

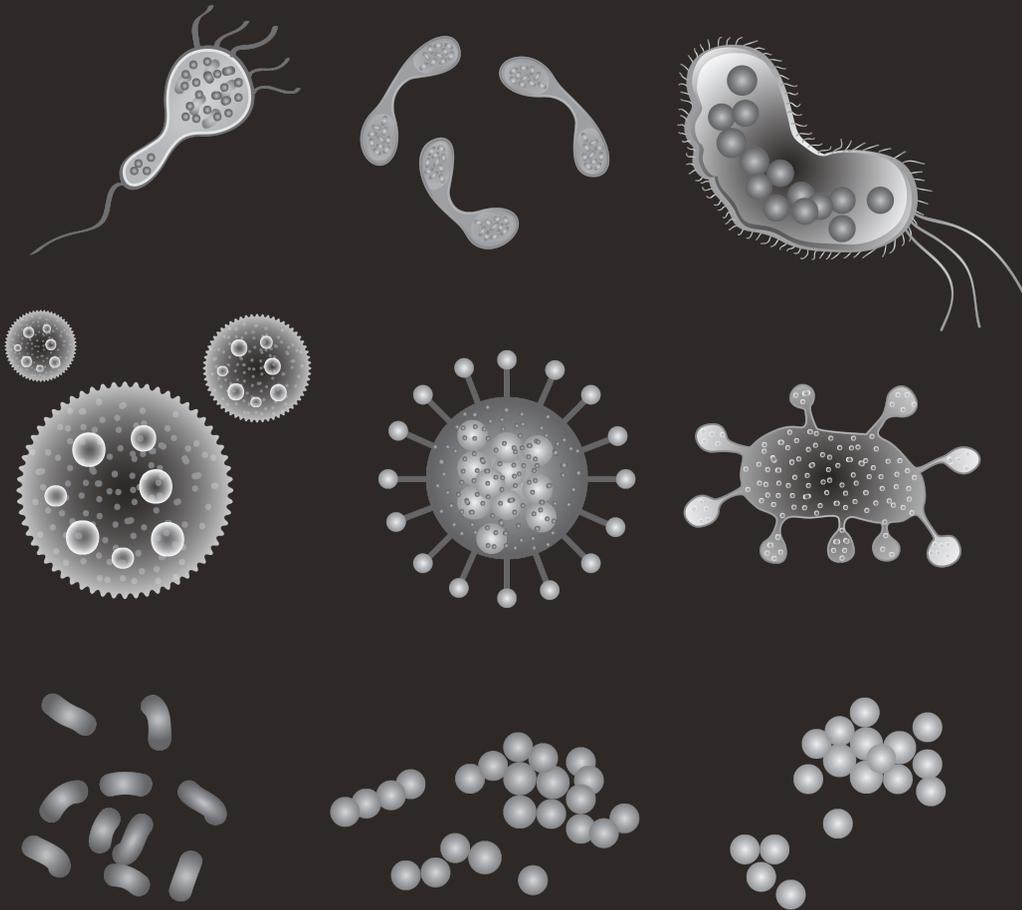


South Sudan



Secondary Biology 3

Teacher's Guide



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South Sudan

SECONDARY
3

Biology

Teacher's Guide 3



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INTRODUCTION

Book organisation

This teacher's guide is organised into two main sections.

Part 1 is the general introduction section detailing information on competence-based curriculum and pedagogical issues.

The main elements of Part are:

- **Background information** to the new curriculum - It gives a brief overview of the general requirements of the new South Sudan competence-based curriculum including the guiding principles, the competences the learners are expected to acquire and cross cutting issues to be addressed during learning.
- **Basic requirements for an effective Biology lesson** - It highlights the teacher's and learner's roles for effective teaching and learning of Biology, teaching and learning resources and grouping learners for learning and teaching methods.

Part 2 provide a unit -to- unit guide Part 2to 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 competencies:** The section explains how the unit will facilitate the learner to acquire the specified competencies.
- **Cross cutting issues to be addressed:** The section outlines the specific cross cutting issues that will be addresses through infusion as the learners

do activities and interact with concepts planned for the unit This is meant to make you conscious 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. Note that a unit may not necessarily address all the cross cutting issues outlined in the curriculum.

- **Teaching methodologies**

The section lists down the main teaching and learning methods that the teacher can employ in the unit.

- **Background information**

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

- **Suggested teaching and learning activities**

This section provides you with guidance on how to facilitate learners to learn by doing the activities outlined in the learner's book. It also guides you on how to assess the process of learning.

Background information on the new curriculum

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

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

Learning competences to be attained

Competencies are statements of characteristics that learners should demonstrate, which indicate they have the ability to do something to the require level performance.

The following are the four competencies envisaged in this curriculum:

1. Critical and creative thinking

Biology lessons and activities facilitate learners to acquire these competencies 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 competencies 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 Biology 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 competencies 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 in groups.

- 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 heritage

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

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

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 should be addressed through the teaching and learning process are:

1. Environment and sustainability

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

2. Peace education

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

You need to be in the fore front in educating your learners on the need for peace, for example by encouraging group work in the learners activities and

showing them ways of solving interpersonal problems peacefully that occasionally arise during interactions and discussions.

3. Life skills

Learners need to progressively acquire some skills, abilities and behaviours that will help them to effectively deal with the events and challenges of everyday life. Such skills include First Aid, communication skills, conflict resolution, basic ICT skills among others. You 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

1. Teacher's role and basic skills for effective Science lesson

The teacher is the most important resource for an effective Biology lesson.

(a) Some key roles of a Biology teacher.

- Organising the classroom to create a suitable learning environment.
- Preparing appropriate materials for learning activities.
- Engaging learners in a variety of learning activities.
- Encouraging and accepting learners' autonomy and initiative.
- Allowing learners' responses to drive lessons and shift instructional strategies.
- Familiarising themselves with learners' understanding of concepts before sharing their own understanding of those concepts.
- Encouraging learners to engage in dialogue, both with you and one another.
- Engaging learners in experiences that pose contradictions to their initial hypotheses and then encouraging discussions.
- Providing time for learners to construct relationships and create metaphors.
- Using a variety of teaching and assessment methods.
- Adjusting instructions to the level of the learners.
- Nurturing learners' natural curiosity.
- Motivating learners to make them ready for learning.
- Coordinate learners' activities so that the desired outcomes can be achieved.
- Assessing learners' activities and suggest solutions to their problems.

- Assist learners to consolidate their activities by summarising the key points learnt.

(b) Key skills of a Biology teacher:

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

Learners' role in learning Biology

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

For active participation in learning, the learner 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 appropriate Biology terms and representations in writing and talk.
- Engaging in lively public discussions in defense 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 like hydroelectric power stations, engineering firms among others

(a) Classroom as a learning environment

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

Classroom organisation

It is important you 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 you.
- Putting up learning and teaching aids on the walls. Examples are wall charts, pictures and photographs.
- Displaying teaching models.
- Providing objects of examination for example cover slides.
- 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 out the learners evenly so that they do not interfere with one another's activities.

- Setting up the materials or experiments 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.
- Organising the sitting arrangement such that learners face the lighted areas of the room.
- Choosing the most appropriate location for you and the chalkboard such that they are visible to all learners and that you have a good view of all learners in the class.

b) Apparatus and materials

For learners to study Biology 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 a highly practical subject, materials help you to convey your points, information or develop skills simply and clearly and to achieve desired results much faster.

Some of the materials that you require for activities and investigations 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 kit depends on the curriculum requirements per level. Most Science

kits are commercially available and target particular levels of learners. However, you are encouraged to come up with a kit based on the syllabus requirements.

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 Biology models include models of body parts, animals among others. These models can be purchased by schools for use during Biology activities.

iii) Resource persons

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

iv) Improvisation

If each learner 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. You are therefore advised to improvise using locally available materials as much as possible.

vi) Scheduling learning activities and venues

Some of the activities suggested in the learner's book need good planning and scheduling in order to get accurate results. The teacher should therefore think ahead while making the scheme of work so that the prevailing weather pattern and the most appropriate timing are considered.

Grouping learners for learning activities

Most of the Biology activities suggested in the Learner'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 learners sitting around those desks.

In certain activities, the teacher may wish to carry out a demonstration. In this case, the learners should be sitting or standing in a semicircle, or arranged around an empty shape of letter "U" such that each learner can see what you are doing clearly and without obstruction or pushing. If the learners are involved in individual work, each learner 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 face each other.

Grouping learners 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 grouping 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 Biology class has several advantages. They 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.

- Learners can learn from one another.
- Cooperation among learners can easily be developed.
- Many learners accept correction from the teacher more readily and without feeling humiliated when they are in a small group rather than the whole class.
- Learners' creativity, responsibility and leadership skills can easily be developed.
- Learners 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 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 learners to learn. These include:

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

g) Experimentation or research

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

- Particular group of learners 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 Biology syllabus

(a) Direct exposition

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

(b) Guided Discovery

In this technique, encourage learners to find out answers to problems by themselves. You do this by:

- Giving learners specific tasks to do.
Giving learners materials to work with.
- Asking structured or guided questions that lead learners to the desired outcome. Sometimes learners 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 or class discussion or pair work

In this technique, you and learners interact through question and answer sessions most of the time. Carefully select your questions so that learners are prompted to think and express their ideas freely, but along a desired line of thought. The method leads learners from the known to unknown in a logical sequence; and works well with small groups. The method boosts confidence in learners and improves interpersonal and communication skills.

