person again, making sure this time you are talking, and that the classroom has background noise.
14. Calculate the average of your measurements.

5. Safety

The risks in doing this investigation are …

I will manage these risks by …

6. Observations
This is what I observed…

Measurement number	Low background noise	High background noise
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
Average		

7. Results
In the investigation, I found out that …

The observations that support this are …

My prediction was (correct/incorrect) because …

8. Discussion
Was this a fair test? Why/why not?

If I could do the investigation again, I would …

This would improve the investigation because …

The reflex arc that occurs in the ruler drop test involves the following processes. Number each box to show the correct order of the steps.

Table 2.30. Processes of a reflex arc

Step ___ Eyes send a message to the visual cortex in the brain.	Step ___ The motor cortex in the brain sends a message to the spinal cord.	Step ___ Finger muscles contract.
Step ___ Spinal cord sends a message to the finger muscles.	Step ___ The eyes detect the ruler is released.	Step ___ Visual cortex in the brain sends a message to the motor cortex in the brain.

Period 3

Collaborative learning in Science

When students are given regular opportunities to work together, they can develop effective group learning skills. The skills of collaboration may not come naturally to most students but can develop when facilitated by a teacher. An effective strategy is to use a range of collaborative learning strategies that give students the opportunities to experience various roles and responsibilities.[50]

Through collaborative learning activities, students are given opportunities to:

- communicate and compare ideas,
- develop each other's ideas,
- discuss and debate ideas and rationales,
- revise and rethink their reasoning, and
- present their understanding using multi-modal representations.

Some collaborative learning strategies include:

Learning triangles: Learners work in groups of three, each with a defined role. One student is the speaker, one a questioner and one a note-taker. The speaker explains the topic or expresses their opinion on an issue. The questioner listens carefully and asks for clarification or further detail. The note-taker observes the process and provides feedback to the speaker and questioner.

50 Primary Connections. (n.d.).

Snowballing: Learners work in pairs. The pairs then join another pair to make a small group. The small groups join with another small group to form a larger group. The group size continues to grow, and the ideas develop and grow with each new group.

Games and activities with a competitive element: Games can be very effective in motivating learners and in revising or consolidating curriculum content. They also practise turn-taking and negotiating. Competitive games and activities that require a group rather than individual success encourage students to work together.

Drama or role-play: These activities can make learning memorable, encourage co-operation and help students with communication and planning. Rehearsing allows for consolidation of learning and the opportunity to practise skills and knowledge in a given context.

Jigsaw: Small groups of students become experts on one component of a topic and then teach that component to their peers. This gives students the opportunity to work with others and to see different points of view. In a jigsaw, students must practise using many important skills, including communication, problem-solving and critical thinking.

Team roles: Students working together on a project or practical can be assigned roles so that each student contributes in different ways to a group activity.

Roles can include:

- A project manager to provide instructions and management of the project, ensuring students work efficiently, stay on task and meet all required steps of the project. This role builds skills in communication, organisation, leadership and time management.
- A technician to do most of the hands-on work. This role builds motor skills, direction-following skills and attention to detail.
- A data analyst to record and analyse the data generated by the group. This role builds reasoning skills, organisational skills and numerical literacy.
- A reporter to communicate the findings or present the project to the rest of the class. In this role, students summarise results, determine how to best share a project and create presentation materials.[51]

51 Cowen, A. (2019, June 4).

Learning activity 3. Group work: Developing a group activity for a Grade 6/7 class

The purpose of this learning activity is to develop a group activity for a Grade 6/7 class to classify the structure and function of animal tissue.

In this learning activity, you should use the lesson plan template in Annex 2 to develop a group learning activity for Grade 6/7 students. The template is modified as you do not need to develop an entire lesson but an activity that could be used as part of a lesson.

The group activity that you develop needs to incorporate some aspect about the structure or function of an animal tissue. You should begin by reviewing the Grade 6/7 curriculum and student textbooks to identify what students need to learn at that grade level.

Your group activity needs to include the following information:

- Learning outcomes
- Success criteria
- Teaching and learning strategies (must be a group strategy)
- Resources needed
- Description and explanation of the activity
- Differentiation opportunities

2.3.3. Practical (Plant and animal tissue)

Expected learning outcomes

By the end of this lesson, you will be able to:

- Investigate the dicot stem of plants through dissection and identify parenchyma, collenchyma and sclerenchyma tissue;
- Identify the structures of epithelial tissue and muscular tissue in animals using microscopy; and
- Collaboratively develop a learning activity for a Grade 6/7 class which focusses on scientific drawings of plant and animal tissues.

Period 1

Observation of tissue of plants

Learning activity 1. Practical: Dissection and identification of plant tissues

The purpose of this learning activity is to identify the tissues of plants through dissection and observation. The method for the practical is:

1. Cut a stick of celery about 5cm long.
2. Lay the stem horizontally on a cutting board and use a scalpel blade (or very sharp knife) to cut a very thin slice of the stem perpendicular to the length of the stem. Your teacher educator may have already prepared the slices of celery for you.
3. Place the slices into a small container of tap water and leave for two minutes.
4. Move the celery slice into a small container of 1% w/v Toluidine blue and leave the slice to stain for one minute.
5. Remove the slices and rinse off excess stain in the container of tap water.
6. Place the slice on a microscope slide. Add a drop of tap water and cover with a coverslip.
7. Find a clear view that shows the structures within the stem.
8. Draw labelled scientific diagrams of what you see at low and high magnification in the space on the next page.

Box 2.7. Scientific drawing of plant tissue

Learning activity 2. Microscopic identification of epithelial and muscle tissues in animals

The purpose of this learning activity is to identify the types of tissue found in the human body from microscopy images.

Your teacher educator will give you some microscopy images of stained sections of human tissues.

Use the information from the lessons about animal tissues to identify the type of tissue in each image.

Draw a labelled scientific diagram of at least three different tissue types. Identify what type of tissue it is and explain the features of each tissue that you used to identify the tissue.

Box 2.8. Scientific drawing of animal tissues 1

Box 2.9. Scientific drawing of animal tissues 2

Box 2.10. Scientific drawing of animal tissues 3

Period 2

Guide to scientific drawings

The skill of accurately observing and recording information about an organism is a scientific skill often required in biology. A scientific drawing provides a permanent record of what has been observed. Attention to detail is important and accurate representations of what has been observed is critical.

Rules exist to guide biologists to correctly produce scientific drawings. These are some of the guidelines for a good scientific drawing:

Table 2.31. Rules for scientific drawing

Rules for scientific drawing
Use a sharp lead pencil only. Do not use pens or coloured pencils.
Use clear, continuous lines. Do not overlap lines.
Do not use any form of shading.
Pay attention to the outlines of structures and to the relative proportions of different parts of the specimen.

Rules for scientific drawing
Draw only what you observe. Do not draw what you think you should see.
Make the drawing large enough that the details can be seen.
Include a title stating what the specimen is.
Include a scale if relevant or include the magnification when using a microscope.
Label all structures. Label lines should start exactly at the structure being labelled.
Do not use arrows to point to structures. Use a line only.
Make sure lines for labels do not cross over each other.
Write labels horizontally.

Look at this drawing of cells. Can you identify any errors in this scientific drawing?

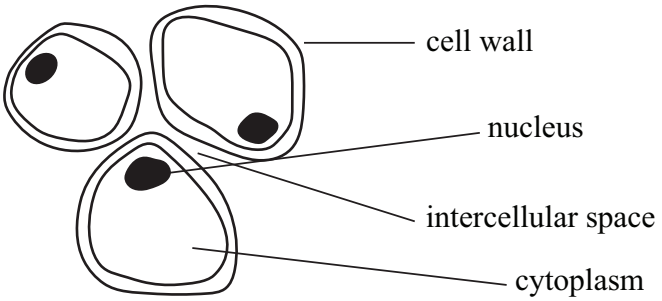


Figure 2.22. Scientific drawing of cells

Reflect on one of your own scientific drawings from the previous period.

