



South Sudan



Secondary Biology 1

Teacher's Guide



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South Sudan

SECONDARY

1

Biology

Teacher's Guide Book 1



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INTRODUCTION

Book organization

This teacher's guide is organised into two main sections Part 1 which is the general introduction section detailing information on competence based curriculum and pedagogical issues.

The main elements of **Part 1** are:

a) **Background information to the new curriculum**

It gives a brief overview of the general requirements of the new South Sudan competence-based including the guiding principles, the competences the students are expected to acquire, crosscutting issues to be addressed during learning.

b) **Basic requirements for an effective Biology lesson**

It highlights the teacher and learner's roles for effective teaching and learning of Biology, teaching and learning resources, grouping learners for learning and teaching methods.

Part 2 provides a topic -to - topic guide to the teacher on how to facilitate learners to acquire the knowledge, skills and attitudes envisaged in each unit. This part is therefore structured into units. The main elements of each unit guide are:

- **Unit heading**
- **Learning objectives**
- **Contribution to learner's competences:**

The section explains how the unit/topic will facilitate the learner to acquire to the specified competences. These competences will be discussed in detail later in the next section.

Cross cutting issues to be addressed

The section outlines the specific cross cutting issues that will be addresses through infusion as the learners do the activities and interacts with concepts planned for the unit This is meant to make the teacher conscious on and be on the lookout for suitable opportunities throughout the teaching and learning process in the entire unit to address the cited cross cutting issues.

These issues will be discussed in detail later in this section.

Note: a unit or topic may not necessarily address all the cross cutting issues outlined in the curriculum

- **Background information**

This section outlines key knowledge, skills attitudes and values that students need to have acquired earlier that will facilitate easier acquisition of the new knowledge, skills attitudes and values envisaged in every unit. It also guides the teacher on how to find out that the students possess them before they start learning the concepts in this unit, and how to help students in case they do not possess them.

- **Suggested teaching and learning activities**

This section provides guidance to the teacher on how to facilitate students to learn by doing the activities outlined in the student's book. It also guides the teacher on how to assess the learning.

Background Information on the new curriculum

The aim of the South Sudan Competence-based Curriculum is to develop the students competences that will enable them interact with the environment in more practical ways.

It clearly defines the knowledge, skills and attitudes that the student should acquire by doing the specified learning activities.

(a) Student's competences to be attained

Competencies are statements of the characteristics that students should demonstrate, which indicate they have the ability to do something to the required level of performance. The following are the four competencies envisaged in this curriculum:

1. Critical and creative thinking

Biology lessons and activities facilitate students to acquire these competences by giving them opportunities to:

- Plan and carry out investigations, using a range of sources to find information.
- Sort and analyse information and come to conclusions.
- Suggest and develop solutions to problems, using their imaginations to create new approaches.
- Evaluate different suggested solutions.

2. Communication

Biology lessons and activities facilitate learners to acquire these competences by giving them opportunities to:

- Read and comprehend critically a variety of types and forms of texts during research activities.
- Write reports on scientific investigations and activities.
- Speak clearly and communicate ideas and science related information coherently.
- Listen and comprehend scientific facts presented by fellow classmates, group members, teachers and resources persons.
- Use a range of media, technologies and languages to communicate messages, ideas and opinions.

3. Cooperation

Biology lessons and activities facilitate learners to acquire these competences by giving them opportunities to:

- Work collaboratively towards common objectives when doing activities.
- Be tolerant of others and respectful of differing views, when working together.
- Adapt behaviour to suit different situations.
- Negotiate, respect others' rights and responsibilities, and use strategies to resolve disputes and conflicts.
- Contribute to environmental sustainability.

4. Culture and identity

Biology lessons and activities facilitate learners to acquire these competences by allowing them to:

- Take pride in South Sudanese identity and the diverse nature of South Sudanese society.
- Build understanding of South Sudanese heritage in relation to the wider world.
- Appreciate and contribute to the development of South Sudanese culture.
- Value diversity and respect people of different races, faiths, communities, cultures, and those with disabilities.

(b) Cross-cutting issues to be addressed during learning

These are issues that are of high national priority and hence have been incorporated in the learning process. The three cross-cutting issues for that should be addressed through the teaching/learning process are:

i) Environment and sustainability

A well-conserved environment is obviously key to our health and survival. It is therefore important for the Biology teacher to make use of the opportunities that arise in the process of teaching and learning Biology through activities to sensitize learners on the importance of conserving the environment. One way is by ensuring that the learners always dispose of the waste materials at the end of an activity in ways that do not **pollute the environment**.

(ii) Peace education

Peace is critical for a society to flourish and for every individual to focus on personal and national development.

Biology teacher needs to be in the fore front in educating his/her students on the need for peace, for example by encouraging group work in the learners activities and showing the them ways of solving peacefully interpersonal problems that occasionally arise during interactions and discussions.

(iii) Life skills

Learners need to progressively acquire some skills abilities and behaviors that will help them effectively deal with the events and challenges of every day life. Such skills include first aid, communication skills, conflict resolution, basic ICT skills etc. The Biology teacher should as much as possible facilitate the learners to acquire these skills whenever an opportunity arises in the lesson execution.

Basic requirements for an effective Biology lesson

Teacher's role and basic skills for effective Biology lesson

The teacher is the most important resource for an effective Biology lesson. (a) Some of the key roles of the Biology teacher include:

- Organising the classroom to create a suitable learning environment.
- Preparing appropriate materials for learning activities.
- Engaging students in variety of learning activities.
- Encouraging and accepting student autonomy and initiative.
- Allowing student responses to drive lessons, shift instructional strategies,

- Familiarizing themselves with student's understandings of concepts before sharing their own understandings of those concepts.
- Encouraging students to engage in dialogue, both with the teacher and one another.
- Engaging students in experiences that pose contradictions to their initial hypotheses and then encouraging discussion.
- Providing time for students to construct relationships and create metaphors.
- Using a variety of teaching and assessment methods.
- Adjusting instructions to the level of the student.
- Nurturing students' natural curiosity.
- Motivating students to make them ready for learning.
- Coordinate students' activities so that the desired objectives can be achieved.
- Assessing students' activities and suggest solutions to their problems.
- Assist students' to consolidate their activities by summarising the key points learnt.

(b) Some of the key skills that the teacher should have include:

- Creativity and innovation.
- Makes connections/relations with other subjects.
- A high level of knowledge of the content.
- Effective disciplining skills manage adequately the classroom.
- Good communicator.
- Guidance and counselling.

Student's role in learning Biology

Learning takes place only when the student acquires the intended knowledge, skills and attitudes. As such, learning is a highly personal and individual process. Thus, a student must be actively engaged in the learning exercise.

For active participation in learning, the student should:

- Raise questions about what is observed.
- Suggest solutions to the problems observed.
- Take part in planning investigations with appropriate controls to answer specific questions.
- Carry out investigations to search for answers with the help of materials in search of patterns and relationships while looking for solutions to problems.

- Working collaboratively with others, communicating their own ideas and considering others' ideas.
- Expressing themselves using an appropriate Science terms and representations in writing and talk.
- Engaging in lively public discussions in defence of their work and explanations.
- Applying their learning in real-life contexts.
- Reflecting critically about the processes and outcomes of their inquiries.

Teaching and learning resources

These refer to things that the teacher requires during the teaching process. They include:

- The classroom
- Textbooks
- Wall charts and wall maps
- Materials and apparatus
- Various tools and equipment
- Science models
- Resource persons
- Firms such as hydroelectric power stations, engineering firms among others

(a) Classroom as a learning environment

A Classroom generally refers to the place where learning takes place. Students learn from everything that happens around them, such as the things that they hear, see, touch, taste, smell and play with.

Classroom organisation

It is important for the teacher to make the classroom an attractive and stimulating environment. This can be done by:

- Carefully arranging the furniture in the classroom in an organised way, to allow free movement of learners and the teacher.
- Putting up learning and teaching aids on the walls. Examples are wall charts, pictures and photographs.
- Displaying teaching models.
- Providing objects for play for example toys.

- Having a display corner in the classroom where learners display their work.
- Setting a corner for storing materials so as not to obstruct learners or distract them.
- Spreading students evenly so that they do not interfere with one another's activities.
- Setting up the materials for the series of lessons or activities going on for a number of days or weeks in a location where they do not interfere with other daily activities.
- Organizing the sitting arrangement such that students face the lighted areas of the room.
- Choosing the most appropriate location for the teacher and the chalkboard such that they are visible to all students and the teacher has a good view of all learners in the class.

(b) Apparatus and materials

For students to study Science through the activity method, a number of materials and apparatus are required. The important role played by materials in learning has been felt for centuries. This is noted for instance in the old Chinese proverb that says:

When I hear I forget

When I see I remember

When I do I understand

Since Biology is highly a practical subject, materials help the teacher to convey his/her points, information or develop skills simply and clearly, and to achieve desired results much faster.

Some of the materials that a teacher requires for Biological activities and calculations can be collected from the local environment.

Many others can be improvised while some have to be purchased. Whether collected, improvised or purchased, there are certain materials that are valuable to have around almost all the time.

These include:

(i) Science Kit

A science kit is a special box containing materials, apparatus and equipment necessary to conduct an array of experiments. The content of the Science kit depends on the curriculum requirements per level. Most science kits are commercially available and target particular levels of students. However, the teacher is encouraged to come up with a kit based on the syllabus requirement

(ii) Models

A model refers to a three-dimensional representation of an object and is usually much smaller than the object. Several models are available commercially in shops. Examples of Science models include plant models, animal models among others. These models can be purchased by schools for use during Science activities.

(iii) Resource persons

A resource person refers to anybody with better knowledge on a given topic area. Examples include; health practitioners such as doctors, nurses and laboratory technologists, agricultural extension officers, environmental specialists among others. Depending on the topic under discussion, the teacher can organize to invite a resource person in that area to talk to talk about the topic. Students should be encouraged to ask as many questions as possible to help clarify areas where they have problems.

(iv) Improvisation

If each student is to have a chance of experimenting, cheap resources must be made available. Complicated apparatus may not always be available in most schools. Such sophisticated equipment made by commercial manufacturers are usually expensive and majority of schools cannot afford them. The teacher is therefore advised to improvise using locally available materials as much as possible.

(v) Scheduling learning activities and venues

Some of the activities suggested in the student's book require good planning and scheduling in order to get accurate results.

Grouping learners for learning activities

Most of the biological activities suggested in the student's book are carried out in groups and therefore the teacher should place 2 or 3 desks against each other and then have a group of students sitting around those desks.

In certain activities, the teacher may wish to carry out a demonstration. In this case, the students should be sitting or standing in a semicircle, or arranged around an empty shape of letter "U" such that each learner can see what the teacher is doing clearly and without obstruction or pushing. If the students are involved in individual work, each student can work on the floor or on the desk or a portion of the desk if they are sharing. In this case, they need not to face each other.