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

(d) Project method

In this approach, you organise and guide a group of learners 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.

Learners 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. If you are using the project method, ensure that the learners understand the problem to be solved and then provide 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, learners easily get distracted and therefore lose track of the main objective of their study. Studying by the project method does not work well with learners who have little or no initiative.

(e) Educational visits and trips/nature walks

This is a lesson conducted outside the school compound during which you and the learners visit a place relevant to their unit of study. An educational visit/ or 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 or nature walk lessons”, learners are likely to be highly motivated and you 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, you or a laboratory technician show the learners an experiment, an activity or a procedure to be followed when investigating or explaining a particular problem. The learners gather around you where each learner can observe what you are doing. It is necessary to involve the learners 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-centred.

When is a demonstration necessary?

You may have to use a demonstration, for example when:

- The experiment or procedure is too advanced for learners to perform.
- The experiment or procedure is dangerous.
- The apparatus and materials involved are delicate for learners to handle.

Refer to Learner's Book page 1-34

Learn about	Key inquiry questions
<p>Learners should investigate the history of classification and understand the classification and taxonomy of organisms into seven levels. They should understand the classifying of organisms e.g. two kingdom system, five kingdom system and three domain systems and its rationale. They should understand binomial nomenclature and the Latin and common names of some common plant and animal species found in South Sudan.</p> <p>Learners should understand the characteristics of kingdoms Bryophyta, Pteridophyta, Monera and Protocista giving examples from South Sudan. They should learn about general characteristics of Kingdom Animalia and how animals are classified into different groups giving examples in each case. They will investigate the features of each group (e.g. phylum, class etc.) through field using equipment such sweeping nets, specimen bottles or containers, forceps, hand lens, trays and microscopes.</p>	<ul style="list-style-type: none"> • Why classify organisms? • Why is the classification hierarchical? • How do you classify organisms? • Why is Latin language used to name organisms in binomial nomenclature? • How would you distinguish between Kingdom Monera and Kingdom Protocista? • How would you describe the general features of Kingdom Fungi? • Why are fungi important to mankind?

Learning outcomes		
Knowledge and understanding	Skills	Attitudes
<ul style="list-style-type: none"> Understand the systems of classifying organisms. 	<ul style="list-style-type: none"> Classify organisms according to the seven level system. Use different equipment and lab techniques for collecting and preserving specimen for identification. Investigate the features of each group (e.g. phylum, class etc.) through field using equipment such sweeping nets, specimen bottles or containers, forceps, hand lens, trays and microscopes. 	<ul style="list-style-type: none"> Appreciate and value the knowledge of classification of living organisms.
<p>Contribution to the competencies:</p> <p>Critical and creative thinking: About the logic of classifying animals and plants, and begin to apply the newly acquired knowledge, first in their surroundings and then to other parts of the country.</p> <p>Communication: They will excitedly share ideas and present what they identify with colleagues as a result they learn new vocabularies.</p> <p>Co-ordination: Sharing their findings and working in groups will strengthen and built team spirit.</p>		
<p>Links to other subjects:</p> <p>Geography</p>		

Introduction to the Unit

Biology is a natural Science concerned with the study of life and living organisms, including their structure, function, growth, origin, evolution, distribution, and taxonomy. In this course, emphasise on how to identify different kinds of living things and how to classify them. All living organisms are classified into groups based on very basic shared characteristics. The classification of living things includes seven levels: Kingdom, Phylum, Classes, Order, Families, Genus and Species.

Cross-cutting issues

1. *Environment awareness and sustainability*

Emphasise to the learners that the environment is made up of both living and non-living things. Therefore, they should not destroy plants and kill animals during their practical studies instead they should try to conserve them. Remind them to keep their environment clean.

2. *Peace education*

Bring to the attention of the learners the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.

3. *Life skills*

Emphasise to learners the need to be keen when doing practical work to avoid breakage of apparatus. This will reduce the cost of carrying out a practical experiment by avoiding buying of new apparatus for the practical.

Competencies to be developed

1. *Critical and creative thinking*

Guide the learners to discover for themselves as they work in groups, answer the probing questions and do more research on the topic. Encourage the learner to think critically and be creative.

2. *Communication*

This competence comes as learners participate in pairs and group work and present their work to the rest of the class. Encourage all learners irrespective of their abilities to participate in group discussions and during presentation by asking questions. The teacher should convey ideas effectively through spoken and written

English by applying appropriate grammar and relevant vocabulary. Presentation of group work discussions can boost the learner's communication skills.

3. Cooperation

As learners interact in pairs sharing their findings and working in groups strengthen and built team spirit.

Remember: You should allow slow learners to do presentations as well and correct them when necessary. Further, advise learners to appreciate the different abilities of their group members.

4. Culture and identity

Bring to the attention of the learners the variety of plants and animals kept for agricultural produce in rural South Sudan. Plants and animals used for food in South Sudan promote the culture of the particular area and therefore should be preserved to prevent their extinction and promote culture and identity. In this unit of classification, bring to the attention the plants and animals in their locality that are used for food classify them.

Additional information

Emphasise the difference between systematics and taxonomy to the learners. Systematics try to determine the organisms that share common recent ancestry and the changes the organisms have undergone whereas taxonomy is determined to classify and name these organisms. However, to know organisms, both systematics and taxonomy are important.

1.1: Definition of classification

(Refer to the Learner's Book page 1)

Activity 1.1(In groups, pair or as a class)

You will engage learners in naming living organisms as many as possible. Ask them to group them as either living or non-living. After they group them, you can ask them to define classification in their own words.

Suggested teaching and learning activities

1. Remind learners of what they learnt in secondary level 1 about diversity of living things.
2. Organise the learners into groups of three for Practical Activity 1.1 and 1.2 of learners Book. Guide the learners to examine the observable features on the specimens.
3. The learners should record the observable features of the specimens.
4. The learners should note the similarities and the differences between the specimens in a table.
5. The learners to draw well labelled diagrams of the specimens, stating the magnification.
6. Let the learners group the specimens according to their similarities.
7. Allow each groups to do the presentation of their findings to enhance their communication skills.

Assessment opportunities

Observation and recording: Observe as learners carry out the activity. Are they following the correct procedure?

Conservation: As learners are doing the experiment, allow them to ask questions for more clarification.

Product: Check on learners drawings after they are done with the practical. Are their drawings portraying the aim of the experiment?

1.2: Necessity of classification

(Refer to Learner's Book page 4)

Activity 1.2 (In groups, a pair or as a class)

This is a lesson that involves observation and should take place in the laboratory. Ensure the laboratory is booked in advance and that the video to be watched by the learners is downloaded from the link provided.

Suggested teaching and learning activities

1. Organise the learners into groups of three, from their findings of Practical

Activity 1.1 and 1.2, let them discuss the necessity of classification.

2. Allow the learners to watch the video link: <https://www.youtube.com/watch?v=oxhYaiSnIAo>.
3. Explain the three domains of classification and the systems of classification with active participation of learners through question –answer method.
4. Engage the learners to differentiate between natural and artificial classification.
5. Allow the learners into their groups to discuss the evolutionary tree.

Assessment opportunities

Observation: Observe learners as they fill table 1.1 in the learner’s book. Are they filling it correctly.

Conservation: Engage learners as they do the activity. Encourage them to ask questions.

Product: Check Table 1.1 filled by learners.

1.3 and 1.4: Taxonomy

(Refer to Learner’s Book page 5)

Activity 1.3 (In groups, a pair or as a class)

This is a discussion lesson that will involve observational activities by the learners. You will engage learners in a discussion regarding the history of classification and the kingdoms of classification.

Suggested teaching and learning activities

1. Guide the learners to review the necessity of classification, by asking them to state the importance of classification. Based on their responses, relate the ranking and grouping system to the hierarchy of classification of organisms. Mention the taxonomists who were involved. Assist the learners to appreciate their contributions.
2. Organise the learners into groups of three for Practical Activity 1.3. Guide the learners to name the specimens using their native language.
3. Let the learners explain the impact of the observations during the discussion.

Emphasise the difficulties the learners experienced and the need to appreciate the native languages in the South Sudan, in order to bring peace and stability. Guide learners in groups to distinguish the two types of classification, stating why natural classification is preferred over artificial classification.

4. Divide learners into groups of three and let them carry out Practical Activity 1.4. and 1.5. The learners will find out that the lengths of the stems will reduce from D, E, B, H, G, A and C. let learners relate the results with seven taxa units: Kingdom, Phylum/Division, Class, Order, Family Genus and Species.
5. Guide the learners to relate the hierarchy of classification diagram in the Student's Book page 6 to the practical activity.
6. In groups, learners explain why organisms are first grouped into kingdom before narrowing down to other taxa.
7. Guide learners to research on the history of two kingdoms and five kingdoms and the domains of classification of organisms.
8. Learners to name the organisms using the native local names and the teacher to assist to name using the scientific names.

Assessment opportunities

Observation: Observe as learners do practical activity 1.3. Are they doing the right thing? If not how are you helping them..

Conservation: Remind learners of the two branches of taxonomy. This will help them in doing activity 1.3.

1.5: History of classification

(Refer to Learner's Book page 7)

Activity 4 (In groups or as a class)

Suggested teaching and learning activities

1. You will begin the lesson by giving learners time to carry out activity 1.3. This makes the learners appreciate who we are and motivates him or her be proud of the native language in our country. It also creates the learners understanding, interest and raising self ego.
2. Ask learners three, in groups of to find out from the internet and library the

history of classification, emphasizing on the three domain system, two kingdom system and five kingdom systems and their rationale.