What did you do well? What errors did you make?

If each rule in the table is worth one mark, how many marks would you receive for this drawing?

Learning activity 3. Group work: Developing a learning activity for Grade 6/7 students about scientific drawings

The purpose of this learning activity is to develop a learning activity for a Grade 6/7 class about scientific drawings.

You may choose to use animal tissues, plant tissues or both as the content for the teaching resource.

Remember that a learning activity can be anything that is used in the classroom to build student understanding about a concept. Resources might be an activity, game, worksheet, book, text, song, rhyme, crossword, quiz, video or poster.

You will work with a small group of student teachers to develop an activity.

Develop the activity in the space given in your textbook.

As you develop the activity, consider:

- When would this activity be used in a lesson?
- How does this activity help student learning?
- Who would use this activity?
- What are the learning objectives that are connected with this activity?
- How will this activity help students understand scientific drawings?
- What are the success criteria for the activity?

Box 2.11. Learning activity for Grade 6/7 students about scientific drawing

Review questions

1. Match the plant tissue with its function. Under each tissue type, list the key cell types of the tissue.

Epidermis Cell types:	Transport of water and dissolved ions from the roots upwards through the plant
Xylem Cell types:	Store nutrients for the plant
Collenchyma Cell types:	Transport and distribution of the organic nutrients
Parenchyma Cell types:	Barrier protection to external environment
Phloem Cell types:	Strength and structural support to the leaves and shoots
Sclerenchyma Cell types:	Supporting tissue in plants that makes them hard and stiff

2. What are the four main tissue types of the human body? Briefly describe the main function of each.

2.4. Organ Systems

In this sub-unit, you will gain an understanding of how cells and tissues functioning together form organ systems of plants and animals. You will explore how the human body works to maintain homeostasis.

2.4.1. Cooperation among organ systems of plants

Expected learning outcome

By the end of this lesson, you will be able to:

- Observe and classify the structure and functions of each organ of plants.

In plants, similar cells working together form a tissue. When different types of tissues work together to perform a unique function, they form an **organ**. Organs working together form organ systems. The organs of a plant allow it to carry out the seven processes of life. Plant organs include the **roots**, **leaves**, **stem**, **flowers**, **fruit** and **seeds**.[52]

Most vascular plants have **primary roots** that grow downwards and secondary roots that grow out to the side. The primary root originates at germination and anchors the plant in the ground. There are two types of root systems. Taproot systems have a single, thick primary root called a taproot. It anchors the plant very securely in the ground and smaller, secondary roots grow out from the side. Taproots can grow deep into the ground and store nutrients for the plant. Fibrous root systems have many small, branching roots. These root systems have many fine roots that increase the surface area of the root for absorption of water and nutrients. The roots are thread-like and anchor the plant less firmly in the ground.[53]

52 BBC Bitesize. (2019, September 5).
53 CK-12. (n.d.).

The stem of a plant is a structure that supports leaves, flowers and fruits. It functions to transport water and other dissolved substances from the roots to other parts of the plant. The stem also stores nutrients and produces new living plant tissue.

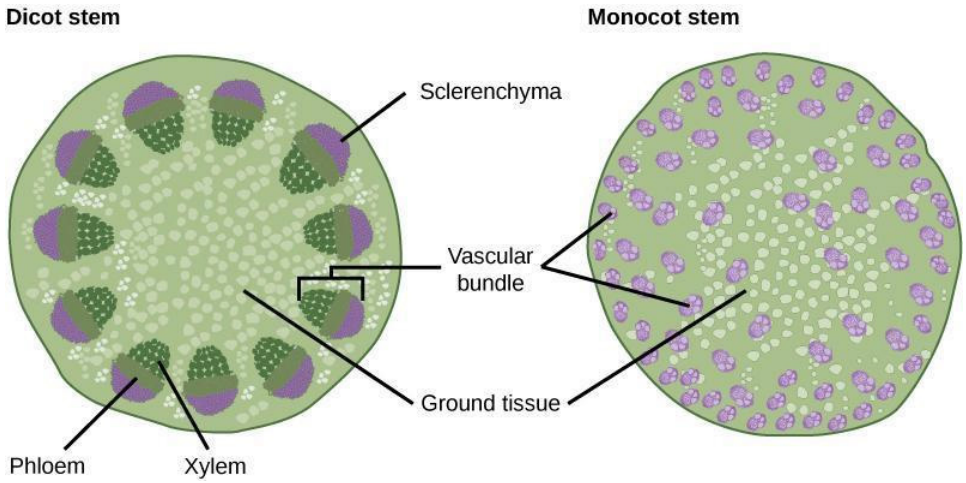


Figure 2.23. Structures of a plant stem[54]

Leaves are the specialised structures where photosynthesis occurs to make food (energy) for the plant. Leaves contain an organelle called chloroplasts that absorb sunlight. The sunlight, with water and carbon dioxide from the air, is converted into energy (sugars) for the plant and oxygen. Leaves can also store water and may have a waxy outer layer to waterproof and provide protection to the plant.[55]

54 https://commons.wikimedia.org/wiki/File:Figure_30_02_06.jpg By CNX OpenStax. Licensed under the Creative Commons Attribution 4.0 International license. View license here: https://creativecommons.org/licenses/by/4.0/

55 National Geographic Society. (1996-2021).

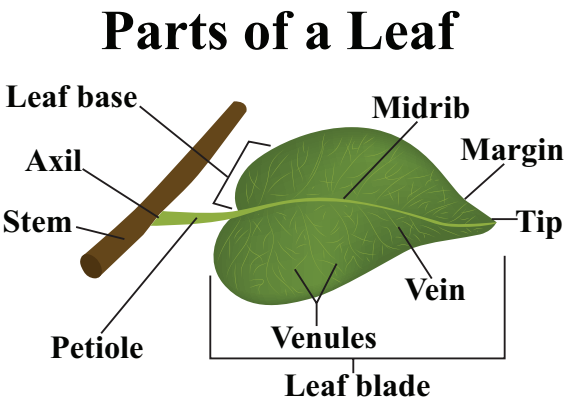


Figure 2.24. Structures of a plant leaf

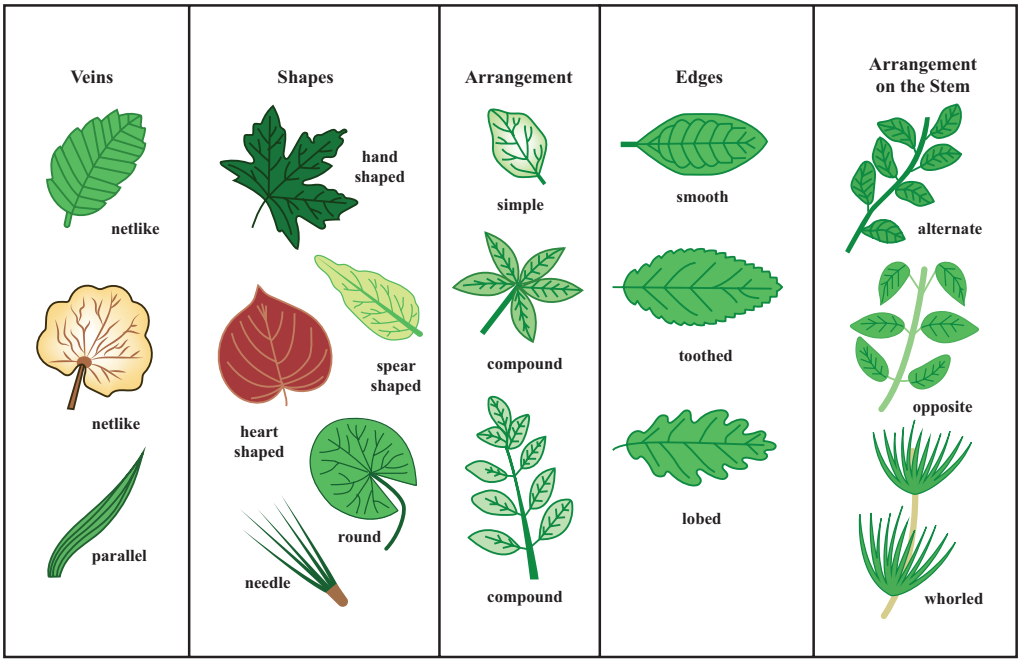


Figure 2.25. Leaf structure and arrangement

Flowers are the reproductive part of a plant. In Year 1, you learnt about the parts of flowers and pollination. Pollination is the process where pollen from the anther (the male reproductive cell) is transferred to the stigma. In the stigma, the pollen is transported to the ovules where fertilisation occurs.