Grouping students for learning has increasingly become popular in recent years. In fact, the shift from knowledge-based to competence curriculum will make grouping the norm in the teaching process.

Learning group can be formed based one or a number of the following considerations:

- Similar ability grouping
- Mixed ability grouping
- Similar interests grouping
- Common needs grouping
- Friendship grouping
- Sex-based grouping

Grouping learners in a Science class has several advantages that include:

- The individual learner's progress and needs can easily be observed.
- The teacher-learner relationship is enhanced.
- A teacher can easily attend to the needs and problems of a small group.

Materials that were inadequate for individual work can now be easily shared.

- Students can learn from one another.
- Cooperation among students can easily be developed.
- Many students should accept correction from the teacher more readily and without feeling humiliated when they are in a small group rather than the whole class.
- Students' creativity, responsibility and leadership skills can easily be developed.
- Students can work at their own pace.

The type of "grouping" that a teacher may choose may be dictated by:

- The topic or task to be tackled.
- The materials available.
- Ability of learners in the class (fast, average, slow).

Class size

There is no one method or approach to teaching that is appropriate to all lessons. A teacher should, therefore, choose wisely the method to use or a combination of methods depending on the nature of the topic or subtopic at hand.

Teaching methods

There are a variety of possible methods in which a teacher can help the students learn. These include:

- (a) Direct exposition
- (b) Discovery or practical activity
- (c) Group, class or pair discussion
- (d) Project method
- (e) Educational visit/ field trips
- (f) Teacher demonstration
- (g) Experimentation/Research

The particular technique that a teacher may choose to use is influenced by several factors such as the:

- Particular group of students in the class.
- Skills, attitudes and knowledge to be learned.
- Learning and teaching aids available.
- Local environment.
- Teacher's personal preference
- Prevailing weather condition.
- Requirements of Science syllabus.

(a) Direct exposition

This is the traditional way of teaching whereby the teacher explains something while the students listen. After the teacher has finished, students may ask questions. However, in a competence-based curriculum, this technique should be used very minimally.

(b) Guided Discovery

In this technique, the teacher encourages students to find out answers to problems by themselves. The teacher does this by:

- Giving students specific tasks to do.
- Giving students materials to work with.
- Asking structured or guided questions that lead students to the desired outcome. Sometimes students are given a problem to solve and then left to work in an open-ended manner until they find out for themselves.

This is the most preferred method of teaching in the implementation of competency-based curriculum.

(c) Group/class discussion or pair work

In this technique, the teacher and students interact through question and answer sessions most of the time. The teacher carefully selects his/her questions so that students are prompted to think and express their ideas freely, but along a desired line of thought. The method leads students from the known to unknown in a logical sequence; and works well with small groups. The method boosts confidence in students and improve interpersonal and communication skills.

The main disadvantage of this method is that some students may feel shy or afraid to air their opinions freely in front of the teacher or their peers. It may give them more confident learners a chance to dominate the others.

(d) Project method

In this approach, the teacher organizes and guides a group of students or the whole class to undertake a comprehensive study of something in real life over a period of time such as a week or several weeks. Students using the project method of studying encounter real life problems, which cannot be realistically brought into a normal classroom situation. A project captures learners' enthusiasm, stimulates their initiative and encourages independent enquiry. The teacher, using the project method, must ensure that the students understand the problem to be solved and then provides them with the necessary materials and guidance to enable them carry out the study.

The main disadvantage of this method is that if a project is not closely supervised, students easily get distracted and therefore lose track of the main objective of their study. Studying by the project method does not work well with students who have little or no initiative.

(e) Educational visits and trips and nature walks

This is a lesson conducted outside the school compound during which the teacher and the students visit a place relevant to their topic of study. An educational visit/nature walk enables learners to view their surroundings with a broader outlook that cannot be acquired in a classroom setting. It also allows them to learn practically through first-hand experience. In all "educational visit/nature walk lessons", learners are likely to be highly motivated and the teacher should exploit this in ensuring effective learning. However, educational visits are time consuming and require a lot of prior preparation for them to succeed. They can also be expensive to undertake especially when learners have to travel far from the school.

(f) Demonstration lessons

In a demonstration, the teacher shows the learners an experiment, an activity or a procedure to be followed when investigating or explaining a

particular problem. The learners gather around the teacher where each learner can observe what the teacher is doing. It is necessary to involve the students in a demonstration, for example by:

- Asking a few learners to assist you in setting up the activity.
- Requesting them to make observations.
- Asking them questions as you progress with the demonstration.

This will help to prevent the demonstration from becoming too teacher centered.

When is a demonstration necessary?

A teacher may have to use a demonstration, for example when:

- The experiment/procedure is too advanced for students to perform.
- The experiment/ procedure is dangerous.
- The apparatus and materials involved are delicate for learners to handle.
- Apparatus are not enough for all learners or groups.

Diversity of living things

(Refer to student's book page 1-24)

Learn about		Key inquiry questions
<p>Learners should investigate the characteristics of living things, variety of life forms from unicellular to multicellular organisms and learn the differences and similarities among organisms. This should include how organisms exist in diverse forms citing some of the specific examples such as grasshoppers, butterfly, cockroaches, pond snails, etc., They should know how to collect/capture organisms (specimens) for practical investigation. They should be introduced to concept of taxonomy, taxonomic hierarchy, artificial and natural classification, specimen, identification and keys.</p> <p>In groups learners should investigate how to use classification keys and levels of classification, know system of binomial nomenclature, understand the basic rules for scientific naming of organisms and be able to cite some focal examples.</p>		<ul style="list-style-type: none"> • What are the main characteristics of living things? • Why do we classify living things? • How do we name living things? • How can we create a classification system for familiar plants or animals by observing their characteristics? • How binomial nomenclature system is considered important in scientific naming of organisms?
Learning outcomes		
Knowledge and understanding	Skills	Attitudes
<ul style="list-style-type: none"> • Understand the diversity of living things. 	<ul style="list-style-type: none"> • Investigate how living things can be grouped according to their similarities and differences. • Identify different kinds of organisms using taxonomic keys. • Collect insects using nets (sweep net), jam jar / sunk into soil, Pooters and plankton net. • Develop simple keys to classify and investigate living things according to their similarities (Dichotomous key). • Critical observation and recording skills. 	<ul style="list-style-type: none"> • Appreciate the variety of organisms. • Show curiosity about the existence of organisms and the importance of sustaining diversity (conservation). • Thinking critically. • Sharing views and opinions. • Cooperating with others.

Contribution to the competencies:

Critical and creative thinking: about the variety of organisms, and creatively develop simple keys for identification and classification.

Communication: will be improved among learners during practical work as they exchange and share opinions.

Co-operation: likewise, learners will cooperate among themselves as carry out experiments share results, tools and apparatus.

Links to other subjects:

Mathematics: collection and use of statistical data, enumerating and counting individual organisms

Geography: associating organisms to their respective habitats

IT: accessing internet for recent advances in biology

Introduction to the unit

This unit is about Diversity of Living Things. Remember students have come across different types of Living things which come in various shapes and sizes in their surroundings. In this unit students will learn different branches of biology and importance of studying biology as a subject. They will explore various life forms of organisms ranging from unicellular organisms such as bacteria to multicellular organisms such as lion, cow and man. Learners will also learn on how organisms are grouped based on the taxonomic hierarchy of classification and how organisms i.e. both plants and animals can be identified using a dichotomous key.

Using the student textbook

This teacher's book has been written to help you guide students to learn Biology in the most enjoyable and captivating manner. You are reminded to always arouse the curiosity of learners as you teach. Some things that you may do before you go for a lesson include:

- Go through the expected learning outcomes – this should help guide the manner of teaching.
- Read through the unit for the lesson in advance to get an overview of the content required.
- Form a mental picture of the teaching situation and the ways in which you will interact with pupils when dealing with the suggested activities.
- Collect the materials that will be needed during the lesson in advance.
- In some cases, try out the suggested activities/experiments in advance to avoid embarrassments like the experiment failing to work during the lesson.

Encourage students to use reference materials such as textbooks, encyclopedia and internet for information and not limit their research or reading about a topic to only what is provided in the textbook.

Competencies to be attained

1. Co-operation

Encourage students to work as a team during group discussions. They should freely interact with one another as they brain storm and exchange ideas in their group work activities. Encourage them to share their results, tools and apparatus as they carry out their practical activities.

2. Communication

Encourage learners to discuss in English during group discussions and presentation of their findings in class. Let them exchange and share opinions irrespective of their abilities when answering questions. Through this, learners will highly build their command in language. Encourage students to ask questions and provide answers where need be. This way, they will build on their confidence and soon develop the love and passion for the subject.

3. Critical and creative thinking

This unit is about diversity of living organisms. As students discuss about the variety of organisms, let them creatively develop simple keys for identification and classification of organisms through constructing simple dichotomous keys. Present to students pictures, photographs or charts and allow them to discuss in their respective groups as they try to give their findings.

4. Culture and identity

Allow learners to research on ways in which they can use the knowledge acquired from the unit to improve the living conditions of people within their communities. Let them also apply some of the practical skills acquired in class to contribute to the development of their community and country at large.

Cross cutting issues

1. Environmental awareness and sustainability

When discussing the importance of Biology, take this opportunity to emphasize that one reason why we must study biology is to enable us manage the environment well. Encourage students to conserve plants and animals as well as keeping the environment clean to prevent spread of diseases and pollution of the environment.

2. Peace and values of education

Throughout the unit, students will be actively involved in discussing different activities in pairs, in group and as a class. Students should be made aware of the need to accommodate everyone's ideas and opinions. As they discuss they will at times agree or disagree on issues at hand. They should be made to embrace the views of others and treat them as a learning process. Any form of intolerance should be highly condemned.

3. Life skills

Encourage students to plant crops, trees and to keep animals such as cow, goats and sheep at home. Let them know that through planting crops they can harvest and sell hence a source of income. They can also use the plants as a source of food, medicine, home to birds and shelter. Through keeping animals such as cows, they can obtain milk and meat. Let them know that when they further their studies they can become agricultural officers, environmental activists, nutritionists and veterinary officers.

1.1 Definition of Biology and its branches

(Refer to Student's Book page 2)

Introduce the topic by creating a link between Biology and what the students have already learnt in primary science. This will make them realize that they are on familiar ground and that Biology is now an area of study. Let the students know that in primary science they learnt about living and non-living things and in this class they will study Biology as the study of living things. They will explore different branches of Biology which will help them demystify the term Biology.

In activity 1.1, allow students to work in groups. Provide each group a specimen bottle where they will place their specimens. Allow them to collect different organisms within the school as you watch them closely. Caution them against organisms which may sting. Back in class allow them to investigate different characteristics of the organisms using the specimens collected. Go round the class and listen at how students discuss in groups. Observe at how they come out with the characteristics of living things from the specimens collected. Allow the groups to share their findings and you can also allow each group to present as you moderate their time. Ensure that students take notes in their notebooks.