3. Allow each group to role play group Activity 2 to enhance their creativity and communication skills.
4. From the learners' contribution, you should explain the characteristics of common names and the scientific names. Learners should then differentiate between common names and the scientific names.
5. Using table 1.3, ask learners to come up with the rules or principles which are used in coming up with the scientific names or use of binomial nomenclature using various organisms.
6. Divide the class into two and let them carry out group Activity 3.
7. End the lessons by instructing the learners to do Check your progress 1b in the Learner's Book page 11.

Assessment opportunities

Conversation: Observe learners as they discuss activity 1.3.

Product: Check learner's findings.

Answers to Work to do

(Refer to Learner's Book page 3-4)

1.
 - Do not destroy the natural habitat of the specimens.
 - Collect only the required number of specimens.
 - Do not kill the specimens as much as possible. If possible return them back to their natural habitat. The dead specimen should be preserved in appropriate preservation reagents.
2. Classification is grouping of living organisms according to their similarities and differences while taxonomy is the study of classification or grouping of living organisms according to their similarities and differences.
- 3.

Plant	Animal
Pawpaw	Donkey
Grass	Cat
Sugarcane	Rat
Mango	Housefly
Orange	Cow
	Bird
	Dog

Answer to Work to do

(Refer to Learner's Book page 4)

Natural classification	Artificial classification
Many characteristics are considered.	Fewer characteristics are considered.
Stable and most modern method of classification.	May change as knowledge about organisms change.
Members of a group are similar in hereditary patterns.	Members of a group are not similar in hereditary patterns.
Provides plenty of useful information.	Provides only limited information.

Answers to Check your progress 1a

(Refer to Learner's Book page 4)

1. Pooter: Catching crawling insects from trees.

Pitfall trap: Catching small crawling animals on the ground.

Sweep net: Catching small flying animals such as insects.

Bait trap: Attracting and trapping small animals.

Fish net: Catching small fishes and small aquatic organisms.

Forceps: Picking up small crawling and dangerous specimen.

Hand lens: Magnifying specimen under view.

2. Kingdom, Phylum or Division, Class, Order, Family, Genus and Species.

Answers to Check your progress 1b

(Refer to Learner's Book page 11)

1. (a) Refer to table 1.3 in the learners book page 10
(b) They share the same family.
(c) Not in the same species.
2. Binomial nomenclature rules
3. The scientific rules of naming organisms.
4. Organisms that are closely relate and can procreate to give rise to viable offspring.

1.6: The five kingdoms

(Refer to Learner's Book page 11-34)

Activity 1.6 (In groups, a pair or as a class)

This is an observational lesson that will involve active participation by the learners. You will engage learners in group experimental activities and discussion of the activities and assessing learning achievements.

Suggested teaching and learning activities

1. You will begin the lesson by allowing learners to carry out activity 1.6. This makes the learners to understand the need to maintain all the habitats clean.
2. Organise the learners into groups of three for Practical Activity 1.6. Let them examine the observable features on the specimens and record their findings.
3. Let the learners try to group the specimens according to the five kingdom systems of Monera, Protoctista, Fungi, Plantae and Animalia.
4. Allow each groups to do the presentation of their findings to enhance their communication skills.
5. From the learners' contributions, you should explain the general characteristics of Monera, Protoctista, Fungi, Plantae and Animalia.
6. You should supervise and check the learners working in Practical Activities (refer to Learner's Book page 14 -28) groups or individuals.

7. Group the learners into groups to discuss on benefits of fungi and the history of antibiotics.
8. End lessons by instructing the learners to read on the bacteria causing both food poisoning and mastitis in camels.

Lesson assessment

Observation: Observe as learners do the activities. Are they following the correct procedure?

Conversation: Engage learners as they do the activities. This gives them opportunity to ask questions that makes them understand better.

Product: Check notes compiled by learners, their drawings and tables filled.

Answer to Check your progress 1C

(Refer to Learner's Book page 34)

1. Check out for the scientific name
 - *Dromaius novaehollandiae*, for characteristics refer to learner's Book page 31, economic importance-look out for medicinal properties, career and components of pharmaceutical products and alternative source of white meat.
2. Refer to Learner's Book pages 18-20.
3. Reward based on the appropriateness of the answer given by the student

Additional information to the teacher

The economic importance of bacteria to man

Bacteria cause decomposition of dead plants and animals or organic matter; thus releasing nutrients into the soil.

- Some cause nitrogen fixation. *Azotobacter* convert nitrogen to nitrates which improves soil fertility while others such as *Pseudopodia detrificans* and *thiobacillus denitrificans* cause denitrification hence reducing soil infertility
- Bacteria are used in the manufacture of vitamin B₁₂ and vitamin K.
- Bacteria are used in sewage treatment.

- Some bacteria cause food spoilage and food decay.
- Symbiotic bacteria in the stomach of ruminants secrete cellulase enzyme and ligase which digest cellulose.
- Some bacteria cause diseases in man for example *Salmonella typhi* causes typhoid, *Vibrio cholerae* causes cholera among others.

In biotechnology bacteria are used to produce organic acids, alcohol, biogas, milk products and insulin.

1. They store glycogen or oil droplets. The cell wall of fungi is made up of chitin although a few have cellulose cell walls. Their basic unit is the hypha which has a cell wall enclosing the cytoplasm with numerous nuclei. Several hyphae filaments form a structure called mycelium.
2.
 - Fungi cause decomposition of dead organic materials or organisms hence releasing nutrients into the soil.
 - Fungi are used by the military to prepare biological weapons.
 - Some fungi cause food spoilage. For example bread mould.
 - Some cause diseases in human, livestock and in plants.
 - Yeast is used in the brewing and bread baking industries.
 - Some such as mushrooms are used as food.
 - Some fungi such as penicillium are used as antibiotics.

Economic importance of insects

- Some are a source of food such as honey.
- Act as flower pollinators.
- Some destroy crops or seeds and fruits.
- Some act as vectors for human and animal diseases.
- Some make silk used in cloth industries.
- Used in research for example entomology.

- Some are used in detecting weather changes traditionally for example locusts indicate drought.
- Some destroy timber for example termites.

Adaptations of insects

- Have ability to fly in different ecosystems; presence of hard exoskeleton which supports the insect from the ground.
- Excrete uric acid which requires little water for excretion. Hence water is conserved.
- Have efficient gaseous exchange due to presence of tracheal system.
- Exhibit internal fertilisation which increases their chances of survival and eliminate the need for water in order to achieve successful reproduction.

Adaptations of insect exoskeleton to its functions:

- Made of chitin secreted by epidermal cells. Chitin is hard or rigid hence offers surfaces for attachment of muscles, protects inner delicate parts.
- The exoskeleton is unevenly distributed or thin at the joints to allow movement. It regulates growth or hinders growth if exposed to air and it hardens or allows growth when soft.
- Modified to form mouthparts for feeding, or modified for flight, it is pigmented for camouflaging for protection or transparent to allow light to pass through in some parts.
- It is waterproof to reduce desiccation.

**UNIT
2****Pathogens and diseases**

Refer to Learner's Book page 35-62

Learn about	Key inquiry questions
<p>Learners should investigate pathogens and their role in causing diseases in living organisms generally, and in humans in particular. They should explain diseases transmission, signs and symptoms, the different types of microbial pathogens and their life cycles including species of viruses and protozoa, and how some bacterial pathogens cause diseases by virtue of a toxic component of the bacterial cell such as lipopolysaccharide. They will know about obligate, opportunistic and accidental pathogens.</p> <p>Learners should know how diseases are spread among the population and the life cycles of important parasites such as plasmodium, Schistosoma, etc. and relate this to scientific approach to disease control.</p> <p>In the laboratory, learners should culture, isolate and identify some bacteria (non pathogenic species) by using microscope and some basic biochemical tests, as well as with some protozoa e.g. euglena, paramecium, etc.</p> <p>Students should learn about the economic importance of some these pathogens, they will be introduced to concepts of vectors, communicable and non-communicable diseases, they will know the methods of how to control some of the endemic diseases found in South Sudan.</p>	<ul style="list-style-type: none">• How do pathogens cause diseases?• Why are some microorganisms economically useful and others harmful?• How are the obligate pathogens different from the opportunistic and accidental pathogens?• How do diseases affect our economic productive potential?• How are some viral pathogens capable of causing a disease long after they have infected the host?• How would you advise community about the dangers of communicable diseases?• How would you distinguish between parasitic and bacterial infections?

Learning outcomes		
Knowledge and understanding	Skills	Attitudes
<ul style="list-style-type: none"> Explain the role of pathogens in causing diseases. 	<ul style="list-style-type: none"> Investigate pathogens and their role in causing diseases in living organisms generally. Identify and isolate bacteria and protozoa. Develop the skill of using a microscopes. 	<ul style="list-style-type: none"> Appreciate the importance of disease control and hygiene.
<p>Contribution to the competencies:</p> <p>Critical and creative thinking: Students will be inspired into critical thinking as they learn about pathogens microorganisms and their role in causing diseases.</p> <p>Communication: learners will share their observation and excitement about what they see under microscope thereby communication is improved.</p> <p>Co-operation: Students will appreciate working in groups.</p>		
<p>Links to other subjects:</p> <p>Geography: climates and resource distributions, medicine (e.g. diseases), economics (e.g.) some useful microorganisms such as yeast, how diseases affect human productive potential.</p>		

Introduction to the Unit

Pathogens are micro-organisms that cause diseases both in animals and plants. In this unit, attention will be given to those that cause diseases to human beings. Most of the human diseases caused by these micro-organisms are preventable. However, in the event that they are not prevented and an infection occurs, the affected individual has to be examined to identify the causative pathogen so as to effectively cure the infection.