A seed is an embryonic plant enclosed in a protective outer covering. Fruit is the fleshy or dry-ripened ovary of a flowering plant, enclosing the seed or seeds.

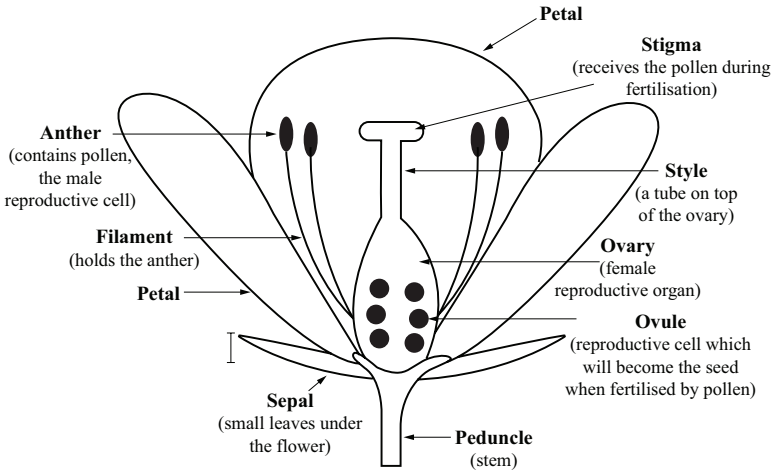


Figure 2.26. Structures of a flower

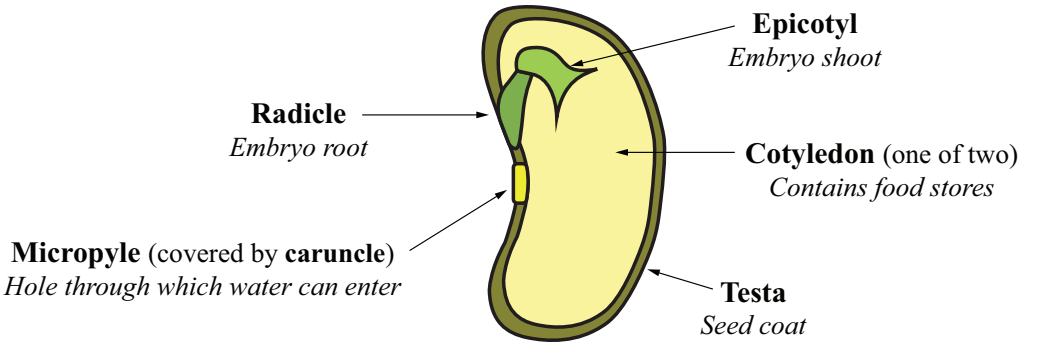


Figure 2.27. Structures of a seed

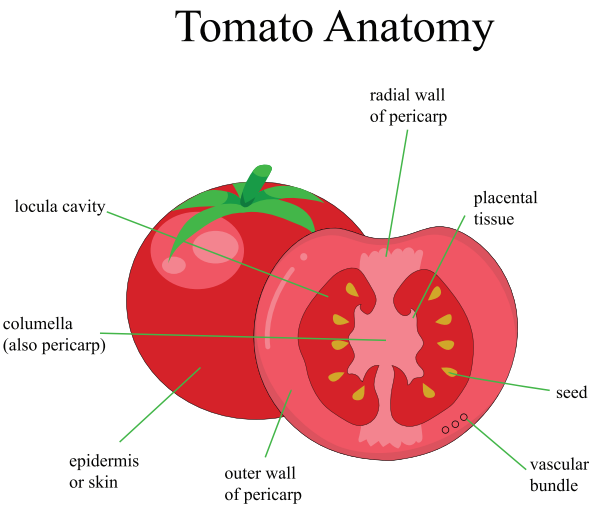


Figure 2.28. Structures of a fruit (Tomato)

Learning activity. Practical: Observation of plant organs

The purpose of this learning activity is to observe the structure of plants through dissection and observation.

Your teacher educator will provide you with the materials and equipment required for this practical.

You will observe and describe the following plant organs:

- Flower
- Leaf
- Seeds (soaked)
- Fruit

Use the background information in your textbook to identify the structures of each plant organ.

To dissect the fruit, flower and seeds, make a lengthways cut as in the diagrams. The leaves can be observed without dissection.

You can carefully separate the structures if possible (for example, flower parts).

Observe the structures using the magnifying glasses.

Draw and label the structures as you dissect the parts.

Leaf	Fruit
Flower	Seed

Label the organs of the plant and match the organs of the plant with its function.

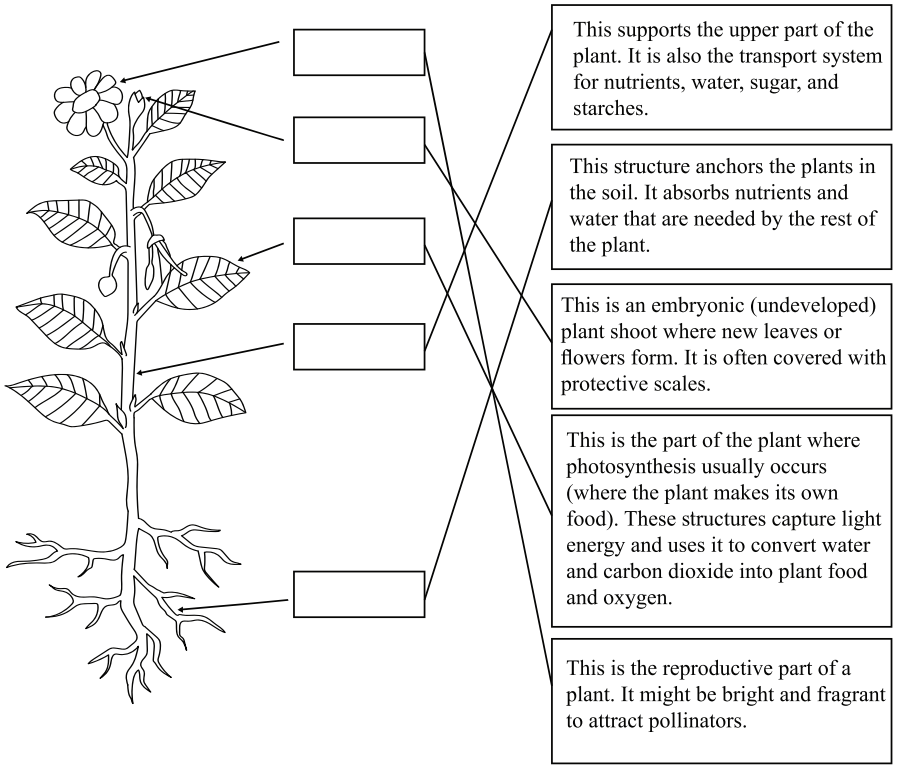


Figure 2.29. Organs of a plant

2.4.2. Organs and organ systems of the human body

Expected learning outcomes

By the end of this lesson, you will be able to:

- List the major organs and organ systems of animals including humans;
- Describe parts associated with each organ system of humans; and
- Explain the function of each system.

Period 1

Organ systems of the human body

Learning activity 1. Jigsaw (research): Organ systems of the human body

The purpose of this learning activity is to research in detail an organ system of the human body.