Assessment opportunities

Observations - Observe as students collect the organisms within the school. Are they able to identify some of the characteristics using the organisms collected?

Conversation - Talk to learners as they carry out the activity. Are they able distinguish a living thing from a non-living thing? Which features have they based their results from?

Activity 1.2

Activity 1.2 is a practical activity and it involves playing a game of naming branches of biology. Divide the class into pairs and provide each pair with a manila paper. Allow each pair to cut the Manila paper into small pieces. Let them carry out the activity as outlined in the activity. Go round the class to ascertain each pair is doing the activity. Allow the pairs to share their findings with the rest of the class. Take them through other branches of biology in student's book page 3 and ensure that they take notes in their notebooks.

Assessment opportunities

Observation - observe as learners work in pairs. Look at how they play a game of naming branches of biology. Are they able to identify different branches of Biology?

Conversation - Talk to learners as they discuss in pairs. Are the pairs able to identify what biochemistry is about? What about cytology?

Product - look at branches provided by learners. Are the branches identified correct?

1.2 Importance of studying Biology

(Refer to Student's Book page 3)

In **Activity 1.3**, divide the class into pairs and allow learners to discuss the question in student's book page 3. Go round the class and look at how the pairs discuss. Encourage them to note down their answers in their notebooks. Allow the pairs to share their findings. Lead the class to a general discussion on importance of studying biology. Conclude the lesson by asking learners to do further activity in student's book page 4.

Assessment opportunities

Observation - look at how the pairs discuss. Are they able to list down professions or jobs that require knowledge of biology?

Conversation - Talk to learners as they are discussing study questions. Are they able to respond to questions within the activity?

1.3 Characteristics of living things

(Refer to Student's Book page 5)

Activity 1.4

The following activity entails investigating characteristics of living things. Divide the class into groups and take them for a nature walk. Let students collect the materials listed within the activity. Back in class, let them observe the breathing, movements and

feeding structures of different organisms collected as they discuss using a hand lens provided. Ask student's probing questions such as; what do you think are the function of wings, legs, in an insect? Ensure learners take notes in their note books.

Assessment opportunities

Observation - Observe learners as they do the activity. Are they able to observe breathing and movement structures in an organism?

Conversation - Talk to learners as they discuss in groups. Are they able to give facts during the discussion?

Answers to Self-Test 1.1

(Refer to Student's Book page 7)

1. Although a motor vehicle can move, be able to use oxygen and produce waste, it does not reproduce, grow or show irritability. Therefore, it cannot be regarded as a living organism.

2.

Characteristics	Plants	Animals
Growth	Grow throughout their lives.	Stop growing at some point.
Movement	Show minimal movement.	Able to move around.
Nutrition	Uses simple substances to make food through photosynthesis.	Depend on plants and other animals for food.

3. Movement, respiration and excretion.

1.4 Various life forms of organisms

(Refer to Student's Book page 7)

Activity 1.5

This is a practical activity and it involves investigating various life forms of an organism. Divide the class into different groups and provide learners with the materials required for the activity. Allow learners to carry out the activity using the steps outlined within the activity. Explain to learners how to use a microscope and let them do the activity as you watch them carefully. Allow them to make mistakes since mistakes are part of learning. Ask probing questions such as; when observing the specimen, what can you see? Ensure learners draw the organisms in their notebooks and that they take notes.

Assessment opportunities

Observation - Observe as learners examine the specimens using a microscope. Are they able to observe the specimen under a microscope?

Conversation - ask learners questions such as; which other dye can be used instead of methyl blue? Why is a hand lens not used to observe the specimen?

Product - look at their diagrams. Are they able to come up with correct diagrams?

Activity 1.6 and 1.7

Activity 1.6 is a practical activity and involves observing insects and other animals. Divide the class into groups and provide them with the materials such as sweep net, pooter and specimen bottles. Guide them for a nature walk as they collect various organisms. Observe learners carefully to ensure that the activity is done in groups and discussion enhanced. Caution learners to be very careful as they collect insects and other organisms since they may sting. In **Activity 1.7**, allow learners to be in pairs and let them brainstorm about the various life forms of organisms in Figure 1.6, 1.7 and 1.8. Let them identify and present their findings in an evolutionary tree shown in learner's book page 10. You can also play a video for the learners to watch from the following link: <http://www.youtube.com/watch?v=BVpWQclZzIY>. Ensure learners take notes and answer questions in self-test 1.2.

Assessment opportunities

Observation - Observe learners as they do the activity. Are they able to do the activity in groups?

Conversation - talk to learners as they collect different organisms. Are they able to come up with the evolutionary tree using the organisms collected?

Answers to Self-Test 1.2

(Refer to Student's Book page 10)

Unicellular	Multicellular
Paramecium	Fungi
Amoeba	

- a. Blue green algae
b. Centipede
- Check Fig 1.6 and Fig 1.7 in Student's book page 8 and 9 respectively.

1.5 Classification of organisms and its importance

(Refer to Student's Book page 10)

The purpose of this sub-unit is to make students aware of the great biodiversity of plants and animals that exists and the importance and the need to preserve them. Show students the importance of using the external features of plants and animals in classification of organisms into various taxonomic units. Specific emphasis should be on the kingdoms. The grouping of living things into taxonomic units creates order in their study. In order for the students to appreciate the value of biodiversity, the teacher should emphasize the economic importance of the various groups of plants and animals. Some cause diseases and others are useful to humans as a source of food, medicine and other uses.

Activity 1.8

In this activity, divide the class groups and allow learners to look at the pictures within the activity. Let them discuss what they can see from the pictures and why do they think such kind of arrangement is important.

Let them also observe the second picture i.e. biodiversity in the forest and allow them to identify some of the organisms that can be seen from the picture. Write down different types of the organisms identified by learners on the board and initiate a class discussion based on importance of putting organisms into groups. Ensure learners discuss in groups and are communicating as you go round the class. Ensure learners take notes in their notebooks.

Assessment opportunities

Observation - observe as learners discuss the activity in groups. Are they able to identify importance of classifying organism into groups?

Conversation - talk to learners as they discuss in groups. Are they able to give the facts?

Activity 1.9

Introduce the activity by asking students what they noticed about the number of living organisms that exists in their school compound. Are they few or many? Ask them if they think it is possible to identify and study each of the organism individually. How long do they think it will take to study the organisms; around the school, in their country and in the world? You can then proceed to divide the class into groups and provide learners with seeds of rice, wheat, peas, beans and maize.

Ask learners to follow the procedure outlined in learner's book page 11 and carry out the activity in their respective groups.

Go round the class as you observe learners do the activity in groups. Allow learners to ask questions as you respond to them during the activity. Ensure that learners work

as a team in their groups and provide a chance for their leader to share their findings with the rest of the class as you moderate their time.

Assessment opportunities

Observation - Observe as learners do the activity. Are they able to count each seed?

Conversation - talk to learners as they carry out the activity. Are they able to explain the need for classification in grouping of seeds?

Activity 1.10

This is a practical activity and it involves collecting different types of living organisms. Guide the students through the procedure first before they leave the classroom. This is to ensure that they know what to do and therefore to avoid wasting too much time. Caution students to be extra careful when handling animals and under no circumstances should they handle centipede if they come across them because they may be poisonous. If they are not sure about how safe an organism is, they should ask the teacher to avoid it. Back in class, allow learners to do the activity in groups as outlined in the activity. Move from one group to another in order to assist them when they have a problem. Allow them to share their findings with the rest of the class. Emphasize to learners that the external features present in an organism is important in identifying the organism under observation. Conclude the lesson by asking each group to list on black board the various observable external features of collected organisms.

Assessment opportunities

Observation - observe as learners collect different living organisms and as they discuss in groups. Are they able to group organisms based on the external features?

Conversation - Talk to learners as they carry out the activity. Are they able to explain why different organisms are placed into different groups?

Product - look at each groups work. Are the organisms collected placed in the right group?

Answers to Self-Test 1.3

(Refer to Student's Book page 13)

1. Classification is the grouping of organisms for ease of identification and study
2. Artificial classification is based on superficial characteristics while natural classification is based on the natural order that is supposed to exist and that is informed by science.

3. He proposed of three kingdoms, divided into classes. He also suggested orders, genera and species with additional rank lower than species.
4. It puts information together to avoid chaos and confusion among scientists.
 - It enables scientists to place organisms in their correct groups for ease of study
 - It allows scientists to better understand the phylogenic relationships among organisms.
 - Classification allow scientists to identify, group and properly name a newly discovered organisms.

1.6 Taxonomy hierarchy of classification

(Refer to Student's Book page 13)

Activity 1.11

This is a discussion activity. Divide the class into groups and introduce the activity by writing the following names on the black board. Cow, cat, elephant and lion. Ask the groups to give the names of the organisms written on black board in their native languages. Move round the class and observe how each group are doing the activity. Give each group a piece of chalk to write the names of the organisms in the blackboard as they read the name for the class. Ask learners probing question such as; do you think other people in the world can identify the animals using your native language? Why is this so? Ensure that all learners cooperate and work as a team as they carry out the activity. Allow the groups to share their work and conclude the lesson by going through the facts in learner's book.

Assessment opportunities

Observation - observe as learners work in groups. Are they able to identify the organisms in their native languages?

Conversation - as learners communicate, ask them questions such; do you think people from different parts of the world can recognize the names of animals written in your native language?

Activity 1.12

This activity is about categorizing people according to their addresses. Divide the class into groups and allow learners to go through the procedure under your guidance. Let them try to estimate the total number of people in each administrative unit in South Sudan and come up with a table similar to table 1.2 in learner's book page 13.

Let each group brainstorm and fill the table. Ask each group to provide answers for study questions within the activity and try to relate their findings with the hierarchical relationship between taxonomic units. Allow learners to share their findings with the rest of the class go round the class as you listen carefully at how learners discuss and brain storm. Ensure learners take notes during the discussions.

Assessment opportunities

Observation- observe as learners discuss in groups about the total number of people in different administrative units within South Sudan. Are they able to approximate the total number of people in each administrative unit?

Conversation- talk to learners as they carry out the activity. Are they able to identify the administrative unit that has the highest and the least number of people?

Product- look at how learners in different groups have completed their table. Do their results reflect the number of people in each administrative unit?

Activity 1.13

This is a practical activity and it involves placing organisms into various taxa. Divide the class into groups and provide each group with the following, a laboratory rat or rabbit, housefly, butterfly, grasshopper, grass, bean plant and maize plant. Take learners through the steps outlined in the activity and allow them to carry out the activity on their own. Move round the class as you observe how each group carry out the activity. Allow learners to make mistakes since mistakes is part of learning. Summarize the lesson by guiding learners on how to tabulate their findings as shown in table 1.4 of learner's book. Make sure learners take notes in their notebooks.