Cross-cutting issues

1. *Environment awareness and sustainability*

Emphasise to the learners that the environment is made up of millions of micro-organisms. Some are harmful and others are useful to mankind. Remind them to

keep their environment clean because most harmful micro-organisms thrive well in unhygienic environments.

2. Peace education

Bring to the attention of the learners to the need to accommodate other people's views. Discipline should be observed at all times in these groups since some cases can make learners diverge from the main objectives.

3. Life skills

Emphasise to learners the need to be keen when doing practical work to avoid breakage of apparatus. This will reduce the cost of carrying out a practical experiment by avoiding buying new apparatus for the practical.

Contribution to competencies

1. Culture and identity

Pathogens and diseases can be a threat to the people that are supposed to uphold the cultures of South Sudan, therefore, encourage learners to always seek treatment whenever they feel unwell and maintain high standards of hygiene to keep good health as they maintain culture.

2. Critical and creative thinking

Guide the learners to discover for themselves as they work in groups, answer the probing questions and do more research on the unit. Encourage the learners to think critically and creatively as they learn about pathogens, micro-organisms and the role they play in causing diseases.

3. Communication

The competence comes as learners share their observation and excitement about what they see under the microscope thereby communication is improved.

Working in pairs and groups and presenting their findings, encourages all learners irrespective of their abilities to participate in group discussion and during presentation by asking questions. Convey ideas effectively through spoken and written English by applying appropriate grammar and relevant vocabulary thus improving their communication skills.

4. Co-operation

As learners interact in pairs and as they engage in discussions it promotes co-operation among them.

Additional information

- Read reference books and medical journals on pathogens and diseases to equip yourself with knowledge to tackle the unit effectively.
- When organising the learners into groups consider gender and the special educational needs of learners. The groups formed should be well represented to enable the learners appreciate their diversity and accept that we are all gifted differently.

2.1: Pathogens and their mode of transmission

(Refer to Learner's Book page 35)

This is a discussion lesson that will involve observational activities by the learners.

You will engage learners in a discussion regarding pathogens and their mode of transmission.

Suggested teaching and learning activities

1. Introduce the unit by asking the learners, how many of them remember to wash their hands before meals or after visiting a toilet, or how many drink boiled water. This will create an interest in the learners trigger their understanding and boost their listening and motivation hence boosting listening and speaking skills.
2. From the learners feedback define the term health and relate the pathogens with poor health.
3. Tell learners a story about Majok. Refer to the Learner's Book page 35.
3. Organise the learners into groups of three for Activity 2.1 and 2.2. Guide the learners to examine the observable micro-organisms found in water or different habitats.
4. The learners should record the observable features of the specimens.

5. Allow each groups to do a presentation of their findings to enhance their communication skills.
6. Discuss types of pathogens, their effects and benefits.
7. Guide learners to culture different non-pathogenic bacteria.
8. Guide learners to test for the presence of bacteria in the surrounding.

Lesson assessment

Observation

Question and answer

2.2 Pathogens

(Refer to Learner's Book page 36)

Activity 2.1 (In groups or as a class)

This is a discussion lesson that will involve observational activities by the learners. You will engage learners in a discussion regarding the activities and assessing learning achievements.

Suggested teaching and learning activities

1. Introduce the lesson by asking the learners who has ever been sick. Allow them to discuss the disease, symptoms and the treatment they received. This makes the learners appreciate that hygiene is essential in our lives. It also boosts the learners understanding, interest and motivation enhancing their listening and speaking skills
2. Organise the learners into discussion groups of three. Guide the learners to examine worms provided or photographs.
4. The learners should record the observable features of the specimens.
5. The learners to identify the worms.
6. Guide the learners to classify pathogenic organisms using the seven taxa units. Explain broad categories of pathogens.
7. Allow each groups to do the presentation of their findings to the class to allow learners enhance their communication skills.

Transmission through the air: Pathogens are spread through liquid droplets that are released when an infected person coughs or sneezes. Another person inhales the infected droplets; he or she may acquire the disease causing microbes. Diseases that spread through air are called air-borne diseases. These include common cold, influenza, pneumonia, diphtheria, tuberculosis, and whooping cough. In crowded places, such diseases may spread rapidly to many people.

Through vectors (mechanical or biological vectors) **a mechanical vector** is an animal that carries a pathogen from one host to another without being infected. **biological transmission** occurs when the pathogen reproduces within **a biological vector** that transmits the pathogen from one host to another.

Obligate pathogens cannot reproduce outside the hosts while opportunistic and accidental pathogens reproduce only when the pathogens are inside the host's body where it uses the cell contents.

Lesson assessment

- Observation
- Question and answer
- Drawing

2.3 Viruses

(Refer to Learner's Book page 37)

Activity 2.2 (In groups, a pair or as a class)

This is a discussion lesson that will involve observational activities by the learners.

You will engage learners in a discussion regarding the activities and assessing learning achievements.

Suggested teaching and learning activities

1. Organise the learners into groups of three. Guide the learners to discuss Activity 2.2.
2. Allow each group to do the presentation of their findings to the class to enhance the communication skills of the learners.
3. From the learners discussion elaborate the viral diseases which are immunised according to WHO.

4. Brainstorm the learners on child immunisation, by asking them about vaccinations which a newborn child is given until he or she is eighteen months old.

Lesson assessment

- Observation
- Question and answer
- Drawing

2.4 Bacteria

(Refer to Learner's Book page 42)

Activity 2.4 (In groups or as a class)

This lesson may require a field study to nearest research institute or hospital or medical clinic or health centre to observe the bacteria under the microscope.

You will engage the learners in discussions regarding Activity 2.3, 2.4 and 2.5.

You are therefore required to get necessary permission from concerned authorities.

Organise the class in a way that will encourage the teaching methods suggested.

Suggested teaching and learning activities

1. Introduce the lesson by brainstorming on the following questions:
 - a) Which parts of the body are prone to bacterial infections?
 - b) Which are the common bacteria that cause diseases?
 - c) What are the modes of transmission of bacterial infections?
2. The learners should work in groups when role-playing to enhance cooperation and interpersonal skills.
3. The learners should ask questions to the expert in the field. This can also enhance your level of knowledge.
4. You can assist the learners in asking questions in order to get more information.
5. Using the collected information elaborate the effects of pathogenic bacteria life cycles and their effects to the host.

6. Emphasise on the completion of antibiotics dosage as recommended by medical practitioners. Let the learners know its importance due to their resistance after prolonged use.

Lesson assessment

- Question and answer
- Observation
- Discussion

2.5 Pathogenic fungi

Further Activity (In groups or as a class)

- You will identify a resource person to use during the lesson and inform the school administration.
- You will engage the learners in discussion regarding the activities and assessing their achievements.

Suggested teaching and learning activities

1. The learners should work in groups to role play the life cycle of blood flukes to enhance cooperation and interpersonal skills as they work together.
2. The learners should ask the resource person questions during the discussion.
3. Allow learners to observe medical charts from a health centre to enable the learners come up with their own questions. Through your guidance on pathogenic worms assist the learners in asking the resource person questions in order to get more information.
4. Using the collected information elaborate the effects of pathogenic worms to the host.
5. Emphasise on maintaining high standards of hygiene.

Lesson assessment

- Observation
- Discussion
- Question and answer

2.6 Protozoan disease causing organisms

(Refer to Learner's Book page 47)

Activity 2.6 (In groups or as a class)

You will engage the learners in a discussion regarding protozoan disease causing organisms.

You will need a resource person to talk to the learners about protozoan disease causing organisms.

Suggested teaching and learning activities

1. The learners should work in groups while role playing the life cycle of plasmodium and trypanosoma to enhance cooperation and interpersonal skills.
2. Encourage the learners to ask questions during the discussion. Through your knowledge on pathogenic protozoan assist the learners in asking questions in order to get more information.
3. Organise learners into groups to carry out Group Discussion Activity 2.5.
4. Allow each group to present their findings to the rest of the class. Emphasise on the ways or practices the learners came up with of eradicating malaria in South Sudan and Africa at large.
5. Using the collected information elaborate the effects of pathogenic protozoan to the host and ask learners to point out where the life cycles would be interrupted to prevent or reduce infections
6. Emphasise on the need to observe high standards of hygiene.

Lesson assessment

- Discussion
- Question and answer

2.7 Pathogenic worms

(Refer to Learner's Book pages 49)

Activity 2.7 (In groups or as a class)

- This is a discussion lesson that will involve observational activities by the learners.

- You will engage learners in a discussion regarding the activities and assessing learning achievements.
- You are therefore required to get the various reference materials in advance and Organise the class in a way that will encourage the teaching methods suggested.
- Download a video from the link given below.

Suggested teaching and learning activities

1. Introduce the lesson by allowing the learners to watch this link:

[Https://www.Youtube.com/watch?v=leeWD59D9Q](https://www.Youtube.com/watch?v=leeWD59D9Q)

This will improve the learner's understanding, increase interest and motivation hence boosting listening and speaking skills.