In Year 2 of your Science studies, you learnt that the human body has 11 organ systems. In this lesson, you will research and share information in more detail about each of those organ systems.

You have covered the digestive system in detail in Year 2 of your studies, so that will not be covered again in this lesson.

You will work with a group of student teachers to become an expert about one of the organ systems of the human body. Your worksheet is in Annex 3. Complete the required elements for the organ system that you have researched.

Period 2

Organs and organ systems of the human body

Learning activity 2. Jigsaw (expert sharing): Organ systems of the human body

The purpose of this learning activity is for you to share the information about the organ system that you have researched with other student teachers in the larger group.

In this learning activity, you will share your expert knowledge with student teachers from other research groups. The other research groups will share their knowledge with you about the organ system they have researched.

Do not share why you think this is the most important system of the body.

You should complete the worksheets in your textbook as the information about other organ systems is shared with you by other student teachers. By the end of the lesson, you should have a complete set of notes about 10 organ systems of the human body.

2.4.3. Structure of skin and nervous system of humans

Expected learning outcomes

By the end of this lesson, you will be able to:

- Collaboratively develop an investigation for a Grade 6/7 class which examines the structure and functions of human skin; and
- Examine the structure and function of the human nervous system.

The nervous system

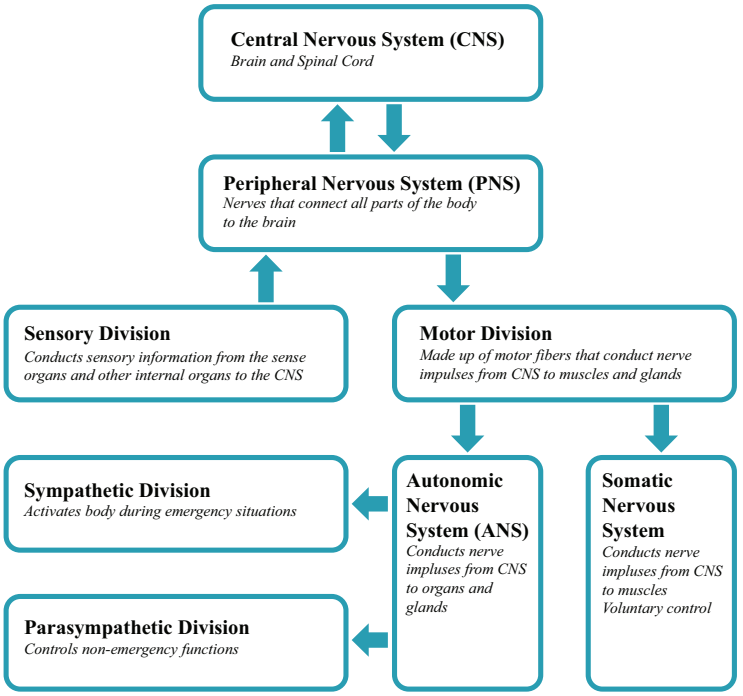


Figure 2.30. Structure of the human nervous system

The Brain

The brain is the most complex organ of the human body and the control centre of the nervous system. It contains 100 billion neurons. The brain controls mental processes such as reasoning, imagination, memory and language. It also interprets information from the senses. In addition, it controls basic physical processes such as breathing and heartbeat.

The brain has three major parts: the **cerebrum**, **cerebellum** and **brain stem**.

The cerebrum is the largest part of the brain. It controls conscious functions such as reasoning, language, sight, touch and hearing. It is divided into two hemispheres (or halves). The hemispheres are very similar but not identical to one another. They are connected by a thick bundle of axons deep within the brain. Each hemisphere is further divided into four lobes.

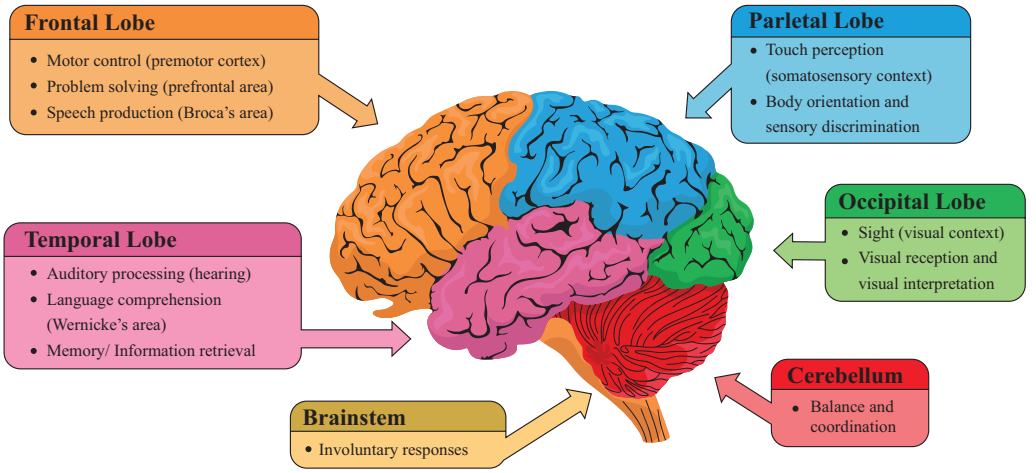


Figure 2.31. External structures of the brain

The cerebellum is just below the cerebrum. It coordinates body movements. Many nerve pathways link the cerebellum with motor neurons throughout the body. The brain stem is the lowest part of the brain. It connects the rest of the brain with the spinal cord and passes nerve impulses between the brain and spinal cord. It also controls unconscious functions such as heart rate and breathing.[56]

56 CK-12. (n.d.).

Spinal cord

The spinal cord is a thin, tubular bundle of nervous tissue that extends from the brainstem and continues down the centre of the back to the pelvis. It is protected by the vertebrae, which encase it. The spinal cord serves as an information superhighway, passing messages from the body to the brain and from the brain to the body.

Learning activity 1. Quiz: Structure and function of the human nervous system

The purpose of this learning activity is to learn about the structure and function of the nervous system.

1. Name the organs of the central nervous system.

2. What are the main functions of the central nervous system?

3. What is the role of the spinal cord?

4. Which part of the brain controls conscious functions such as reasoning and problem solving?

Learning activity 2. Practical: Collaboratively conduct an investigation for a Grade 6/7 class which examines the structure and functions of human skin

The purpose of this learning activity is to collaboratively conduct an investigation for a Grade 6/7 class that examines the structure and function of human skin.

One of the functions of human skin is to provide insulation. This practical investigation will allow you to investigate how multiple layers provide greater insulation. This models human skin that is composed of many layers.

You will choose a material to use in your investigation. Decide how much of this material will be one layer. For example, 10 sheets of newspaper or 100 cotton balls or 100g of sand. You will then use two-times and three-times this amount in the other tests to model multiple layers. You will have one test with no insulation as a control.

Measuring insulation

Equipment:

- 4 x small bottles or jars with lids
- hot (not boiling) water
- thermometer
- insulating materials – choose from fabric, cotton wool, tissues, newspaper, newspaper, packaging material (for example, Styrofoam), sand or a material you have chosen
- 4 x plastic containers/tubs
- measuring cylinder
- jug

Method:

1. Place a bottle or jar in a plastic container.
2. Fill the surrounding space with one layer of insulation material.
3. Repeat steps 1 and 2 for the bottles 2 and 3, using twice or three-times the amount of insulation material.
4. Place the fourth bottle/jar in the third container and do not add insulating material (this is the control).
5. Collect hot water in a jug.
6. Measure 100ml of water and add to the first bottle.
7. Immediately take the temperature of the water in the bottle.
8. Record the temperature and put the lid on the bottle/jar.
9. Record the time.
10. Repeat steps 6-9 for the other two bottles/jars.
11. Record the temperature in each bottle after five minutes and 10 minutes.