Assessment opportunities

Observation - observe as learners carry out the activity. Are they able to classify organisms up to species level?

Conversation - talk to learners as they carry out the activity. Are they able to place different organisms into various taxa?

1.7 The binomial system

Introduce the sub-unit by writing the following names on the black board, cat, dog, maize and beans. Ask the students to give the names of those organisms in as many languages as possible. Ask them how they think scientists who do not originate from the same country and do not therefore speak the same language would know that they were referring to the cat (unless they held up pictures of the animal in question).

For **activity 1.14**, allow learners to discuss in groups the questions within the activity. Let them come out with their findings and allow them to share their findings with other groups. In **activity 1.15**, divide the class into pairs and allow them to read the story. Go

round the class and observe how the pairs read the story. Ask the pairs to summarize the story in form of a flow diagram and compare their results with those of other pairs. Explain to learners the need for scientists all over the world to have a universal method of naming organisms for easier communication. Conclude the lesson by having a discussion on how scientific names of organisms are written and why scientific names are commonly used.

Assessment opportunities

Observation - observe as learners do the activity. Are they able to use the characteristic feature to locate an organism?

Conversation - talk to learners during the activity.

Product - look at the flow diagrams designed by each pair. Have learners come up with the correct flow diagram?

Answers to Self-Test 1.4

Refer to Student's Book page 18

1. Species, Genus, Family, Order, Class, Phylum, Kingdom
2. a) Wolf: they share the same Genus -Canis
b) Human beings: They don't share same order.
c) Domestic dog: they share same Genus.
3. (a) Lion, wolf, domestic dog and domestic cat
(b) Animalia
(c) Related to lion, domestic dog, wolf and cat. They all have similar characteristics.

1.8 Dichotomous key

In this sub-unit, students will be introduced to the construction and use of dichotomous keys. The students will be required to use the characteristics of plants and animals to construct and use the dichotomous key. The keys consist of a set of instructions that use observable characteristics either to name or identify an unknown organisms. The students are therefore required to know how to get variations from each of the characteristics then arrange the characteristics and their variations to form a key. They will be expected also to use already constructed keys to identify unknown organisms.

Activity 1.16

This is a practical activity and involves investigating observable unique features of organisms. Let learners be in pairs and provide them with the materials required for the activity. Take them through the procedure and let them carry out the activity on their

own. As they carry out the activity, go round as you assist them where they encounter difficulties. Allow them to make mistakes since mistakes is part of learning. Ensure learners take summarized notes and are discussing as they carry out the activity.

Assessment opportunities

Observation - observe as learners do the activity. Are they able to identify unique characteristics from the organisms provided?

Conversation - talk to learners as they carry out the activity.

Product- look at how learners present their findings in the table. Are their findings correct?

Activity 1.17

In this activity, learners are required to construct a dichotomous key using plant specimens. Place learners into different groups and allow them to collect different types of leaves within the school compound and bring them to class. Caution learners to avoid destruction of plants around the school. It is better for them to cut off a part of a plant and allow the rest to grow. Guide the students as they study the leaves collected. Take them through the activity in learner's book and allow them to carry out the activity on their own using the leaves collected. Go round the class to ensure that all learners in different groups are working as a team. Allow them to make mistakes as mistakes is part of learning. After the activity, allow each group to present as you moderate their time.

Assessment opportunities

Observation - observe as learners do the activity in groups. Are they able to come up with the dichotomous key?

Conversation - Talk to learners as they do the activity. Are they able to tell what the numbers and letters used in the dichotomous key represent?

Product - look at how each group has constructed a dichotomous key. Are the dichotomous key constructed correct?

Activity 1.18

This activity involves constructing a dichotomous key using animal specimens. Divide the class into pairs and allow learners to collect different types of small animals within the school compound using the materials provided. Let them bring the specimens in class and apply the previous knowledge of constructing a dichotomous key using plant leaves to do the activity. Observe carefully as you go round the class as learners conduct the experiment and advise where need be. Encourage learners to collect only the number of specimen that they need so as not to cause an imbalance in the ecosystem. Ensure learners take notes and practice doing this activity regularly so that they can develop more skills in constructing a dichotomous key.

Assessment opportunities

Observation - observe as learners do the activity. Are they able to identify external features of the organisms collected?

Conversation - talk to learners as they construct the dichotomous key. Which features do they base when constructing the dichotomous key?

Product - look each pairs work. Are they capable of constructing a dichotomous key using the organisms collected? Are their dichotomous key correct?

Answers to Self-Test 1.5

(Refer to Student's Book page 23)

1b, 2b, 3a

1b, 2a

1a

1b, 2b, 3b

Answers to check your progress 1

(Refer to Student's Book page 23)

1.
 - i. Treating and preventing diseases.
 - ii. With the help of proper nutrition knowledge, biology aids in prevention of deficiency disease.
 - iii. Environmental degradation.
 - iv. Food insecurity
2. A stone cannot grow, feed, move unless thrown, die, reproduce, respire, excrete and show irritability
3. Biochemistry, physiology, entomology and microbiology
4.
 - a. *Bidens pilosa* is the correct way of writing. The genus name should start with a capital letter while a species name should start with a small letter.
 - b. Bidens
5.
 - (a) Fungi-mushrooms or mould.
 - (b) - Some mushrooms are used as food.
 - Used as medicine e.g. penicillin.
 - Crop and animal diseases.
 - Food spoilage.

6. C

7. Scientific names make it easier for scientists to identify and refer to the same organism all over the world.

8. Check on the listed characteristics to award marks to the students.

T – Has a cylindrical body, many legs, and one pair of antennae.

P – Has eight jointed legs, no wings, two body parts, no antennae.

Q – Has one pair of wings, six jointed legs, three body parts, one pair of antennae.

R – Has no wings, has six jointed legs, three body parts, one pair of antennae.

S – Has no wings, has six jointed legs abdomen is very thin and long, one pair of antennae.

U – Has two pairs of antennae, two body parts. It has ten legs of different sizes and shapes.

Learn about		Key inquiry questions
<p>Learners should understand the structure of prokaryotic and eukaryotic cells (i.e. plants and animals)/unicellular and multicellular organisms, the cell theory, components and functions. They should understand how to use microscopes for investigation of a selection cell shapes (e.g. onion, soft tissues from plant roots, and stems), they should know different parts of the microscopes.</p> <p>Learners should understand tissues, organs, organ systems and organisms and the difference between plant and animal cells. They should prepare slides of plant and animal cells and measure and estimate cell sizes.</p> <p>As a result they will be able to define the cell, explain the differences between animal and plant cells, understand the cell as a unit of life that is highly specialized, the structure, the concept of organization and differentiation of cells into specialized units.</p>		<ul style="list-style-type: none"> • What are living things made of? • How can we distinguish between plant and animal cells? • What are the functions of the different parts of the cell? • Why is the cell a unit of life? • How does a microscope work? • Why microscopes are essential in the study of small object/bodies? • How unicellular organisms are capable of existing independently in a single cell? • How would you distinguish between cells and tissues? • Why cell specializations are considered very important? • How would you distinguish between the prokaryotic and eukaryotic cells in terms of their organizations?
Learning outcomes		
Knowledge and understanding	Skills	Attitudes
<ul style="list-style-type: none"> • Understand structures of the cell, organization and functions. 	<ul style="list-style-type: none"> • Able to observe the shape of a cell under a microscope. • Prepare slides and perform simple experiments with plant tissues for example. • Use a microscope. 	<ul style="list-style-type: none"> • Appreciate the structure of the cell. • Show curiosity and wonder about the existence of microscopic units of life. • Appreciate the microscope • Think creatively about the cell as unit of life. • Co-operating with others • Accuracy, systematic, ethical and patient.

Contribution to the competencies:

Critical and creative thinking: about the cell as a unit of life will be enhanced.

Communication: will improve as learners exchange ideas and discuss results of their experiments.

Co-operation: will develop during group work in the laboratory and subsequent presentation of results, thus, instilling in them the culture of being accurate, systematic, ethical and patient.

Links to other subjects:

Physics: properties of light, lenses.

Chemistry: chemical processes.

Mathematics: geometric shapes of cells, their numbers, measurements.

Introduction to the unit

This unit aims at making the students aware that although living things are classified into different groups, they are all made up of common basic unit known as the cell. Students need to know that the cell cannot be seen by the unaided human eye or the magnifying lens because it is too small. However, it is possible to see the cell using a more powerful instrument. This way you can introduce the light microscope and electron microscope as instruments for observing very small organisms or parts of organisms. You will guide the students in investigating the cell as the smallest unit of structure and function in living things. The student will therefore have the opportunity to study the great diversity of cells and cell organelles. The students will also be expected to acquire skills in manipulation of the light microscope and prepare temporary slides.

Competencies to be attained

1. Communication

As students work in pairs, groups and as a class, encourage them to communicate effectively through use of good grammar and pronunciation of words. Ensure that students develop good listening and writing skills as they communicate and discuss. They should convey their ideas effectively through spoken and written English by applying appropriate grammar and relevant vocabulary as they learn this unit.

2. Critical and creative thinking

This unit provide many opportunities that requires students to think when interpreting pictures, drawing biological diagrams, observing, and tabulating their results. Encourage students to always think creatively as they read a story and summarize in the number of words specified within the activity. Ensure students are also in a position to plan

and carry out investigations, using a range of sources to find information. They should also be capable of sorting, analyse information and drawing conclusions from the experiment under investigation.

3. Co-operation

Throughout this unit, students will be expected to discuss in pairs, in groups or as a class. Ensure that students work collaboratively towards achieving a common objectives when doing the activities. Encourage them to be tolerant of each other and respectful on differing views, when working together.

4. Culture and identity

Students should be made aware that just as the cell is the basic unit of life, it can be compared with many aspects of life such as the administrative units of a country or family lineage. Therefore, students should take pride of their culture, identity and the diverse nature of South Sudanese society. They should build an understanding of South Sudanese heritage in relation to the wider world and appreciate their contribution to the development of South Sudanese culture. Encourage them to value diversity and respect people of different races, faiths, communities, cultures, and those with disabilities.

Cross cutting issues

1. Environmental awareness and sustainability

You can raise students' awareness on unicellular forms of life that are of environmental importance. For example, some unicellular algae are useful in purification of aquatic systems as they absorb human waste, metal ions that enter water systems through sewage effluents. If these metals accumulate in water, they could reach toxic levels. Some algae are used in sewage treatment plants. Here algae use the metal ions as nutrients and therefore reduce the concentration. For this reason, the use of harmful pesticides that kill such algae should be avoided.

2. Peace education

Bring to the attention of learners the need to accommodate other people's views and opinions. Let them understand that confrontations is not always the way to solve issues but rather, they should learn to agree to disagree. Discipline should be observed at all times in the groups since some cases can make learners diverge from the main objectives.