2. Organise the learners into groups for group discussion Activity 2.7 and to talk about the video watched. Guide the learners to come up with questions. This will promote the competences of critical thinking and cooperation.
3. Allow each groups to present their findings to enhance the communication skills of the learners.
4. The learners should be able to come up with control measures.

2.8 How to identify bacteria using different biochemical tests

(Refer to Learner's Book page 50)

Activity 2.8 (In groups or as a class)

- You will engage the learners in carrying out tests observing and drawing inferences from different biochemical tests.
- Organise the class into groups to carry out the biochemical tests.

Suggested teaching and learning activities

1. The learners should work in groups to enhance cooperation and interpersonal skills.
2. The learners should ask questions when making observations to enhance

critical thinking as they make inferences. Allow the learners to observe the medical charts in the health centre to enable the learners come up with their own questions. Through your guidance on experiments assist the learners in asking questions in order to get more information.

3. Using the collected information elaborate the role of catalase enzyme, and the principles of starch hydrolysis test.
- Allow the learners to group discuss on the relationship of poverty and infectious diseases.
 - Emphasise on the need for maintaining high standards of hygiene.
 - In groups let the learners discuss and present to the class the economic importance of some pathogens. (Learner's Book page 54).
 - Using Check your progress (Learner's Book page 54), check the learners achievements and provide other revision activities to enhance learners educational interests.

2.9 Communicable and non-communicable diseases

(Refer to the Learner's Book page 55)

Activity 2.10 (In groups or as a class)

- Prepare charts for communicable and non-communicable diseases.
- This lesson may require a field study to the nearest research institute or hospital or medical laboratory or health centre to observe bacteria under the microscope. You are therefore required to get necessary permission from concerned authorities or identify a resource person to talk to learners on endemic diseases found in South Sudan.

Suggested teaching and learning activities

1. Learners to listen to a resource person. Encourage them to ask questions as they look at charts and listen to enhance critical thinking.
2. In groups, learners to discuss ways of controlling some of the endemic diseases found in South Sudan. This enhances communication skill and cooperation as they

work together and also critical thinking as they identify the endemic diseases found in South Sudan.

Learners to make presentations of their findings to the class. This will enhance their communication skills.

Assessment opportunities

Conservation: Ask questions as learners carry out activities.

Product: Check on notes, tables and graph. Also check pictures drawn by learners.

Answers for Check your progress 2

(Refer to Learner's Book page 60)

1. The learners should talk about development of strains that are resistant to the available drugs in the market which will make the government spend a lot of money in research to develop a new antibiotics. Besides, absence of the necessary drugs when the new resistant strain is circulating in the population would mean transmission to several people and outbreaks ensue.
2. The learners should explain in line with poor sanitation and hygiene.
3. The learners should highlight some of the vector transmission control measures from published journals or creative ideas on how to curb the vector transmission.
4. Apply the “pull and push strategy” whereby the tsetse flies are attracted using anything with a blue colour then trapped and killed.
5. The viruses are cellular obligates and require the living organism machinery to survive. They do not have their own biochemical pathways that can be targeted to develop drugs. As such the immune system is the only way to target them as foreign bodies and eliminate them.
6. Check for informative campaign slogans

UNIT
3

**Biodiversity, human activities
and climate change**

Refer to Learner's Book page 62-84

Learn about	Key inquiry questions
<p>Learners should investigate biodiversity and its different levels (genetic, species and ecological); they should explain the hotspots of biodiversity regionally and globally with reference to South Sudan. They should explain threats to biodiversity as a result of human activities e.g. deforestation, habitat destruction, species depletion due to overhunting, overfishing and use of pesticides/other chemicals; environmental pollution (e.g. air, water, soil and noise) and describe ex-situ and in-situ conservation.</p> <p>Learners should investigate the impact of human activities on climate change in terms of increased use of fossil fuels; deforestation; global warming; melting ice caps and glaciers; and coral reef bleaching, and know about the factors affecting changes in Earth's average temperature (e.g. changes in solar output; changes in earth albedo; moderating effect of oceans; clouds and water vapor and air pollution) and the greenhouse effect and greenhouse gases. They should investigate the concentration of greenhouse gases in a practical way using appropriate apparatus and learn about atmospheric layers, Ozone depletion and possible preventive measures. They should explain the possible effects of climate change on agriculture, water resources, forests, sea level and coastal areas, human health, human population, whether extremes and biodiversity and how this might impact on South Sudan in a global context.</p>	<ul style="list-style-type: none"> • What could we do to slow global warming if we wanted to? • What if global warming does not occur, what would the consequences of taking the above actions be? • How do human activities affect the ozone layer? • How could global warming be controlled? • How does global climate change affect food production, water supplies, forests and biodiversity, sea levels, human health and weather extremes? • What are some global conventions on climate change? • Why is biodiversity conservation necessary? • How are human activities related to global climate change?

Learners should explain possible solutions, such as the Rio Earth Summit (1992) and the Kyoto Protocol (1997) as well as other international conventions. They should know the theory of global warming and predict its consequences, the methods of dealing with global warming and, know the theory of ozone depletion in the stratosphere.		
Learning outcomes		
Knowledge and understanding	Skills	Attitudes
<ul style="list-style-type: none"> Understand biodiversity, habitat, ecosystems, populations and the impact of climate change. 	<ul style="list-style-type: none"> Classify meteorological data, and be able also to read satellite imageries of climatic nature. Observe and gauge changes in biodiversity Measure greenhouse concentration in the atmosphere. 	<ul style="list-style-type: none"> Appreciate the negative impact of human activities on biodiversity and local, regional and global climate. Appraise biodiversity values and the efforts exerted by man to conserve and protect them.
<p>Contribution to the competencies:</p> <p>Critical thinking: students will think critically about the phenomenon of global warming and biodiversity depletion.</p> <p>Communication: this is improved through open discussion among the students on issues of concern.</p> <p>Co-operation: this is enhanced as students work together in small groups during fieldwork and lab sessions</p>		
<p>Links to other subjects:</p> <p>Mathematics: measurements, statistics</p> <p>Chemistry: Molecular structures, chemical reactions</p> <p>Geography: Solar radiation, temperature, rains etc.</p> <p>Environment and sustainability: Biodiversity</p>		

Introduction to the Unit

The content in this unit is about biodiversity and its different levels with reference to South Sudan. The impact of human activities on climate change. Effects of climate change. The greenhouse effect and greenhouse gases. The theory of global warming and its consequences.

You may remind the learners of what they learnt about living things in primary level or secondary level one. You can do this by giving examples.

There is a variety of life in the world, different lives are adapted to a particular ecosystem therefore the need to understand biodiversity, habitats, ecosystems and populations and how human activities impact on the climate and hence affecting biodiversity.

Inform learners that human activities can have negative effects on biodiversity and on local, regional and global climate. However, there are efforts and values exerted by human that protect and conserve biodiversity.

Cross-cutting issues

1. Environmental awareness and sustainability

Emphasise to the learners the need to preserve the biodiversity of organisms in nature and the need to protect organisms against extinction.

Encourage learners to appreciate the rich biodiversity of birdlife in South Sudan and the fact that South Sudan is the only country in Africa with both species of eland; the common eland *Taurotragus oryx* and the Derby's eland *Taurotragus derbianus*.

Emphasise to the learners the endangered, threatened and rare species in South Sudan. Refer to Table 3.1 in the Learner's Book page 64.

Make learners appreciate the need for conserving the biodiversity of organisms.

2. Peace education

Bring to the attention of the learners the need to accommodate other people's views. Discipline should be observed at all times during group activities since some cases can make learners diverge from the main objectives.

Competencies to be developed

1. Cooperation and communication

Encourage learners to cooperate as they discover the biodiversity of South Sudan by themselves as they work in groups, answer probing questions and doing more research on the topic. Promoting the competence of **co-operation**. Presentation of group work discussions can boost the learner's **communication**.

Learners studying and investigating and understanding the phenomenon of global warming and the biodiversity of South Sudan promotes the competence of critical thinking.

2. Culture and identity

Make learners aware of South Sudan's rich biodiversity that needs protection and care for it to be sustained for the future generations. From the shoebill and black-crowned crane in the Sudd wetland to the Sudd swamps. These identify with our country and therefore need to be protected.

Emphasise to the learners to read more on The Draft South Sudan Wildlife and Protected Area Policy, 2012 to appreciate the categories of ecosystems in South Sudan. Link, <https://www.cbd.int/doc/world/ss/ss-nr-05-en.pdf>. These will make them proud of our country and the need to protect its biodiversity.

3.1 Biodiversity

(Refer to the Learner's Book page 62)

Activity 3.1 (In groups or as a class)

This is a discussion lesson that will involve observational activities by the learners. You will engage learners in a discussion regarding different lives collected from their locality, guide them to suggest local names of different biodiversity, group them and identify how the different lives feed and where they live and assessing the learners' responses.

You are therefore required to get the various reference materials in advance on the threatened, endangered and rare species in South Sudan, get pictures of these animals and a map to show where they are found in South Sudan.

Suggested teaching and learning and activities

1. Introduce the lesson by asking learners to name the living things in their locality,

allow them to go out and find out about the lives in their locality. Ask them to keep the memories of what they observe using cameras, diary drawings and present their reports to the class.