Material used:

Table 2.32. Insulation observations

Amount of insulation material	Initial temperature	Temperature after 5 minutes	Temperature after 10 minutes
No insulation			
1 layer of insulation			
2 layers of insulation			
3 layers of insulation			

Developing a classroom investigation as a teacher

- What are the learning outcomes for this investigation?
- How does it align to the Grade 6/7 curriculum?
- What are the success criteria for the investigation?
- Will you assign roles for students for this activity? If so, how will you do this?
- How will you differentiate for students with special needs?

2.4.4. Interrelationship between systems of the human body

Expected learning outcome

By the end of this lesson, you will be able to:

- Describe the importance of the human body systems to work together to maintain homeostasis.

Background: Homeostasis

Homeostasis refers to the body's ability to maintain a stable internal environment. This includes regulating hormones, body temperature and water balance. Maintaining homeostasis requires that the body continuously monitors internal conditions. Each physiological condition has a particular set point – the physiological normal range.

A **normal range** is the restricted set of values that is optimally healthful and stable. Control centres in the brain help regulate physiological conditions to keep them within the normal range. As the body works to maintain homeostasis, any change outside the normal range induces a **feedback loop** to return the body to normal conditions.

A feedback loop has three basic components. **A sensor** monitors a physiological value. It is responsible for detecting a change in the environment. The **control centre** compares the physiological value to the normal range. If the value is too far from the set point, then the control centre activates an **effector**. The effector causes a change to reverse the situation and return the value to the normal range. Effectors are muscles and glands.[57]

Your teacher educator will facilitate a discussion about homeostasis. Contribute your ideas and understanding of homeostasis to the discussion. Think about things that cause changes to body systems.

57 Lumen Boundless Anatomy and Physiology. (n.d.).

Learning activity. Concept mapping: Interrelationships of human organ systems

The purpose of this learning activity is to understand how the body systems work together to maintain homeostasis.

After this, you will work with a group of student teachers to construct a concept map to show how the organ systems of the human body are connected. You will work with the same group from the jigsaw activity in Lesson 2.4.2. This means that every group will have a student teacher who has expert knowledge about one particular system.

When you work with your groups, consider how you will draw the concept map. Is there one system that should be at the centre of the concept map or will you place all systems around the edge of the chart? Or, will your group use general body functions such as transport, control and structural?

Make sure your concept map shows the functions that connect the various organ systems by drawing arrows to connect two systems.

Begin by mapping the relationships that are normal bodily functions, such as breathing or eating. Consider the organ systems that are involved in these processes and how they work together.

Then, consider changes that the body may experience and add these relationships to the concept map. How does the body protect us from pathogens? What happens while we are sleeping?

How many body systems can you connect to show the interrelatedness between systems?

Review questions

1. Define and describe homeostasis.
2. List five organ systems of humans and briefly explain the function of each.
3. List the organ systems of plants and briefly explain the function of each.

Unit Summary

Key messages

- Living things are the organisms that possess life and carry out the seven life processes.
- There is great diversity of living things on Earth and include microorganisms, plants and animals.
- Living things have structural and behavioural adaptations that allow them to live in a particular habitat.
- Multi-cellular organisms are complex systems increasing in levels of organisation.
- Cells are the basic units of multi-cellular organisms.
- Groups of cells that are organised together for a particular function form tissues.
- There are four basic types of tissue in the human body (epithelial, muscular, nervous and connective).
- Plant tissues can be described as meristematic (capable of cell division) or permanent (mature cells do not divide).
- Permanent plant tissues are further divided into simple and complex tissue types.
- An organ is two or more tissue types that form a unit with a particular structure and function.
- Groups of organs that work together to perform a function are organ systems.

Unit reflection

A mind map is a graphical organiser that is a visual representation of concepts. Create a mind map that shows the increasing complexity of multi-cellular organisms, from cell organelles to the entire organisms. You may choose to focus on a single organism or create a mind map incorporating many types of organisms that you have learnt about in this unit.

Further reading

2.1. Living Things

Reece, J. B., Meyers, N., Urry, L. A., Cain, M. L., Wasserman, S. A., & Minorsky, P. V. (2015). *Campbell Biology Australian and New Zealand edition* (Vol. 10). Pearson Higher Education AU.

2.2. Structure and Function of Cells

Plopper, G., Ivankovic, D. B. (2020). *Principals of cell biology.* Jones and Bartlett Publishers, Inc.

2.3. Tissues

National Council for Educational Training. (n.d.). *Tissues.* https://ncert.nic.in/ncerts/l/iesc106.pdf

2.4. Organ Systems

Wakim, S., & Grewal, M. (2021, May 27). *Human biology.* https://bio.libretexts.org/@go/page/16710

Unit 3

Ecology

In this unit, you will explore ecology and ecosystems and distinguish between different types of ecosystems. You will investigate the relationships between living things in an ecosystem and use scientific inquiry processes to understand how energy flows in an ecosystem. You will work collaboratively to develop learning activities about ecosystems for Grade 6/7 students that support students in developing ways of working scientifically.

Expected learning outcomes

By the end of this unit, you will be able to:

- Define ecosystem and ecology;
- Describe types of ecosystems and distinguish the various types of ecosystems;
- Collaboratively develop a learning activity for a Grade 6/7 class which involves investigation of an ecosystem of the local area;
- Illustrate the cycle/diagram for the relationship between plants and animals in their respective area;
- Explain the relationship between plants and animals;
- Evaluate the benefits of the relationship between plants and animals;
- Interpret energy flows in an ecosystem; and
- Discuss the advantages from energy flows in an ecosystem of the student teachers' local area.

Competencies gained

A2.1 Demonstrate understanding of appropriate use of a variety of teaching and learning strategies and resources

A5.1 Demonstrate understanding of the subject matter to teach the assigned subject/s for the specified grade level/s

B1.1 Demonstrate capacity to teach subject-related concepts clearly and engagingly

B3.1 Demonstrate capacity to create a safe and effective learning environment for all students

D2.1 Improve own teaching practice through learning from other teachers and professional development opportunities

Key terms

Apex predator, consumers, decomposers, ecology, ecosystem, food web, producers, snowballing

3.1. Ecosystems

In this sub-unit, you will define and describe different types of **ecosystems** including local ecosystems and compare the local ecosystem with other ecosystems of Myanmar. You will explore the living things within these ecosystems and consider the interrelationships between organisms. You will use practical investigations to model and understand how energy flows in an ecosystem and consider the impact of changes within an ecosystem on other living things.

3.1.1. Ecology and ecosystems

Expected learning outcomes

By the end of this lesson, you will be able to:

- Define ecosystem and ecology;
- Describe types of ecosystems and distinguish the various types of ecosystems; and
- Collaboratively develop a learning activity for a Grade 6/7 class which involves investigation of an ecosystem of the local area.

Understanding ecology and ecosystems

Your teacher educator will ask you what you understand by the terms "**ecology**" and "**ecosystems**". Write your ideas in the boxes. You will share your understanding with another student teacher and then the class to build a class definition of the terms.

ECOLOGY	ECOSYSTEM

Learning activity 1. Snowball: Ecosystems of Myanmar

The purpose of this learning activity is to build an understanding of the ecosystems of Myanmar and define and describe some predominant ecosystems of the country.

You will work initially with another student teacher to define and describe the ecosystems in the table. Then, you will join with another student teacher pair to share ideas and build understanding. Then, your group of four will join with another group of four student teachers to share ideas.

This is a collaborative learning activity known as **"snowballing".** The map (Figure 3.1) shows the ecosystems of Myanmar. Not all these ecosystems are included in Table 3.1.