3. Life skills

You can raise the students' awareness on the use of microscopes in detection of disease causing microorganisms, particularly the blood. The microscope is also used to examine tissues to check for presence of parasites, filarial worms etc. It is also used to identify bacteria that cause different diseases.

2.1 Definition of the cell

(Refer to Student's Book page 26)

Introduce the sub-unit by asking the students to suggest what a stone house is made up of. The expected answer is stones. Let them understand that a stone is a unit used in the structure of a stone house. The house can be very big, but it is made up of many smaller units put together during construction. Relate this idea to the fact that all living organisms are similarly made up of many small units which when put together make up an organism, and that these units are called cells. Define the term cell as the basic structural and functional unit of every living thing.

Activity 2.1

This is a class activity and involves reading a story and relating it to the cell in organisms. Ask one learner to read the story audibly as the rest of the class listen carefully. Let learners then work in pairs to summarize the story in a maximum of 30 words and represent their information in form of a flow diagram. Go round the class as you observe how learners do the activity. Allow them to make mistakes since mistakes is part of learning. Give some learners a piece of chalk to illustrate what he or she has grasped from the story and present it in form of a flow diagram. Let learners then try to relate the story with the cell. Conclude the lesson by emphasizing the relationship between the cells as a unit in an organism. Some are made up of one cell and others are made up of many cells. Ensure learners take summarized notes in their notebooks and answer the study questions within the activity.

Assessment opportunities

Observation - observe as learners do the activity. Are they able to summarize the story?

Conversation - talk to learners as they do the activity. Can they relate the story with a cell?

Product - look at how learners have summarized the story into 30 words. Are their summary correct?

2.2 Magnifying instruments

(Refer to Student's Book page 27)

Introduce the sub unit by asking the students why they think they have been using the magnifying lens to study the external features of plants and animals. They may suggest, 'in order to see the features of plants and animal more clearly'. Then ask them if there were some organisms that were too small to be seen to even to even with the magnifying lenses. Lead them to understand that there are some plant and animal structures which cannot be seen with a magnifying lens. Ask them to give suggestions as to how these structures can be seen. Allow them to brain storm. You can then introduce them to the activity.

Activity 2.2

This is a practical activity and it involves examining specimens with a naked eye. Divide the class into pairs and ask them to collect various insects and plant leaves within the school environment and bring them to class. Take them through the procedure and allow them to carry out the activity on their own. Observe the pairs as they carry out the activity by going round the class. Are the pairs able to observe the tiny holes present in plant leaves? Are they able to observe different organs in various insects collected? At this point introduce a discussion on the need for magnifying instruments in observing specimens. Let learners come up with reasons for using a magnifying lens. Ensure learners take notes in their notebooks.

Assessment opportunities

Observation - observe as learners use the magnifying lens to observe the collected specimens.

Conversation - talk to pairs as you go round the class. Are the pairs capable of giving reasons for using a magnifying lens?

Product - are the pairs capable of observing the tiny holes in plant leaves? How do they look like?

Activity 2.3 and 2.4

This is mainly a practical activity that will involve learners to identifying the features of a hand lens, examining specimens using a hand lens and how to take care for a hand lens. In **activity 2.3** divide the class into pairs and provide each pair with a hand lens. Ask the pairs to try to look at the specimen using the hand lens. Observe how the pairs use the hand lens. Allow them to make mistakes since mistakes is part of learning. You can then demonstrate to the pairs how use a hand lens. Let the pairs draw the specimens and guide them on how to calculate magnification. As learners carry out the activity go round the class to observe how learners do the activity in pairs.

For **activity 2.4**, place learners in groups of four and let them brainstorm how the hand lens provided can be taken care of. Ask each group to choose a leader who will make a presentation of their findings on behalf of other learners. Moderate each group's presentation and discuss as you demonstrate to learners how to take care of magnifying lens. Ensure learner's take notes and answer the questions in Self-Test 2.1.

Assessment opportunities

Observation- observe as learners work in pairs. Are they able to use a hand lens to observe the specimen?

Conversation-talk to learners as you demonstrate how to use a magnifying lens.

Product-look at the magnification obtained by each pair. Are they correct?

Answers to self-Test 2.1

(Refer to Student's book page 29)

1. Magnification = Image distance/Object distance
= $6.8/0.6$
= $68/6$
= $\times 11.33$
2. Examining features such as gills of a fish, spiracles in insects and other vertebrates.

2.3 Parts and functions of a light microscope

(Refer to Student's Book page 29)

Activity 2.5 and 2.6

This is a practical activity that involves observing and identifying different parts of a microscope and its uses. In **activity 2.5**, group the students into 5 or so, depending on the number of microscopes available. If there is only a single microscope, then they can do the activity in turns. Ask each group to carry out the activity as outlined in each and every step of the activity. The idea is for them to examine the microscope first on their own and discover various features. They can use the illustration in student's book page 31 on the parts of light microscopes to identify each part. Let learners explain the need of using a microscope instead of a magnifying lens studied in the previous activity. **Activity 2.6** is about care of the microscope. Place learners into groups and allow them to discuss ways in which a microscope can be handled and taken care of.

Let them also discuss ways in which microscope can be stored. Provide each group an opportunity to share their findings with those of other groups. You can then allow them to present as you moderate their time. Ensure learners take notes. Caution learners to handle microscope with a lot of care since it is a very delicate and expensive instrument to purchase.

Assessment opportunities

Observation - observe as learners do the activity. Are they able to identify different parts of a microscope?

Conversation - talk to learners as they carry out the activity. Are they able to give the facts on handling a microscope?

Product - ask some learners to demonstrate to class how to handle a microscope. Are they able to handle a microscope? Are they able to identify various parts of a microscope?

Answers to Self -Test 2.2

(Refer to Student's book page 35)

1. c-a-b-d
2. See table below.

Hand lens	Light microscope
<ol style="list-style-type: none"> 1. Used mostly during the day. 2. Has one lens. 3. Mostly made up of two parts. 4. Has a low magnification. 5. Live objects can be examined. 	<ol style="list-style-type: none"> 1. Can be used both during the day and at night. 2. Has a series of lenses. 3. Made up of many parts. 4. Has a high magnification. 5. Only cut sections of objects can be viewed.

Activity 2.7

Introduce the lesson by organizing the students into groups. Provide them with the materials required for the activity and allow them to carry out activity 2.7 on observing prepared slides using a light microscope on their own. Instruct them to use a sharp pencil and draw continuous outlines of what they observe in their notebooks.

Emphasize to them to avoid shading and ensure that they come up with a simple illustration as possible showing only the basic features that are observable. Move round the class and observe how each group do the activity. Allow learners to ask questions as you respond to them. You can also allow them to make mistakes since mistakes is part of learning and correct where need be. Ask each group to share their drawings. Take them through the guidelines required when drawing as presented in facts in the learners book.

Assessment opportunities

Observation - observe as the learners look at the slides using a light microscope. Are they able to draw what they can observe?

Conversation - talk to learners as they carry out the activity. Are they able to draw the specimens?

Product - look at each groups work. Are they able to make a well labelled diagram?

Activity 2.8 and 2.9

Activity 2.8 and **2.9** are practical activities involving calculating magnification. Introduce the lesson by asking the students how they think the size or length of a cell can be estimated when viewed under a microscope. Guide students in carrying out activity 2.8, as outlined in the book. Let them read the procedure and use the steps to carry out the activity. Check to it that every learner is doing the activity by going round the class. You may ask probing questions such as how do we find the area of a rectangular piece of paper. How many times does the area of a folded paper compare to an unfolded paper? How do we call the factor of comparison between the two areas? This will enhance critical thinking among learners. After the activity, ensure that all learners take notes. For **activity 2.9**, divide the class into pairs and provide learners with the required materials for experiment. Take them through the procedure step by step and allow the pairs to carry out the activity on their own as you observe. Instruct the students to count the total number of cells that they can see arranged end to end in the field of view. Give some students a piece of chalk to demonstrate to the class how the diameter of a cell can be obtained and how millimeters can be calculated to micrometers. Go round the class during the activity and listen at how each pair carry out the activity. Conclude the lesson by asking the pairs to change the objective lens to medium power and to calculate the length of the new magnified cell image, and to compare it with that of the low power. Allow learners to compare their results at the end of the activity and make sure that they notes in their notebooks.

Assessment opportunities

Observation - observe as learners work and discuss in pairs. Are they able to count the cells?

Conversation - Talk to learners whilst they are discussing questions. Can they calculate the size of the image of the cell as seen under low power objective lens? Can they determine the number of cells present in a diameter of field of view?

Product - look at the result obtained by each pair. Are their magnification correct? Are the pairs capable of estimating cell size?

2.4 Structure of plant and animal cells

(Refer to Student's book page 38)

Activity 2.10, 2.11 and 2.12

Activity 2.10 and 2.11 are all practical activities involving observing a human cheek cell and plant cell under a light microscope. Introduce the activity by organizing students into groups. Allow the students to go through the steps as outlined within the **activity 2.10** carefully as you observe. You can then provide them with the materials to choose from the ones they will use in the activity.

Instruct them to try and isolate in the view of a unit structure which is a cell. Let them describe what they can see. You can give some students a piece of chalk to write a list of different description on board. Some possible description are: they can see many spherical structures, round things, etc. Let the learner tell what are located inside the spherical units which are the cell. They may say a space with a dark spot in the middle, tiny dots, etc. Guide them in making three clear distinction i.e. the cell membrane, nucleus and cytoplasm. Instruct them to draw the structure of one cell as observed in the light microscope and state the difference in the appearance of the cells. Let them discuss in their groups and fully describe the animal cell as seen under the light microscope activity 2.10. Allow them to share their findings with those of other groups. They can also compare their drawings with the animal cell drawn in the book. Encourage learners to label the components of the cell they have drawn. For **activity 2.11**, allow learners to carry out the activity on their own using the instruction within the activity. Let them use the knowledge and practical skills of the previous activity and carry out the activity. Provide them with the materials required for the activity and move round the class as you observe the groups working. Ask the learners to draw a plant cell as observed in the light microscope and label its part. Let them identify some of the similarities and differences observed between a plant cell and an animal cell from the previous activity. Allow them to share their findings and provide each

group an opportunity to present in class as you moderate their time. Ask learners to do **activity 2.12** using the materials provided. Let them be in groups and use the previous knowledge of activity 2.10 and carry out the activity on their own. You may move round the class and observe how the groups work. Allow each group to make a drawing and compare their results with those of other groups. Summarize the lesson by clarifying the fact that there are other components in the cell cytoplasm that cannot be seen with any objective lenses and that a more powerful microscope known as the electron microscope is the only one that can show these organelles. Ensure learners take summarized notes in their notebooks.

Assessment opportunities

Observation - observe as learners work in groups. Are they able to identify some of the structures present in a human cheek cell?

Conversation - Talk to learners whilst they are observing the human cheek cell under a light microscope. Ask them about what they have found and whether they expected to find the structures above from the experiment.