2. Guide learners to read “The fifth report to the convection on biological diversity” and listen to their explanations on the different types of biodiversity.
3. Organise the learners into groups to carry out Group Activity 3.3. Ensure high quality of English as the learners role play Group Activity 3.5.
4. Explain the value of biodiversity. Refer to learners book for highlighted points.

Assessment opportunities

Conversation: Engage learners in discussion as they do the activities.

Product: Check on the pictures drawn by learners, notes compiled by learners and tables filled by learners. Do they reflect the theme of the lesson?

3.2: Biodiversity and human activities

(Refer to the Learner’s Book page 68)

Activity 3.6 (In groups, a pair or as a class)

This is a discussion lesson that will involve observational activities by the learners

You will engage learners in a discussion regarding the human activities threatening biodiversity in South Sudan and assessing learning responses.

You are therefore required to get the various reference materials in advance and organise the class in a way that will encourage the teaching methods involving collaboration among learners. If possible have the learners sit in semi circles in their groups.

Learners to read activity 3.6 and answer study questions that follows

The learners should hold discussion of the questions in the activities.

Assessment opportunities

Conversation: Lead in discussion after learners are done with reaching activity 3.6.

Product: Check on answers provided by learners. Are they correct.

Answer to check your progress 3a

(Refer to learner's Book page 70)

1. True, award marks based on their explanation but their arguments must show decrease in population of white eared kob or extinct.

Answers to check your progress 3b

(Refer to learner's book page 70)

Check for learners correct arguments.

3.3 Environmental pollution

(Refer to learners book page 72)

Group activity 3.7

1. Organize learners into convenient groups.
2. Ask learner to discuss environmental pollution-using pictures in their books.
3. Learners should be able to describe the various forms of pollution, their causes and ways of preventing them.
4. Instruct learners to write a report and present them in class.
5. Use their presentation to explain environmental pollution as they take short notes.

3.4 Climate change

(Refer to the Learner's Book page 75)

Activity 3.8 (In groups, a pair or as a class)

This is a discussion lesson that will involve observational activities by the learners.

You will engage learners in a discussion regarding the activities and assessing learning achievements. You are therefore required to get the various reference materials in advance and organise the class in a way that will encourage the teaching methods suggested.

Suggested teaching and learning activities

1. Introduce the lesson by distinguishing between climate and weather. Expand their knowledge.

2. Organise the learners into groups of five for Group Activity 3.8 and 3.9. Guide the learners to conduct the role play.
3. Organise the learners into groups to discuss different convention on climate change.
4. Ask learners on issues of climate change. From the learners' response define global warming and climate change.
5. Brainstorm possible human sources of greenhouse gases. Where do these gases come from? Are the sources common all over the world or are some areas larger sources than others? Read and discuss the charts and graphs. How does the information support or contradict the ideas formed during the brainstorming session? Encourage the students to compare the greenhouse gases graphs with other graphs (for example, global temperature and human population increases) during the same time span. Encourage them to come up with their own comparisons. What kinds of trends do they predict? Can seemingly upward trends be reversed?
6. Ask students to discuss global emissions of greenhouse gases. For example, the United States of America has only a small percentage of the world's population but emits a disproportionate share of the global carbon IV oxide. China has a population of over a billion people.
 - a) What would happen if China "developed" to the point where most families owned an automobile that emitted carbon IV oxide?
 - b) Calculate the personal/family/class contribution of carbon IV oxide due to vehicle use.
 - c) Using a city map (if necessary), have each student estimate the distance from their home to school in miles.
 - d) Have each student identify their type of family vehicle based on the types listed in the table below.
 - e) Have each student calculate the amount of gas used weekly if they rode to and from school every day in a private car. To do this:
 - i) Add up the total number of miles for 10 round trips to school (remember,

each time they are dropped off at school, the driver has to drive home, so there are 2 round trips a day).

- ii) Divide the total by the miles per gallon to determine the gallons of gas burned
- iii) Multiply the carbon IV oxide released per gallon. For example: If you live 4 miles from school, your car travels 16 miles per day to drop you off and pick you up, or 80 miles per week. At that mileage, a full-size car will burn 5 gallons of gas per week. Five gallons of gas will produce 100 pounds of carbon IV oxide every week.
- iv) Calculate the class total as if everyone rode to school in a private vehicle.
- v) Have students who ride the bus do the same calculations again, using the figures for the bus and dividing the total carbon IV oxide released by the approximate number of students that ride on the bus.
- vi) Determine how many students walk or use a bicycle to school. They do not contribute additional carbon IV oxide to get to and from school.

Answers to check your progress 3C

Refer to learner's Book page 80.

1. Combustion of fossil fuels and deforestation as well as use of natural gas may double the quantities of carbon (IV) oxide in the atmosphere in about 100 years to come.

Answers to check your progress 3d

Refer to learner's Book page 81

1. Refer to learner's Book page 75.
2. Carbon (IV) oxide, chlorofluorocarbons methane nitrogen (I) oxide.
3. Refer to learner's Book page 80.
4. Mining, industrialisation

- Increases unpredictability of seasonal rains. Increase intensity of rainfall, storms. Increase the length and frequency of droughts.
- Plant trees. Stopping mining.

Answers to check your progress 3e

Refer to learner's Book page 84

- Conserve energy.

Use energy efficient bulbs and appliances. Participate in local utility's energy conservation programs planting trees.

Additional information to the teacher

Biological diversity is the variety of species of living organisms of an ecosystem. In ecosystems that are more bio diverse, such as tropical forests, a large variety of plants, micro-organisms and animals live; in ecosystems that are less bio diverse such as deserts.

The availability of abiotic factors such as light, moisture, mineral salts, heat and carbon IV oxide, more or less conditions the biodiversity of an ecosystem. Photosynthesis depends on water and light, and plants also need mineral salts, carbon IV oxide and adequate temperature for their cells to work. In environments where these factors are not restrictive, the synthesis of organic material (by photosynthesis) is at a maximum, plants and algae can reproduce easily, the population of these organisms increases, potential ecological niches multiply and new species emerge. The large mass of producers makes the appearance of a diversity of consumers of several orders possible. In environments with restrictive abiotic factors, such as deserts, producers exist in small numbers and have less diversity, a feature that is extended to consumers and causes fewer ecological niches to be explored.

The vegetal stratification of an ecosystem, such as the strata of the Amazon Rainforest, creates vertical layers with particular abiotic and biotic factors, dividing the ecosystem into several different environments. Therefore, in the upper layer near

the canopies of large trees, the exposure to light, rain and wind is greater, whereas moisture is lower compared to the lower layers. As you go down the strata, the penetration of light diminishes and moisture increases. Regarding biotic factors, communities of each stratum present different compositions and features, food habits, reproduction strategies, among others. Such variations in abiotic and biotic factors put selective pressure on living organisms, causing them to be diversified; as a result, there are more ecological niches to be explored and more varied organisms emerge during the evolutionary process.

In ecosystems with more biodiversity, the food webs and ecological interactions among living organisms are more complex and diverse. In these ecosystems, environmental changes can be more easily compensated for the large amount of available resources, food and survival options.

In ecosystems with less biodiversity, individuals are more dependent on certain organisms that serve as food and interact with a small number of different species. In these ecosystems, abiotic factors are generally restrictive and species are more specialized for such conditions and, as a result, more sensitive to environmental changes. Therefore, even small-scale environmental damage can cause big disturbances in the equilibrium of the ecosystem.

UNIT
4

Respiratory systems and exchange with the environment

Refer to Learner's Book page 85-120

Learn about		Key inquiry questions
<p>Learners should investigate the structure of respiratory systems in animals such as fish, frogs, insects and mammals, with an emphasis on human respiratory structures. They should understand the role of respiration as gaseous exchange with the environment and the importance of respiration in living organisms in energy production and the significance of aerobic and anaerobic respiration including the chemical equations and stages of respiration in cells.</p> <p>Learners should explain the role of oxygen and the enzymes in respiration and investigate the process of aerobic respiration and conduct experiments to investigate anaerobic respiration involving yeast fungi and germinating peas or beans.</p> <p>Learners should be able to explain, using diagrams and chemical equations, the cyclical process of the carbon cycle and the relationship between respiration and photosynthesis.</p>		<ul style="list-style-type: none"> • What is respiration? • Why is energy important in lives of living organisms? • Why is respiration essential in living organisms? • What are the differences between aerobic and anaerobic respiration? • What is the role of Oxygen in respiration process? • How many stages of respiration occur in the cells of living organisms? • What are enzymes?
Learning outcomes		
Knowledge and understanding	Skills	Attitudes
<ul style="list-style-type: none"> • Explain the structure and function of the respiratory systems in animals and its role in exchange between organisms and the environment. 	<ul style="list-style-type: none"> • Investigate the process of aerobic and anaerobic process of respiration and the effect of temperature • Observe and compare the structures of respiratory systems of humans, frogs, fish, etc. 	<ul style="list-style-type: none"> • They will appreciate the role of respiration in living organisms • Appreciate how organisms produce energy

Contribution to the competencies:

Critical and creative thinking: About the role of Oxygen in their lives and how it can lead to production of energy in the body of living organisms.

Communication: Will be improved through group discussion.

Co-operation: They will work together in small groups.

Links to other subjects:

Chemistry: taking in of Oxygen to break down some food with enzymes, the equation of respiration etc.

Physics: breathing when the body moves up and down.

Introduction to the Unit

The content in this unit is about respiratory systems of living things. You may remind the learner of what they learnt about respiration in primary level or secondary level one. You can do this by giving examples.