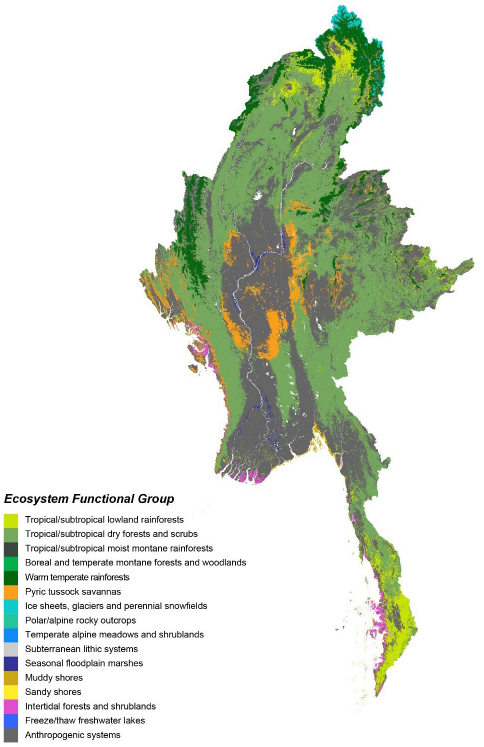


Figure 3.1. Ecosystems of Myanmar[58]

As you describe the features of these ecosystems, consider the following questions:

- Have you visited or lived in this ecosystem? If so, describe what you know from your experience.
- Do you know someone who has been to this ecosystem and how do they explain the ecosystem?
- Have any of your group members been to these ecosystems and what can they recall to add to the information about the ecosystem?
- What is the climate (temperature, rainfall, elevation, geography, winds, water bodies) and the flora and fauna of the ecosystem?

58 Murray, N. J., Keith, D. A., Tizard, R., Duncan, A., Htut, W. T., Hlaing, N., ... & Grantham, H. (2020). *Threatened ecosystems of Myanmar. An IUCN Red List of Ecosystems Assessment. Version 1.0*. Wildlife Conservation Society. https://www.myanmar-ecosystems.org/home

Table 3.1. Defining and describing ecosystems

Ecosystem	Examples
Tropical/subtropical lowland rainforests  Tanintharyi island rainforests[59]	Kachin-Sagaing mid-elevation subtropical rainforest Kayin evergreen tropical rainforest Tanintharyi island rainforests
Define and describe the ecosystem:	
Ecosystem	**Examples**
Ecosystem: Intertidal forests and shrub lands  Ayeyarwady delta mangrove forest	Tanintharyi mangrove forest Ayeyarwady delta mangrove forest Rakhine mangrove forest on mud
Define and describe the ecosystem:	

59 https://www.myanmar-ecosystems.org/myanmar-ecosystems

Ecosystem	Examples
Ecosystem: Pyric tussock savanna  Sagaing hills pine savanna	Rakhine coastal savanna Sha Thorny Scrub Sagaing hills pine savanna
Define and describe the ecosystem:	

Ecosystem	Examples
Ecosystem: Icesheets, glaciers and perennial snowfields  Kachin snowfields[60]	Kachin snowfields
Define and describe the ecosystem:	

60 http://aseansection.blogspot.com/2016/01/snowfall-pounds-myanmars-kachin-state.html

Ecosystem	Examples
Ecosystem: Warm temperate rainforest  Shan warm temperate rainforest	Shan warm temperate rainforest Chin Hills warm temperate rainforest Kachin Montane temperate broadleaf forest
Define and describe the ecosystem:	

Learning activity 2. Group work: Develop a learning activity for a Grade 6/7 class that incorporates investigation of local ecosystems

The purpose of this learning activity is to collaboratively develop a learning activity for a Grade 6/7 class which involves investigation of an ecosystem of the local area.

Begin by reviewing the Grade 6/7 curriculum. Identify what students need to know about ecosystems. Use the curriculum as a guide to develop your resource.

This learning activity should be an investigation to build student understanding about ecosystems.

Scientific investigations can take many forms including:

- Observations
- Laboratory experimentation
- Fieldwork
- Local and/or global databases
- Research

Your teacher educator will direct you to work with a small group of student teachers to develop a teaching resource to help Grade 6/7 students understand local ecosystems.

Develop the resource in the space in your textbook.

As you develop the resource, consider:

- When would this resource be used in a lesson?
- How does this resource help student learning?
- Who would use this resource?
- What are the learning objectives that relate to this resource?
- How will this resource help students understand local ecosystems?
- What are the success criteria for the resource?

Box 3.1. Learning activity to investigate local ecosystems

Learning objectives: Investigation type: Activity details: Success criteria: Differentiation for students who have special needs:

3.1.2. Relationship between plants and animals in an ecosystem

Expected learning outcomes

By the end of this lesson, you will be able to:

- Illustrate the cycle/diagram for relationship between plants and animals in their respective area;
- Explain the relationship between plants and animals; and
- Evaluate the benefits of the relationship between plants and animals.

Background: Roles of living things in ecosystems

The living organisms in an ecosystem can be divided into three categories: **producers**, **consumers** and **decomposers**. They are all important parts of an ecosystem.

Producers are organisms such as green plants, lichens and algae that make their own food. These organisms convert water, sunlight and carbon dioxide into carbohydrates.

Consumers are animals and they get their energy from the producers or from organisms that eat producers. Consumers may be herbivores, carnivores or omnivores. Herbivores are animals that eat plants, carnivores are animals that eat herbivores and sometimes other carnivores, and omnivores are animals that eat plants and other animals.[61]

Decomposers are organisms such as bacteria, fungi and earthworms that break down dead plants and animals into organic materials that go back into the soil.

Learning activity. Observation: Plants and animals in the local area

The purpose of this learning activity is to observe the plants and animals in the local ecosystem and illustrate the relationships between the organisms.

61 Lumen Boundless Biology. (n.d.).

In this learning activity, you will observe the plants and animals in the local ecosystem.

You will go outside with the class to observe as many living things in the local environment as possible. Record these observations about the local environment in your textbook.

When your teacher educator instructs you, take your textbook and writing equipment and move with the class outside to a suitable area to observe the living things in the ecosystem.

You will have some time to identify and record as many living things as you can observe. Record these in the table using the three main classifications.

Make detailed observations by considering:

- What can you see on the ground/in the earth?
- Can you see any insects?
- Are there organisms on the plants?
- Are there living things in the air/flying?

When you return to the classroom, work with another student teacher to identify living things that you may not have been able to observe but that are known to be in the ecosystem (for example, nocturnal animals or animals that may not have been present in the exact locality observed).

Table 3.2. Observations of the local environment

Decomposers	Producers	Consumers

Once you have listed as many organisms from the local environment as you can, draw a food web that shows the interrelationships between these organisms.

Remember, a **food web** shows the network of feeding relationships in an ecosystem. The direction of the arrows shows the direction of the flow of energy as it is transferred from one organism to another. The arrows should point *from* the food to the organism that eats it.

Identify the organisms that are producers, consumers and decomposers.

Box 3.2. Food web of the local environment

Consider the ecosystem from your local environment.

How do the animals in the ecosystem help the plants?

How do the plants in the ecosystem help the animals?

3.1.3. Energy flows in an ecosystem

Expected learning outcomes

By the end of this lesson, you will be able to:

- Interpret energy flows in an ecosystem; and
- Discuss the advantages from energy flows in an ecosystem of the student teachers' local area.

Learning activity 1. Modelling: Energy transfer in an ecosystem

The purpose of this learning activity is to understand energy flow in an ecosystem through a model analogy. This learning activity will be done outside.

When your teacher educator instructs you, move outside and follow the instructions of your teacher educator. The process for the activity is:

1. You will be distributed into lines of between two and five student teachers.
2. Your teacher educator will give you the equipment you need.
3. The first student teacher in each line is to fill their cup from the bucket and transfer it to the next student teacher in line.
4. The first student teacher needs to return to the bucket and refill their cup. You need to transfer the water to the next student teacher and repeat until all the water in the bucket has been used up.
5. The second student teacher needs to transfer the water to the third student teacher and so on, until the last student teacher receives the water. The last student teacher needs to tip their water into an empty bucket.
6. As each student teacher receives the water, you need to continue transferring it up the line until all the water in the initial bucket is used up.
7. Do not cover any holes in your cup with your fingers.
8. At the end of the process, record the amount of water in the last bucket.

If time permits, you may be asked to repeat the process to obtain more data.