Product - Look at their drawings. Do they reflect the structure of an animal and plant cell?

2.5 Functions of parts of plant and animal cell

(Refer to Student's book page 42)

Activity 2.13

This is a research activity aimed at determining functions of different parts of plants and animals. Organise learners in pairs and provide them with textbooks and other reference materials. Let them carry out research on their own from the books provided as you move round the class observing how the pairs work. Allow each pair to present their result in any form such as a table or flow diagram. Let them compare their results with other pairs within the class. Choose at least three pairs and provide them with a chalk to make a presentation of their findings on chalk board as you moderate their time. During their presentation, you may ask probing questions such as; what are the function of the following; nucleus, cell membrane and mitochondria in both plant and animal cells? Ensure that learners take notes and answer questions in self-test 2.3.

Assessment opportunities

Observation - observe learners as they do research in pairs. Are they able to come up with the facts?

Conversation - talk to learners whilst they are discussing in pairs. Ask them probing questions such what is the function of nucleus in both animal and plant cell.

Product - look at how each pair has presented their work. Are the tables or flow diagram presented correct?

Answers to Self-Test 2.3

(Refer to Student's Book page 44)

1. Plants cells do not have a skeleton like animals to give them shape; they depend on the rigidity of their cells.
2. To enable plants trap sunlight energy to be able to manufacture their food.

Answers to Self-Test 2.4

(Refer to Student's Book page 45)

1. a. A. Plant cell B. animal cell
b.

Plant cell	Animal cell
Have a cell wall	Do not have a cell wall
Has a fixed shape	Has no fixed shape
Has chloroplast	Do not have chloroplast
Has a nucleus located towards the periphery.	The nucleus is centrally located

2. Mitochondrion, protoplasm, nucleolus, ribosomes, endoplasmic reticulum, mitochondrion, Golgi apparatus and lysosomes

Activity 2.14

In this activity, learners are challenged to work in groups and discuss the structural modification of different specialized animal cell provided and describe how they are suited to their function. Introduce the lesson by telling learners about the structure of an organisation. Tell them that in an organisation there are several departments, each specializing in one area: for example, sales, marketing, human resource, finance etc. All departments work together for the success of the company. Relate this to the different cells in the body of a multicellular organism. Explain further that all cells in the body

cannot perform all body functions therefore there is need for specialization (division of labour). At this point you can then provide models of specialized animal cells to each group. Let them discuss the structural modifications of the cell that suits it to its function as you move round the class observing how they discuss. Allocate each group about 3 minutes to present to the class the content of their discussion and learners to write short notes in their notebooks.

Assessment opportunities

Observation - observe how learners discuss in different group. Listen at how they discuss. Are they able to describe how different cells are adapted to their function?

Conversation - talk to each group as you move round the class. Are learners communicating effectively? Are they able to name different types of specialized cells and how they are suited to their functions?

Activity 2.15

This is mainly a practical lesson that will involve activity by the learners of observing specialized plant cells. You will engage learners in a discussion regarding the activities and assessing learning achievements. You are therefore required to get the various materials of specialized plant and animal cells in advance and organise the class in a way that will encourage the teaching methods suggested. In this activities, categorize learners into groups of five and let them perform the tasks in rotation. Instruct them to carefully study the cells as seen in the photomicrograph and identify and write down the different types of cells they can see. You can assist the learners to identify the cells. Ask learners to draw a well labelled diagram of cells observed and share their findings with those of other groups. Conclude the lesson by emphasizing to learners that cell specialization is the structural modification of a cell to perform a specific function better.

Assessment opportunities

Observation - observe as learners discuss in groups. Are they capable of observing the cells using the photomicrograph provided?

Conversation - talk to learners in their groups as they carry out the activity. Can learners define the term cell specialization?

Product - look at their drawings. Do they reflect the cell observed in a photomicrograph?

2.6 Specialized plant cell

(Refer to Student's Book page 48)

Activity 2.16 and 2.17

Introduce the activities by discussing with the students the meaning of the word “special”. For example, ask them if they have at home special clothes or special plates, books etc. The idea is to bring out the fact that anything that is special e.g. clothes, are used for special or specific situations for example going to church, weddings, etc., and that they have a different look from the ordinary daily wear. Ask them to suggest what is different about special things. Use the student's book page 48 to explain what a specialized cell is and then introduce students to the activities. In **activity 2.16**, arrange learners in groups of not more than 4. Provide each group with charts, Manila paper and micrographs containing various specialized animal cells. Take learners through the procedure as outlined in the activity and allow them to carry out the experiment on their own. During the activity, go round the class as you observe how learners work.

Assess individual learners to gauge their attitude and interest in the lesson by looking at their level of participation and how learners appreciate the complexity of life from cells to an organism.

Check that each group has followed the right steps to achieve the desired results. You can then allow learners to compare their results before carrying out a general class discussion. Emphasize how different plant cells are suited to specific functions. For **activity 2.17**, begin the lesson by asking learners a question like, how is wheel adapted to its function? Let learners think and provide a response. They may suggest that the wheel is circular in shape to enable rotate or roll. Go further and explain to learners that if the wheel was square in shape, then it would not roll because the structure ill not relate to that kind of a function. Explain how each modification or how the main modification makes the cell suited to a specific function, e.g. the sperm cell has an extension (tail) which propels it, enabling it to swim to the ovum/ egg for fertilization to occur. You can then allow learners to be in groups and using the materials provided, let them go through the procedure as outlined in learner's book and carry out the activity on their own. Move round the class as you observe how each group do the activity. Let the students point out the modification of animal cells to perform their specific functions. Allow each group to compare their findings and provide each group an opportunity to present their findings in class as you moderate their time.

Assessment opportunities

Observation - observe as learners work in groups. Are they able to carry out the activity?

Conversation - talk to learners as they carry out the activity. Are the learners able to identify specialized cells in both plants and animals?

Product - ask learners to give modification of some specialized cells at random. Are they able to tell how the cells are suited to their functions?

Answers to Self-Test 2.5

(Refer to Student's Book page 53)

1. Root hair, mesophyll cells, red blood cells, nerve cells.
2. Cheek cells are normal cells in the body while ciliated cells are specialized for trapping dust particles and germs.
3. To trap any dust and micro-organisms when you breathe in.
4. Oviduct and trachea.

Advantages of cell specialization

(Refer to Student's Book page 53)

Activity 2.18

Introduce the lesson by telling learners that one specialized cell is not very efficient at carrying out a job, e.g. if students wanted to carry out a job, e.g. cleaning the class, then the job is much faster if many of them work as a team. From this example you can then allow learners to discuss in their respective groups the advantages of specialized cells in both animal and plant cell in relation to their function using the reference materials you have provided them with. Move round the class and observe how each group discuss. Ask each group to note down their points as they discuss and allow them to share their findings with the rest of other groups. You can also allow each group to present their findings as you moderate their time. Conclude the lesson by advising learners to write summary notes in their notebooks.

Assessment opportunities

Observation - observe as learners work in groups. Are they able to give some advantages of specialized cells?

Conversation - talk to each group as they do the activity. Are they able to come up with the facts?

2.7 Levels of organisation in multicellular organisms

(Refer to Student's Book page 53)

Introduce the topic by letting the students know that the patterns of similarities and differences among structures in living organisms reflects the strong relationship between the structure and their function. Let students know that cells operate independently and interdependently in order to perform the necessary functions of life. The structures within the human body for example cells, tissues, organs and organ systems interact in one way or another to perform a wide variety of functions that support the whole organism. Different types of models have enabled scientists to investigate and explain the various structures within an organism across a range of scales and organizational levels in an organism from the atomic level to the whole-organism level.

For **activity 2.19** divide the class into pairs and allow them to read the short story which tries to relate a building and its internal components to the levels of organisation of cells in an organism. Allow the pairs to summarize the story in a maximum of 25 words. As they do the activity, you may go round the class and observe how the pairs work. Let them relate the information in the story with the study questions asked within the activity. Allow the pairs to compare their findings with the rest of the class as they explain their answers. You can then explain to the class that different cells when grouped together form tissue and the tissue carries out the functions efficiently.

Let them know that tissues can work together to carry out a specific function e.g. in a school different classes can co-operate to clean the school compound. Let them know different tissues work together to form an organ.

2.8 Organ and organ systems

(Refer to Student's Book page 55)

For activity 2.20, divide the class into pairs. Let the pairs identify some of the organs present in the head, thorax and abdomen and write down different types of organs identified in their notebooks. Ask them to group some of the organs listed and identify the type of organ system they formed. Move round the class and observe how the pairs work. Allow them to make mistakes since mistakes is part of learning. Allow the pairs to compare their work and conclude the lesson by stressing to the class that, an organ is a group of two or more tissues that work together to perform a specific function. Emphasize that many organs together can also carry out a common task, e.g. in the education system, education is made more efficient if schools, parents, teachers, inspectors, etc all work together to enhance learning. Let them know that an organ system is formed when different organs work together to perform a specific function.

Assessment opportunities

Observation - look at how learners do the activity. Are they able to identify different organs in their body?

Conversation - talk to learners as they do the activity. Are they able to identify various levels of organisation in an organism?

Product - are the learners able to relate parts of plants and animal in terms of a cell, tissue, organ and organ system?

Answers to Self-Test 2.6

(Refer to Student's Book page 59)

1. The liver, gallbladder, the pancreas, stomach and alimentary canal.
2. It has a tail to aid in swimming, its middle piece has many mitochondria that provides enough energy to propel it.
3. Vascular bundles and epidermal tissue.
4. 5.71cm
5. a) 0.0007 cm or 7 μ m b) $\times 266\ 666$

Answers to Check your Progress 2

(Refer to Student's Book page 60)

1. a) It can be used to view some details of specimen.
b) It is composed of two lens systems.
2. a) 14 - Eye piece, 13 - Coarse adjustment knob, and 8 - Mirror.
b) (4.) Objective lens -magnifying lens, (5.)
Stage - holds the specimen, (11.) Handle
- for support during handling, (12.) Fine
adjustment knob - to achieve fine focus.
c) Refer to Learner's Book page 33.
d) Low power objective lens to prevent breakage in case
someone adjusts the body piece.
e) Field of view.

- f) Magnification of the eye piece lens \times magnification of the objective lens
- g) Cleaning with a special lens paper:
3. a) Xylem cell b) Guard cell c) Sperm cell d) Nerve cell
 4. Chloroplast, leaf palisade cell, palisade layer, maize plant.
 5. B
 6. a) Mitochondria b) Vacuole c) Chloroplast
 7. i) A watchman protects the company therefore he is compared to the body immune system.
 ii) Managers coordinates activities in the company compared to the brain.
 iii) Secretaries receive and disseminate information compared to the transport system in the body
 iv) Loaders put things into the lorries and warehouse compared to the hands in the body.
 8. D
 9. A sperm cell contains more mitochondria to provide energy required for propulsion to meet the egg.
 10. The cells are dependent upon one another. If one group of cells fails to do its job, the other cells will perish.
 a) Cell b) Cell c) Organ
 d) Organ system e) Organ f) Organ system
 g) Tissue h) Tissue
 12. a) 3 cells
 b) 1 mm
 c) The objective lens was of a lower magnification.
 13. A
 14. $\times 75$
 15. B
 16. a) Microscope b) Hand lens
 c) Hand lens d) Microscope
 e) Microscope
 17. Hold it with my fingers as I observe.