In Biology, respiration has two meanings: At cellular respiration, it refers to the chemical reactions that take place in the cytoplasm and in the mitochondria, which may require oxygen, and are the principle sources of adenosine triphosphate for eukaryotic cells; - at the level of the whole organism, it refers to the process of taking in oxygen from the environment and giving out carbon IV oxide.

You should also motivate the learners and help them change their attitude towards Biology by making the subject interesting.

Cross-cutting issues

1. *Environment awareness and sustainability*

Emphasise to the learners that the environment is made up of both living and non-living things. Living things in an environment feed, digest and assimilate nutrients. The environment is therefore their habitat and should be taken care of.

2. *Peace education*

Bring to the attention of the learners the need to accommodate other people's views and maintaining peace as they relate together during discussions and group activities.

3. Life skills

Emphasise to learners the need to be keen when doing practical work to avoid breakage of apparatus. This will reduce the cost of carrying out a practical experiment by avoiding buying new apparatus for the practical.

Competencies to be developed

1. Critical and creative thinking

Guide the learners to discover for themselves as they work in groups, answer the probing questions and do more research on the unit. Encourage the learner to think critically and be creative. Presentation of group work discussions boosts the learner's competence.

2. Communication

The competence comes as learners participate in pairs and group work and present their work to the rest of the class. Encourage all learners irrespective of their abilities to participate in group discussion and during presentation by asking questions. The teacher should convey ideas effectively through spoken and written English by applying appropriate grammar and relevant vocabulary.

3. Co-operation

As learners interact in pairs as they engage discussion. This can also be enhanced during presentation; you can allow rational presentation within group members.

Additional information

Read reference books on respiration systems. This will equip you with the knowledge on respiration systems to be able to tackle this unit effectively.

When organising the learners into groups consider gender, special educational needs learners. The groups formed should be well represented to enable the learners appreciate diversity amongst them and learn that we are all gifted differently.

Respiration

Activity 4.1 (In groups or as a class)

(Refer to Learner's Book page 85)

This is a discussion lesson that will involve observational activities by the learners.

You will engage learners in a discussion regarding the activities and assessing learning achievements.

Suggested teaching and learning activities

1. Introduce the lesson by reminding the learners what they learnt in Secondary level 1 about respiration systems. Expand their knowledge.
2. Explain two types of respiration.
3. Organise learners into groups of five for Activity 4.1.
4. Allow learners to hold a discussion on the questions in the activities.

- a) What do you observe from the bar chart?

Nitrogen composition does not change after inhalation, carbon IV oxide increases after inhalation by about 100 times, oxygen decreases by about 25% after inhalation.

- b) Describe what the observation means?

Oxygen is used during respiration and as carbon (IV) oxide is usually released.

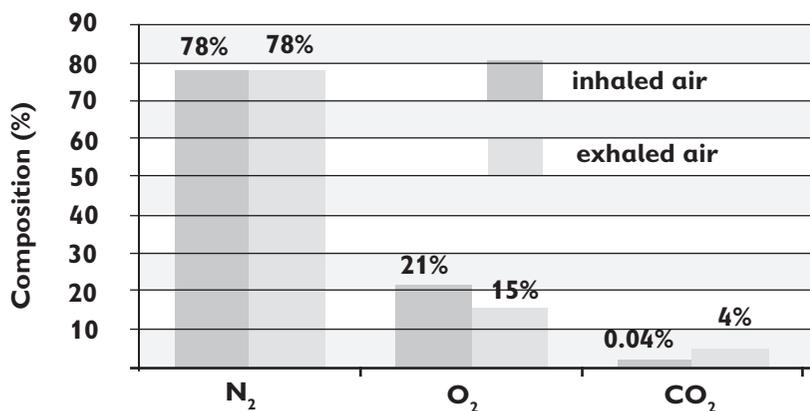
- c) How would you demonstrate that what your bar chart shows is true?

Have the exhaled air bubbled through limewater. If the clear colour changes to a white precipitate then carbon IV oxide is exhaled.

Compare the colour change with when atmospheric air is pumped into limewater.

Setting up this experiment may help explain this fact. Practical Activity 4.2 will emphasis this fact.

The design of graph should look like the one below.



5. Allow each groups to do the presentation of their findings to enhance the communication skills of the learners.

Lesson assessment

- Discussion
- Observation

Practical activity 4.1

Refer to learner's book page 86

In this practical activity, organise learners in groups of five and provide them with the required materials for the activity. Allow them to go through the procedure as outlined in Learner's book. Let them carry out the experiments as you move round the class observing how each group work. Allow them to make mistakes and since mistakes is part of learning and correct them where need be. Summarize the activity by asking each group to compile there report and allow them to present in class as you moderate their time.

4.1 Respiratory systems in animals

Practical activity 4.2 and 4.3

Refer to learner's book page 89 and 91

This are practical activities aimed at examining respiratory structures of organisms. Introduce the lesson by showing learners different pictures or photographs of respiratory system of different organisms. Have a general discussion on the characteristics of respiratory surfaces and ask learners to give some suggestions on how a grasshopper, frog, fish and humans carries out gaseous exchange. You can then divide the class into groups or pairs based on the availability of materials present. Ask each group to go through the procedure and do the activity as you observe closely. After the activities ensure learners release the organisms provided to the environment. You can then have a general class discussion on the diagrams of

various respiratory systems and allow learners to draw and label different parts of the respiratory systems presented. Let each group compare their drawings. Provide some learner's a piece of chalk to draw their diagrams on chalk board as you correct them as the class observes. Ensure learners take notes.

Lesson assessment

- Observation
- Question and answer
- Discussion

4.2 Cellular respiration

(Refer to Learner's Book page 95)

Group activity 4.2 (In groups, a pair or as a class)

Print the structure of the mitochondria and provide each group or pair in class.

Suggested teaching and learning activities

1. Introduce the lesson with Fig.4.15 by asking learners to explain respiration using burning firewood.
2. Review the structure of the mitochondrion and ask learners to do the group activity 4.3 in learner's book page 96.
3. Ask learners to relate the structure of the mitochondrion to the respiration process.
4. Ask learners to research on the stages of respiration. Define glycolysis, Krebs' cycle and electron transport system. Show the learners the breakdown of six carbon glucose molecules, into 3-carbon triose sugar and the role of enzymes in respiration.

Lesson assessment

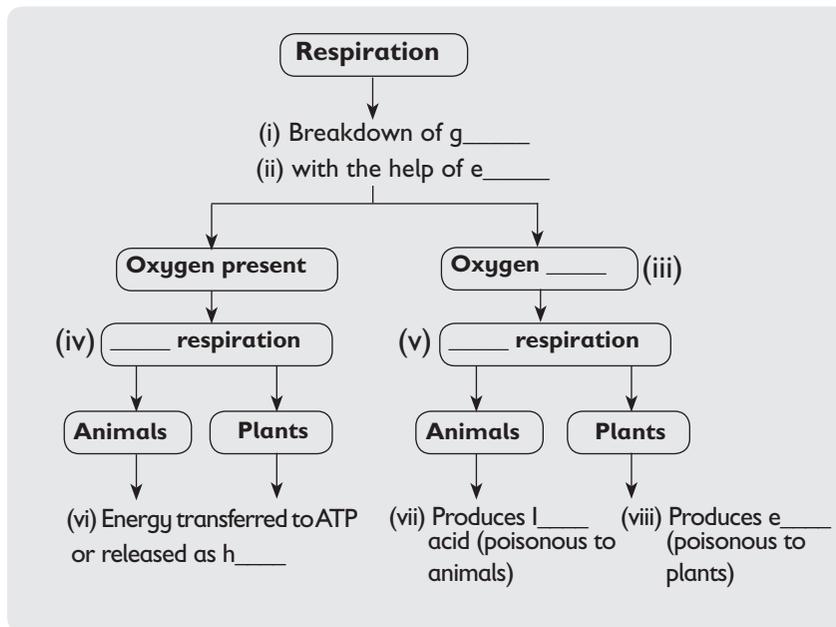
- Oral questions

- Written questions

Answers to Check your progress 4a

(Refer to the Learner's Book page 100)

1. Copy the flow diagram in figure 4.18 and complete the terms used to compare aerobic and anaerobic respiration.



- i) Breakdown of glucose.
- ii) With the help of enzymes.
- iii) Oxygen is absent.
- iv) When oxygen is present aerobic respiration.
- v) When oxygen is absent anaerobic respiration.
- vi) Energy transferred to ATP or released as heat energy
- vii) Produces Lactic acid (poisonous to animals).
- viii) Produces ethanol (poisonous to plants).

4.3 Factors affecting the rate of respiration

(Refer to Learner's Book page 103)

Activity 4.2 (In groups or as a class)

Arrange learners in groups to discuss.

Suggested teaching and learning activities

1. Ask learners to find out from the school library or the Internet factors that affect the rate of respiration.
2. Pick out learners randomly to discuss to the class the findings. This will promote research and communication skills in the learners.

Lesson assessment

- Oral questions
- Written questions

4.4 Enzymes

(Refer to Learner's Book page 103)

Practical activity 4.4 (In groups or as a class)

This is an observational lesson that will involve active participation by the learners.

You will engage learners in group experimental activities and discussion of the activities and assessing learning inferences.