When you return to the classroom, you will determine the efficiency (%) of water transfer for each line of students.

This can be calculated by:

$$\frac{\text{the amount of water at the end}}{\text{the amount of water at the start}} \times 100$$

Table 3.3. Experimental results

Number of student teachers	Efficiency of transfer				
	Trial/group 1	Trial/group 2	Trial/group 3	Trial/group 4	Average
2					
3					
4					
5					

Record the data from all groups of student teachers in your textbook.

Think about the following questions. You will be asked to contribute to a class discussion relating to this activity.

What does the transfer of water represent? What is this an analogy of?

What is the relationship between the length of a food chain and efficiency of energy transfer?

What does water in the bucket at the beginning represent?

What does the water you receive from another student teacher represent?

What does the spilled water represent?

What does the water in the end bucket represent?

Learning activity 2. Discussion: Energy flows in the local ecosystem

The purpose of this learning activity is to understand energy transfers in the local ecosystem.

Turn back to the food web of the local ecosystem that you developed in the previous lesson.

Answer the following questions about this ecosystem. You can work with the same student teacher from the previous lesson to respond to the questions.

What is the original source of energy for the organisms in the food web?

How is this energy converted into food in the ecosystem?

Which organisms have the most energy available to them to use?

Which organisms have the least amount of energy to use?

How many levels of energy transfer can you identify?

Is there an **apex predator** (an organism at the top of the food chain with no direct predators) in your food web?

What might happen if the apex predator or the organisms with the least amount of energy to use are removed from the food web?

What is the difference between a food chain and a food web?

Identify a food chain in your food web.

Review questions

1. The graph shows the relative energy content in trophic levels of an ecosystem in Florida, in the United States of America. Write an explanation that describes the flow of energy in this ecosystem.

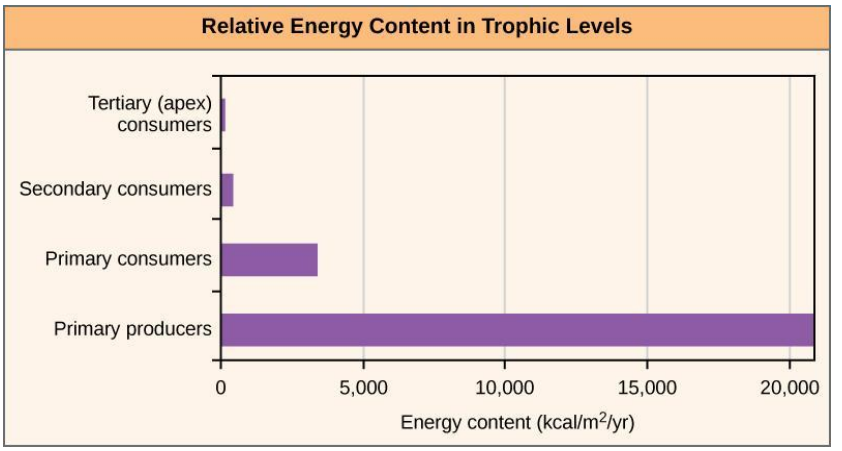


Figure 3.2. Energy flow in an ecosystem in Florida

2. Figure 3.3 shows a marine food web from an ocean system in California, in the US.

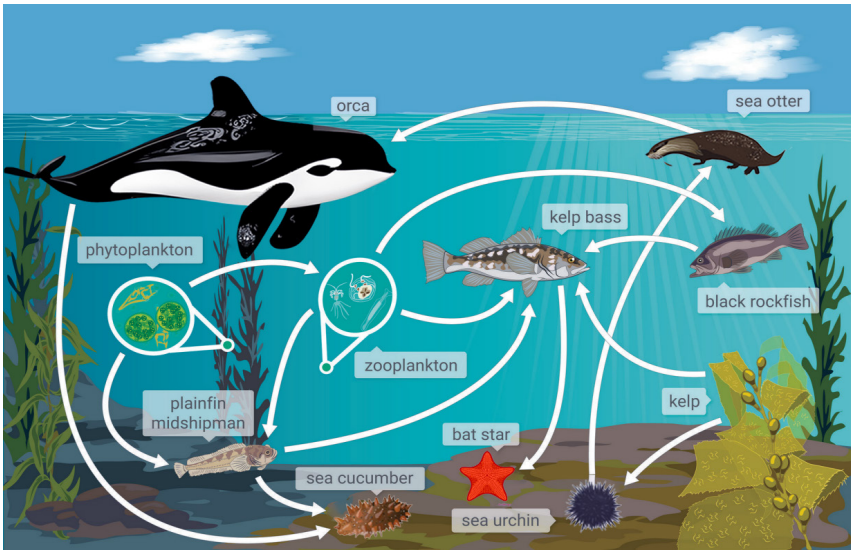


Figure 3.3. Food web in an ocean ecosystem[62]

Identify in this food web:

- Two decomposers
- Two producers
- Two primary consumers
- Two secondary consumers
- Two tertiary consumers

62 https://ie.ixl.com/science/grade-8/interpret-food-webs

Unit Summary

Key messages

- Ecology is the study of how organisms interact with one another and with their physical environment, including biotic (living) and abiotic (non-living) factors.
- Ecology includes the studies of organisms, populations, communities, ecosystems and biospheres.
- Ecosystems are the communities of organisms in a particular physical environment.
- There is a great diversity of ecosystems (marine, aquatic or terrestrial) that vary in the size and number of organisms.
- Organisms in ecosystems are interdependent.
- Matter and energy flow in ecosystems and can be modelled and predicted.

Unit reflection

Consider an ecosystem either in Myanmar or globally.

Write a reflection that describes the ecosystem including the energy flow. Consider what the ecosystem needs to be healthy and balanced. Include in your reflection how the ecosystem is used by humans and what the impact of human activity is, or could be, on the ecosystem. Identify and explain any threats to the ecosystem. Identify and explain possible solutions to the threats or to the human activity that could preserve the ecosystem.

Further reading

3.1. Ecosystems

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Glossary

Terms	Elaborations
Algae	Simple photosynthetic, non-vascular aquatic organisms
Amoeba	Microscopic, single-celled organisms
Amyloplast	A plant organelle that produces and stores starch within the roots and tissues
Anaphase	A stage in cell division that occurs towards the end of mitosis during which daughter chromosomes move away from each other
Angiosperms	Flowering plants
Apex predator	An organism at the top of the food chain with no direct predators
Archaea	Unicellular, prokaryotic organisms
Bacteria	Unicellular, prokaryotic organisms that lack a nucleus; may be pathogenic or non-pathogenic
Behavioural adaptations	The way an organism has evolved to act that enhances its survival in an environment
Biology	The scientific study of life and living things
Cell membrane	The thin layer of cells that surrounds the contents of a cell
Cell wall	The tough outer layer of a plant cell
Chloroplast	A green disc like structure found in cells that contains the green pigment chlorophyll
Concept map	A diagram that shows the relationships between concepts
Collenchyma	Plant tissue that provides strength and structural support to the leaves and shoots
Connective tissue	Tissue that supports, protects and gives structure to other tissues and organs in the body
Consumers	Organisms that get their energy from the producers or from organisms that eat producers
Critique	To critically review or examine something
Curriculum	The overall description of what, why, how and how well students should learn in a systematic and intentional way
Cytokinesis	The stage of cell division during which the cytoplasm separates into two daughter cells
Cytoplasm	The jelly-like substance that fills cells
Decomposers	Organisms that break down dead plants and animals into organic materials
Dicotyledonous	Flowering plants in which the seeds contain two cotyledons
Ecology	The study of how organisms interact with one another and with their physical environment, including biotic (living) and abiotic (non-living) factors