UNIT

3

Movement of substances into and out of cells

(Refer to student's book page 63-85)

Learn about		Key inquiry questions
<p>Learners should build on their prior knowledge about the cellular make up (composition) of the whole organism with a detailed investigation of cell structure and function through simple investigations and close observation.</p> <p>Learners should describe the structure of cell membrane and its properties, basic cell physiology through a study of diffusion of water along concentration gradients (osmosis) and the factors affecting its rate. They should design investigations on the process of osmosis using pawpaw fruit or iris potato, etc. and consider the concepts of solutions, suspensions, colloids and active transport. This should lead to learning about the structure of the cell membrane and its main chemical components, and investigations about the effect of movement of water into and out of the cell.</p> <p>Learners should work individually and in small groups where they should talk/discuss about their findings.</p>		<ul style="list-style-type: none"> • How do substances move into and out of the cells? • Why the process of diffusion is important to plants and animals? • How are solutes different from solvents? • What are the factors affecting osmosis? • Why is active transport of materials necessary in cells and/or living organisms? • How would you investigate the process of osmosis? • How would you distinguish between cell membrane and the cell wall? • Why cell wall is essential for the survival of plants?
Learning outcomes		
Knowledge and understanding	Skills	Attitudes
<ul style="list-style-type: none"> • Describe the movement of substances across the cells. 	<ul style="list-style-type: none"> • Analyse the structure of cell membrane. • Design simple investigations about the process of diffusion (osmosis) in plants and animals using sugar solutions. • Gain skill of the safe assembly and use of apparatus for experiments. 	<ul style="list-style-type: none"> • Appreciate the simple techniques used to accomplish tasks (e.g. diffusion, osmosis). • Adopt the habit of being systematic, resilient and accurate. • Importance of being systematic, accurate, ethical, and meticulous in carrying out experiments. • Share ideas when carrying out the investigations.

Contribution to the competencies:

Critical thinking: learners will develop a scientific mind set of being systematic, accurate, ethical, and meticulous in carrying out experiments

Communication: learners will acquire and use new vocabularies as they share results of their individual and/or group work

Co-operation: by working in small groups learners share ideas when carrying out the investigations thereby develop and adopt a scientific culture and heritage.

Links to other subjects:

Chemistry: use of chemical symbols, chemical mixtures

Mathematics: calculation of surface area to volume ratios

Introduction to the unit

The cell has an internal environment. The constituents of this environment such as water and other undissolved ions among other factors remain relatively constant at all times, even when the external environment of the cell changes. Even when the internal environment of a cell is constant, materials constantly move in and out of the cells. The ability of the cells to establish and maintain a constant internal environment is the result of special properties of the cell membrane. The selective permeability of the cell membrane permits some materials to pass through it but prevents others. The purpose of this unit is to introduce the student to the different processes by which materials move into and out of the cells.

Competencies to be attained**1. Creative and critical thinking**

This unit provides many opportunities for critical and creative thinking. Students will be required to plan and design and experiment as an individual, in pairs, group or as a class. They will be required to give reasons and explanations as to why substances move in and out of the cell, why plant cells do not burst as opposed to animal cells and account for results obtained in some activities throughout the unit.

2. Cooperation

Students will be expected to work in pairs, in groups and as a class. Through this, there will be continuous opportunity for cooperation and team work among student. The unit also provides good opportunities for creation of roles such as a leader and a presenter in the group as the students do different activities.

3. Communication

Communication in this unit will be enhanced as students discuss either in pairs, in groups or as a class. It is important therefore to ensure features required in good communication such as listening, correct use of grammar, pronunciation of words, and clarity is well enhanced during discussions and presentation.

Cross cutting issues

1. Environmental awareness and sustainability

When discussing relations in plants, students could be made aware that the use of certain pesticides and detergents could inhibit the uptake of water and minerals salts by plants. These substances might also inhibit enzymes. Certain practices of farming, for example, irrigation lead to accumulation of salts after irrigation water is drained off from the farmland. Students could also be made aware that Sulphur dioxide emitted from vehicles causes acid rain precipitation that could interfere with opening and closing of stomata in addition to damaging the leaves. This would affect productivity of crops.

2. Peace values

For a society to flourish, then peace plays a very important role. Encourage students to work in unity regardless of their gender, race and tribe as they learn this unit. During their discussions either as a class or group show them ways of solving different issues that arise peacefully and encourage students to appreciate each other as they share and compare their findings.

3. Life skills

In this unit, challenge learners to apply the skills acquired in class to solve some of the challenges that they encounter in their daily life. Let them know that physiological processes such as diffusion, osmosis and active transport play an important role in growth of plants, digestion, and excretion, transmission of nerve impulses and feeding of insectivorous plants. Encourage them to do more research on how physiological processes play a role in different organisms.

3.1 & 3.2 Structure and properties of the cell membrane and Diffusion

(Refer to Student's Book page 63)

Many substances are made up of molecules which are always under a constant random motion. This motion enables molecules to move from one region to another. The motion of a molecule in solution is constantly affected by collisions with other molecules, which results in random motion. Diffusion, which is an important aspect in living systems,

occurs in response to molecular motion and to a concentration gradient, that is, molecules moving from areas of high concentration to areas of low concentration until an equilibrium is established. Some of the examples where diffusion takes place in living organisms include oxygenation of blood in the lungs and the exchange of nutrients into cells and waste products out of cells.

Activities 3.1, 3.2 and 3.3

The activities below will enable learners acquire observation and practical skills as they set up their experiments in pairs and in groups. Ensure all the apparatus required for the activities are available before the lesson starts.

For **activity 3.1**, divide the class into pairs and provide each pair with the relevant materials for the experiment. Introduce the practical activity by asking learners what they usually see happening to smoke from fire. Let learners brainstorm and then introduce the topic by using discovery method. Allow learners to carry out the two activities i.e. activities 3.1 and 3.2 on diffusion as demonstrated by ink, perfume in activity 3.1 and potassium permanganate (VII) crystals in water in **activity 3.2**. Take them through the procedure step by step and then allow them to do the activity on their own as you go round the class observing closely. Let the students describe what they see happening when a drop of ink and potassium permanganate (VII) are dropped into the water and what happens when a bottle of perfume at one corner of the class is opened. Allow them to share their findings and take them through the facts as outlined in the student's book under the facts.

In **activity 3.3**, place learners into groups and then provide them with the required materials for the experiment. Guide learners to carry out this activity by taking them through the procedure and demonstrating to them what is expected from this activity. You can then allow learners to discuss in their groups as they carry out the same activity on their own. Explain to them the purpose of using a visking tubing in this experiment as you go round the class checking how different groups work. After the experiment, ask student's questions at the end of the experiment as they provide the response. You can also allow them to ask questions as you respond to them. Explain to them that the colour of starch only changes when it meets with iodine molecules. Therefore, for the blue-black colour to be noticed, either the iodine molecules diffused through the visking tubing or the starch molecules diffused through.

Allow students to relate the movement, to the structure of the visking tubing. Conclude the lesson by giving student's definition of diffusion and asking them to do research on other experiments that involve diffusion of substances. Make sure learners take notes and fill the table at the end of the experiment in their notebooks.

Assessment opportunities

Observation - observe as learners work in their groups. Are they capable of designing the experiment on their own? Are the learners able to observe any colour change? How do they account for the results obtained?

Conversation - talk to learners whilst they are doing the experiment. Ask them whether they expected to find the results they have obtained?

Product - look at the results obtained by learners. Do they reflect the expected outcome of the experiment? Are the results filled on the table correct?

Activity 3.4

In this activity, learners are challenged to work in pairs to plan and design an experiment aimed at determining how surface area to volume ratio affects the rate of diffusion. Allow learners to be in pairs and let them choose from the materials provided the likely materials they may use to design this experiment. Take them through the procedure step by step and allow the pairs carry out the experiment on their own. Let them fill the table provided using the potato cube dimensions they cut and use their values to complete the rest of the table. Allow the pairs to share their ideas and compare their results. Are the results the same or different? Choose at least four pairs randomly from the class to make a short presentation on their results and based on their results let them briefly explain from their experiment how surface area to volume ratio affects the rate of diffusion. After the presentations, you can now explain to learners how surface area to volume ratio affects the rate of diffusion and relate it to different organisms. Make sure that the learners are clear about their tasks and that they take notes in their notebooks.

Assessment opportunities

Observation - observe as learners carry out practical activity in pairs. Are they able to carry out the activity on their own?

Conversation - talk to the pairs as they carry out the activity. Are they able to explain how the surface area to volume ratio affects diffusion?

Product - look at the tables presented by each pair. Are the results obtained correct? Do the results reflect what was expected at the end of the experiment?

Answers to Self -Test 3.1

(Refer to Student's Book page 68)

1. Amoeba is a small organism and has a greater surface area to volume ratio compared to its volume than in human beings. Therefore, diffusion of substances is faster compared to larger organisms like human beings.
2. When the temperature of particles is increased, the kinetic energy of particles also increases making the particles to move faster hence higher diffusion rate. The lower the temperature the lower the rate of diffusion.
- 3 a) In digestion - when oxygen diffuses from the lungs into the blood and from the blood cells into the muscles.
b) It occurs during pregnancy, when food and oxygen reach the foetus from the mother's body.

3.3 Osmosis

(Refer to Student's Book page 69)

Activity 3.5

This is a practical activity and it involves demonstrating osmosis using a visking tubing. Introduce the concept using the discovery method. Start by organizing the class into groups and provide each group with the required materials for the experiment. Take learners step by step through the procedure first without doing the practical, so that they are aware of what they should do before they start. Let learners predict how the visking tubing with a sugar solution which was half full, at the start, can fill up when immersed in water, yet it is tied up at both ends. Allow the learners to brainstorm and come up with a possible suggestion about this phenomenon. Ask learners to carry out Procedure I in student's book page 69 on their own by filling the visking tubing with sugar solution, and tying up both ends of the tubing. This should then be immersed in a beaker of distilled water. Let students observe and record the observations made. For procedure II, let learners carry out the activity on their own and record their observations in their notebooks. Ask them if the observation made in procedure II is similar to the one in procedure I and explain the term osmosis. Move round the class as you observe how each group carry out the activity. You may allow learners to make mistakes since mistakes is part of learning.

Emphasise to students that unlike diffusion, which involves any type of molecule in liquid or gaseous state, *osmosis only involves water molecules* and that these water molecules move from an area of where they are in high concentration to an area where there is a low concentration, just like in diffusion, but *through a semipermeable*

membrane. Make sure that learners take notes in summary form and provide answers to the study questions in their notebooks.

Assessment opportunities

Observation - listen to the conversation between learners as they carry out the experiment. Are they capable to account for the swelling and shrinking of the visking tubing?

Conversation - talk to learners as they perform the activity. Are they able to relate the experiment with osmosis?

Product - look at each groups work. Do the groups obtain the right results?

3.4 Solute, solution and solvents

(Refer to Student's Book page 70)

Activity 3.6

In this activity, learners are required to understand what is meant by the term solute, solvent and solution. Let the students understand that a solution with a high concentration of water molecules can be described as a dilute solution and a solution with low concentration of water molecules can be described as a concentrated solution. You can then allow learners to work as a class. Take the class through the procedure step by step as you demonstrate to learners what is expected from this activity. Ask learners to then perform the activity on their own as you observe and checking to it that they are doing the correct thing. Make sure that the learners are clear about their tasks and ensure that they take notes in their notebook. You can also refer them to the student's book to explain the terms isotonic, hypotonic and hypertonic solutions.

Assessment opportunities

Observation - observe as learners carry out the activity as a class. Are they able to follow the steps in the procedure and carry out the activity on their own?

Conversation - talk to learners as they carry out the activity. Ask them to form rows and leave small space for one to pass through.

Products - are the students capable of explaining the term solute, solution and solvent from the activity?

Activity 3.7, 3.8 and 3.9

Activities 3.7, 3.8 and 3.9 are all practical activities and are aimed at demonstrating how osmosis takes place in a living tissue. Introduce the activities by having a general

class discussion. Let students know that both plant and animal cells take up substances into them or release substances out of them either by diffusion, osmosis and active transport and that these physical processes have various roles in plants and animals.

For **activity 3.7**, divide the class into different groups and provide each group with the required materials for the experiment. Take them through the procedure as outlined in learner's book as you demonstrate to them what is expected in each step. Ensure that the set-up is in a position where each learner can easily observe. After carrying out a demonstration, you may allow learners to carry out **activities 3.8** as a group and **activity 3.9** in pairs as you observe. Let them go through the procedure on their own and you may provide assistance where need be. Allow learners to make mistakes since mistakes is part of learning as you correct them.

Ensure team work and communication is enhanced throughout the activities. At the end of each experiment, allow learners to share their findings and give an opportunity for different groups to make a presentation as other learners listen. Ensure that learners take notes and provide answers to study questions.

Assessment opportunities

Observation - observe as learners do the activity. Are they able to design the experiment on their own?

Conversation - talk to learners as they carry out the experiment. Are they able to choose the right materials for the experiment from the list provided?

Product - look at how learners fill the table. Are the answers provided correct? Look at their drawings at the end of the experiment. Do their drawings reflect the observations made from the experiment?

3.5 Water relations in plants and animal cells

(Refer to Student's Book page 74)

Activity 3.10

Introduce the activities by first having a general class discussion before asking students to do the activity. Ask students to describe what they think is the immediate environment of cells inside their bodies i.e. what they imagine immediately surrounds a cell in their body.

Explain that all cells in their bodies are surrounded by a fluid medium, and that water sometimes leaves the cells to this fluid medium and vice versa by osmosis. Point out that cells in the skin lose water to the environment or air through sweating.

Ask them if they think this movement of water to and from their cells, leaves the cell unaffected. Let them suggest the possible effect to an organism of movement of water:

- i) out of the cells
- ii) into the cells.

For example i) what would happen to a plant if all cells lose water by osmosis to the air, i.e. on a hot day? ii) What would be the effect of excessive sweating on a hot day? Using discovery method, guide students to carry out the activity.

In activity 3.10, place learners into different groups depending on the availability of materials available. Take learners through the procedure step by step as outlined in learner's book. Ask them to predict the likely outcome of this experiment? You can then allow them to the activity on their own as you observe. Move round the class to ascertain that each group is doing the activity.

Caution learners to handle the microscope provided with great care since it is an expensive tool. Allow each group to share their findings and ensure learners take summarized notes in their notebooks.

Assessment opportunities

Observation - Listen to the conversation of learners as they carry out the activity. Are they able to observe the specimen through the microscope and make a correct drawing?

Conversation - Talk to learners as they carry out the activity. Are their observations similar to other groups?

Product - look at their drawing. Are they correct? Are their diagrams well labelled?

Answers to Self-Test 3.2

(Refer to Student's Book page 79)

1. B
2. C
3. C
4. a) Ensure the visking tube is swollen.
 - b) Glucose is osmotically active. Water is drawn into the visking tubing and it swells.
 - c) Cell membrane.

5. Plant cell has a cellulose cell wall which prevents the plant from bursting. Animal cells have a cell membrane which is semi-permeable hence will draw in water by osmosis and burst.
6. Plant cell have a tough cellulose cell wall which resists stretching hence gives the plant a fixed shape while animals have no cell wall instead they have cell membrane hence irregular in shape.

3.6 Active transport

(Refer to Student's Book page 80)

Activity 3.11

Introduce this activity by asking students how molecules bigger than water like glucose, that are too big to pass through the membrane pores, cross into a cell to be used to provide energy for the cell. Let learners think and provide a response. You can then introduce activity 3.11 which involves a demonstration aimed at showing how active transport takes place in living organisms. Organise students into pairs and let them go through the procedure as outlined within the activity to design an experiment. Provide them with the materials and move round the class observing how different pairs design the experiment on their own. Allow each pair to compare their findings with the rest of the class. You can then ask some learners to give a short presentation in class as others listen.

Correct where need be and conclude the lesson by explaining to learners some of the factors that affect active transport. Ask learners to research on the role of active transport in both plants and animals. Ensure learners take notes and answer the questions in Self -Test 3.3 and Check Your Progress 3.

Assessment opportunities

Observation - observe the pairs as they do the activity. Are the pairs capable of designing the experiment on their own?

Conversation - talk to learners whilst they set up the experiment. Are they capable of designing another experiment that can be used to demonstrate active transport?

Product - look at each pairs work. Do they depict active transport?

Answers to self-test 3.3

(Refer to Student's Book page 82)

1. C

2. C

3 a) Mineral ions will not be taken up the plant.

b) A respiratory poison makes an enzyme inactive and results to lack of energy. Lack of energy prevents active transport from taking place.

Answers to Check your progress 3

(Refer to Student's Book page 82)

1. (a) A: water

B: dilute sucrose solution

C: concentrated sucrose solution

D: water

(b) Liquid is in water: the water molecules move by osmosis from the beaker through the partially permeable membrane into the sucrose solution (C) causing a rise in the initial level of the liquid in the tube.

2. (a) distilled water (b) turgid.

(c) The cell contents are more concentrated than the surrounding water. The water molecules moves into the cell by osmosis, then swells and becomes turgid.

3. (a) There is more depth of dye that penetrates into cube A than cube B in 10 minutes.

(b) Cube A has a large surface area to volume ratio than cube B. Therefore, the dye has a larger surface area over which to diffuse compared to the volume, so it penetrates more in cube A.

4. (a) (i) the starch would change colour to blue-black. The level in the capillary tube would rise.

(ii) Iodine molecules are small enough to diffuse through the visking tubing. Starch molecules are too big to cross through. Therefore, the iodine diffuses into the visking tubing and changes the starch into blue-black, as iodine enter the visking tube, the level in the capillary tube rise.

- (b) (i) The level in the capillary tube would rise.
- (ii) Water moves into the visking tube by osmosis because the sucrose solution is hypertonic to the distilled water.
5. (i) Water would start filling up into the potato cup.
- (ii) The cells in the potato tissue would lose water to the more concentrated sugar by osmosis, in turn absorb more from the beaker.
- (iii) No change: boiling denatures the enzyme in the potato cells and the cells die. Therefore they become osmotically inactive.
6. (a) (i) Petri dish C (ii) Petri dish B (iii) Petri dish A
- (b) Petri dish C

The petiole is curved in such a way that the inside of it is outwards. The cells on the cut surface take in water by osmosis, swell and become turgid because the petiole was put in water which is hypotonic to the cell contents. Increase in size thus the curvature.

Petridish B

The leaf petiole was placed in strong salt solution, which is hypertonic to the contents of the cells on cut surface of the petiole. These cells lose water by osmosis and become flaccid. The outside of the petiole remains firm. The whole petiole curves with the cut surface curved in.

Petridish A

No change thus petiole is the control experiment.

7. Because it involves diffusion of water from a high concentration of water molecules (dilute solution) to an area of low concentration of water molecules (concentrated solution) through a semi-permeable membrane.
8. The onion cell and cheek cell can take up water by osmosis so that cell reactions have a medium in which to occur. Cell can also remain turgid and keep their shape.
9. Mammalian cells have a cell membrane only. Plant cells have a cell membrane and a cell wall.

A cell wall is made up of rigid cellulose material which a cell membrane does not have. Mammalian red blood cells take up water by osmosis and keep swelling.

When the cell membrane cannot withstand increasing pressure inside the cell anymore, then it bursts. But in a plant cell, the wall resists the increase in pressure

due to the increased intake of water by osmosis. Both cells have their internal concentrations at a higher concentration or osmotic pressure compared to the distilled water. That is why the water moves into the cell by osmosis.

10. (a) *Plasmolysis* occurs when a plant cell placed in a hypertonic solution loses water by osmosis until the cytoplasm shrinks away from the cell membrane; the sap vacuole reduces in size due to water loss and the cell becomes flaccid. The shape of the cell is not completely distorted due to the presence of the rigid cell wall.
- (b) When cells are placed in hypertonic solutions they lose water by osmosis.
- (c) No, animal cells do not have a rigid cellulose cell wall. They only have a cell membrane. When placed in a hypertonic solution, they lose water to an extent that the cell gets completely shrunken and distorted.
- (d) There are no plasmolysed cells. This could be because the molarity or concentration of 0.55M is hypotonic or isotonic to the cell contents. Therefore the cell does not lose any water.
- (e) The higher the molar concentration of sucrose solution, the higher the percentage of plasmolysed cells.
- (f) The whole plant would appear wilted and withered.
11. (a) (i) Ensure students have drawn a plasmolysed cell.
- (ii) Plasmolysed cell.
- (iii) The cell is *flaccid* and *shrunken*, since the solution outside the cell is of a higher concentration than the concentration of the cell contents, the cell loses water by osmosis from the cytoplasm as well as the sap vacuole. The cytoplasm shrinks and pulls away from the cell membrane. The sap vacuole decreases in size. The whole cell looks shrunken.
- (iv) Haemolysis
- (b) (i) It is described as being *crenated*.
It appears small, shrunken with a distorted shape.
- (ii) It would regain its shape and become turgid due to taking water in by osmosis. Note if it stays in the distilled water for long, it will undergo haemolysis.



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