Terms	Elaborations
Ecosystem	A community of organisms together with their physical environment
Endoplasmic reticulum	The network of membranes and tubules of a cell that creates, folds, modifies and transports many of the products made by a cell
Epidermis	A tissue that covers the outer surface of plants (top and bottom of a leaf and the outside of the stem and root) and animals (surface layer of the skin)
Epithelial tissue	The tissue that covers the body surface and lines internal organs.
Eukaryotes	Organisms that have cells with a nucleus enclosed within a nuclear envelope
Food web	A diagram that illustrates the network of feeding relationships in an ecosystem
Fungi	The group of eukaryotic organisms including yeasts, moulds and mushrooms
Golgi apparatus	The cell organelle that modifies the molecules from the endoplasmic reticulum and moves them to various locations throughout a cell
Gymnosperms	Non-flowering plants that use seeds to reproduce
Habitat	The place where an organism lives or exists
Helminth	Multicellular, parasitic worms
Homeostasis	The body's ability to maintain a stable internal environment
Inquiry	The scientific process of investigation to obtain more information
Interphase	The resting phase between mitotic cell divisions
Invertebrates	An animal that does not have a backbone
Living	Organisms that carry out all the processes of life
Meiosis	A type of cell division of germ cells in sexually reproducing organisms used to produce the gametes
Metaphase	The stage of cell division when the genetic material condenses into chromosomes
Metabolism	The chemical reactions that take place within cells and provide the cell's energy
Microorganisms	Organisms that are too small to be seen by the naked eye (exceptions exist)
Microscope	An instrument that magnifies objects that are otherwise unable to be seen with the human eye
Mitochondria	The organelles that produce the main energy molecule used by the cell (adenosine triphosphate – ATP)
Mitosis	A type of cell division that results in two cells that are identical to the original cell
Monocotyledonous	Grass and grass-like flowering plants whose seeds contain only one cotyledon
Muscular tissues	A specialised tissue type that is composed of cells with the ability to contract to result in body movement.
Non-living	Things that do not carry out all the processes of life

Terms	Elaborations
Nucleolus	An organelle within the nucleus that manufactures ribosomes
Nucleus	The structure in the cell that is surrounded by a membrane and contains the genetic information
Organ	Part of an organism that has a specific function and is self-contained
Organelle	The structures with a cell that carry out specific functions
Parasites	An organism that benefits at the expense of another organism
Parenchyma	Plant tissue that stores nutrients for the plant
Peer-reflection	Activities in which students evaluate and provide feedback on the work of other students
Peroxisome	Small membrane-bound organelles in the cytoplasm involved in metabolism of lipids and breakdown of toxic materials
Phloem	Plant tissue that transports and distributes organic nutrients to the plant
Producers	Organisms that make their own food by converting water, sunlight and carbon dioxide into carbohydrates
Prometaphase	The phase of mitosis during which the nuclear membrane breaks down
Prophase	The phase of cell division during which chromatin strands form
Protozoa	Unicellular, aerobic eukaryotes with cell walls composed of cellulose
Reflex	An involuntary response to a stimulus
Ribosomes	The cell organelle that translates the information in messenger RNA into amino acids
Sclerenchyma	The supporting tissue in plants that makes them hard and stiff
Self-reflection	To observe and analyse introspectively for personal growth and development
Snowballing	A collaborative learning technique where groups of students teach each other about various concepts
Structural adaptations	The way physical features of an organism have evolved to enhance its survival in an environment
Telophase	The stage of cell division during which the chromatids move to opposite ends of the cell and two nuclei are formed
Tissue	A material in an organism that is made from specialised cells and has a specific function
Vacuole	The large central area in the middle of a cell that is filled with a watery liquid
Vertebrates	An animal that has a spinal cord surrounded by cartilage or bone
Viruses	Non-cellular infectious agents consisting of a nucleic acid core surrounded by a protective capsid coat
Xylem	The tissue in plants that provides support and transports substances from the roots
Yeast	Eukaryotic, single-celled microorganisms that belong to the kingdom of fungi

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Annexes

Annex 1. Lesson plan template

Lesson plan template			
Class:	**Date:**	**Time:**	**Teacher:**
Lesson: *(What is the topic/title of your lesson?)*			
Know the students: **a. prior knowledge** *(What do students know? What can students already do?)* **b. student profile** *(What do you need to consider regarding individual students' needs?)*			
Lesson: *(What is the purpose of the lesson? What do you intend to do?)*			
Learning outcomes: *(Construct SMART learning outcomes. What will students know and be able to do by the end of the lesson?)* By the end of this lesson, students will be able to:			
Criteria for success: *(How will you and your students know if they have achieved the learning outcomes of this lesson? For example: they will be able to solve seven out of 10 mathematics problems; they will be able to label all parts of a flower on a diagram)*			
Formative assessment opportunities: *(Teacher questioning, teacher observation, teacher review of student work, peer assessment with simple rubric, self-assessment)*			
Teaching and learning strategies: *(Is the lesson inquiry-based? Problem-based? Project-based? A direct instruction lesson?)*			

Teaching and learning methods and techniques: *(Will you use brainstorming? Storytelling? Role-play? Questioning? Discussion? Think-pair-share? Groupwork?)*

Teaching aids and resources (visual aids, audio aids, integration of technologies): *(Will you need paper? Drawing materials? Computers?)*

Stage	**Timing** *(45 minutes)*	**Teacher activity** *(What are you doing?)*	**Student activity** *(What are students doing?)*	**Differentiation** *(How will you differentiate teaching and learning to respond to students' needs?)*
Introduction *(How will you gain students' attention, connect to prior learning, communicate intended learning outcomes and success criteria?)*				
Body *(Will the body of the lesson have different stages: for example, explicit teaching, guided practice, independent practice?)*				
Review *(How will you assess student achievement of learning outcomes and support students reflecting on learning?)*				

Annex 2. Short version: Lesson plan template

<table>
<tr><th colspan="2">Lesson plan template</th></tr>
<tr><td colspan="2">Lesson:
(Construct SMART learning outcomes. What will students know and be able to do by the end of the lesson?)
By the end of this learning activity, students will be able to:</td></tr>
<tr><td colspan="2">Criteria for success:
(How will you and your students know if they have achieved the learning outcomes of this lesson?)</td></tr>
<tr><td colspan="2">Teaching and learning strategies: (What type of group activity are you using? How will this facilitate learning?)</td></tr>
<tr><td colspan="2">Teaching aids and resources (visual aids, audio aids, integration of technologies): (Will you need paper? Drawing materials? Computers?)</td></tr>
<tr><td>Group learning activity
(Describe and explain the activity. What are students doing? What is the teacher doing? What roles do the students have in this activity?)</td><td>Differentiation
(How will you differentiate teaching and learning to respond to students' needs?)</td></tr>
</table>

Annex 3. Worksheets: Organ systems of the human body

Organ system: _____

Overall purpose of organ system:

List the major organs and tissues of the system. Give a brief description of the function of each organ or tissue.

What can be done to help the organ system work as efficiently as possible?

Identify a disease of the organ system and explain how it interferes with proper functioning of the organ system.

List any interesting facts about the organ system.

Why is this organ system the most important in the human body?

Organ system: _____

Overall purpose of organ system:

List the major organs and tissues of the system. Give a brief description of the function of each organ or tissue.

What can be done to help the organ system work as efficiently as possible?

Identify a disease of the organ system and explain how it interferes with proper functioning of the organ system.

List any interesting facts about the organ system.

Why is this organ system the most important in the human body?

Organ system: _____

Overall purpose of organ system:

List the major organs and tissues of the system. Give a brief description of the function of each organ or tissue.

What can be done to help the organ system work as efficiently as possible?

Identify a disease of the organ system and explain how it interferes with proper functioning of the organ system.

List any interesting facts about the organ system.

Why is this organ system the most important in the human body?

Organ system: _____

Overall purpose of organ system:

List the major organs and tissues of the system. Give a brief description of the function of each organ or tissue.

What can be done to help the organ system work as efficiently as possible?

Identify a disease of the organ system and explain how it interferes with proper functioning of the organ system.

List any interesting facts about the organ system.

Why is this organ system the most important in the human body?

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UNESCO Project Office in Myanmar