Suggested teaching and learning activities

1. You will begin the lesson by carrying out practical activity 4.4. Assist the learners to setup the experiment as shown in the Student's Book.
2. Lead the learners to view enzymes as catalysts and therefore link the lesson to catalysts in chemistry.
3. Guide learners to investigate the catalytic features observed in the experiment with catalase enzyme and hydrogen peroxide.

Lesson assessment

- Oral questions
- Written questions

Answers to Check your progress 4 b

(Refer to the Learner's Book page 103)

1. Why is pyruvic acid converted into alcohol or lactic acid during fermentation?
Due to lack of oxygen in the cells.

2. Why is there less release of energy during anaerobic respiration?
The glucose is partially broken down.

3. List the three phases of aerobic respiration of glucose. Where in the cell do these reactions take place?

Glycolysis: cytosol (cytoplasm solution).

Krebs' cycle: Mitochondrion matrix.

Electron transport systems: inner membrane of the mitochondrion.

4. What is the role of oxygen in aerobic respiration?
Receive hydrogen ions in the ATP synthesis.

5. Name the substrate and products of the Krebs' cycle.
Substrate: Acetyl CoA

Products: Hydrogen ions, carbon IV oxide, FADH_2 , and NADH_2

6. How do fatty acids enter the Krebs' cycle?

They are converted into triose sugar then enter the process of glycolysis as glyceraldehyde-3-phosphate.

Answers to Group discussion questions

(Refer to the Learner's Book page 105)

1. Suggest the reactants in this experiment and the products too.

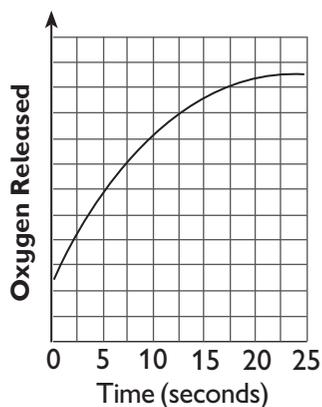
Hydrogen peroxide is broken down in the presence of enzyme catalase from the potato cells to produce oxygen and water.

2. How would you confirm that the gas produced is oxygen? Did you confirm?

Test the gas with a glowing splint it should reignite/rekindle.

The student can also design a similar experiment and the source of catalase be raw liver.

3. Identify any inconsistencies in your results. *Encourage the learners to explain challenges they faced. Probably the foam filling the conical flask.*
4. Describe the shape of the graph and explain the shape of the graph in relevant biological terms.



At low concentrations of the enzyme catalase, the graph will show an increasing rate of the reaction, as the enzyme concentration increases, the graph will show some levelling off when another limiting factor becomes significant.

5. Describe any technical difficulties you had with these apparatus and explain how these could be overcome.

Encourage the learners to share their technical difficulties and how they solved them to build problem solving skills and creativity among them.

6. Design a similar experiment and demonstrate to the rest of the class.

A control experiment should be designed without the catalase or with boiled catalase.

The student can also design a similar experiment and the source of catalase be raw liver.

4.5 Anaerobic respiration experiments

Refer to Student's Book page 109

Activity 4.5 (In groups, a pair or as a class)

This is an observational lesson that will involve active participation by the learners. Assist the learner setup the experiment.

You will engage learners in group experimental activities and discussion of the activities and assessing learners' inferences.

Suggested teaching and learning activities

1. You will begin the lesson using the Activity 4.9. The Activity is more complex and may need your supervision but the learners can manage.
2. Ask learners the properties of yeast as earlier learnt in Unit 1 and its classification as Fungi.
3. Let the learners understand that yeast is used in the baking industry to make bread.
4. Encourage the group leaders to share their findings with the class to build communication skills.

Lesson assessment

- Oral questions
- Written questions

Answers to Group discussion questions

(Refer to the Learner's Book page 111)

Discuss the following questions and answer them in your notebooks then have the group leader present your findings to the rest of the class.

1. What do you observe in the limewater and the boiling tubes? Why?

The limewater connected to the boiling tube labelled A would have a white precipitate, because the living yeast cells respired anaerobically and produced carbon (IV) oxide which reacted with limewater to form a white precipitate (calcium carbonate).

The limewater connected to the boiling tube labelled B would remain clear because the yeast cells are dead.

2. Would your observation agree with the hypothesis that yeast respire anaerobically? Yes
3. How has this experiment ensured that the evidence of respiration is because of anaerobic respiration of yeast and not anything else?

Setup B is a control experiment containing dead yeast cells.

4. What assumptions have you made in this experiment?

The 40 °C is the optimum temperature of yeast cells to function.

The yeast cells are killed at over 100 °C boiling.

The yeast cells have enzyme invertase that breakdown sucrose to glucose and fructose.

5. How will you setup a control experiment for the observations made in limewater?

Use distilled water instead of limewater. Evaluate this experiment and suggest how the design was done to ensure anaerobic respiration occurred. The water used to dissolve sucrose and yeast was boiled to drive out oxygen. The cooking oil was added slowly at the top of the solution to prevent oxygen dissolving. When adding sucrose solution the syringe touched the boiling tube to prevent air entering.

6. Suggest what else you could use instead of sucrose and why.

Glucose because it is a monosaccharide sugar ready to be respired on by the yeast cells.

7. How would you use this knowledge in the real life?

- *Alcohol production.*
- *Bread baking.*
- *Wine making.*
- *Biogas production.*

- *Silage production.*
- *Yoghurt making.*

(Encourage the learners to research on the processes).

8. Suggest changes you would make to this experiment to investigate aerobic respiration in yeast.

Remove the cooking oil.

Use distilled water that is not boiled before mixing it with the glucose.

Answers to Group discussion questions

(Refer to the Learner's Book page 113)

1. Suggest the aim of this experiment.

To demonstrate that germinating seeds respire.

2. Supposing you were asked to state the hypothesis of this experiment, what would you state? Why?

Germinating seeds respire anaerobically.

The volume of air reduced by the end of the experiment.

3. How do you explain the observations you have made?

The germinating seeds respired anaerobically releasing carbon IV oxide which is absorbed by the mixture of sodium hydroxide and pyrogallic acid therefore the volume of the conical flask air did not increase, the removal of oxygen by the mixture ensured anaerobic respiration.

4. Why did you setup two conical flasks A and B?

Conical flask A is the investigative experiment.

Conical flask B is the control experiment.

5. How would you design an experiment to demonstrate that germinating seeds produce carbon IV oxide?

Setup the same experiment but place the glass tube in limewater instead of water and remove the mixture of sodium hydroxide and pyrogallic acid from the setup.

6. How is the knowledge you have gained here used in real world?

Fermentation of barley seeds or sorghum seeds used in alcohol production.

Fermentation cereals used in silage production.

7. Prepare a presentation of your findings then have one-member present to the class.

Encourage learners of different abilities to present their group findings.

Use their findings to probe for further understanding.

4.6 Carbon cycle

(Refer to Learner's Book page 114)

Activity 4.7 (In groups, a pair or as a class)

This is a discussion lesson that will involve active participation by all the learners.

Suggested teaching and learning activities

1. Ask learners to research in the library or internet on the carbon cycle and draw and label the components of the carbon cycle relevant to South Sudan.
2. Guide learners to discuss the effect of human activities on the carbon cycle.
3. Guide learners relate the carbon cycle to the processes of respiration and photosynthesis.

Lesson assessment

- Oral questions
- Written questions

Reducing your personal carbon footprint.

1. Find out ten easy and practical things you can do in personal space, at your school, home, village, estate and town to help stop global warming.
2. What are you doing at your personal level that is adversely affecting the carbon cycle?
3. What can you do at your personal level to improve the carbon cycle?

Encourage the learners to reflect on how they contribute to the amount of carbon (IV) oxide in the atmosphere by investigating:

- Fossil fuel use.
- Spraying of water vapour in the air for agriculture or car wash.
- Car emissions event efficient cars produce water vapour and carbon IV oxide.
- Saving on electricity use.
- Transport to school.
- Type wastages in their homes and school.
- How much recycling they do.
- Use of cooking gas.
- Personal aerosols.
- Livestock farming.

Visit this site to learn more on how to engage your learners in this lesson: <http://footprint.wwf.org.uk/>

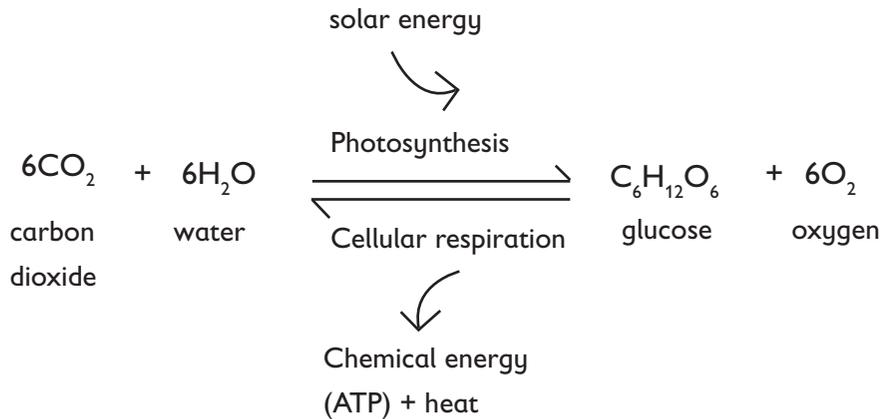
Use questions to remind learners of carbon IV oxide and the global warming.

Fossil fuel combustion has increased the quantity of carbon IV oxide in the atmosphere. Global warming is expected to happen due to the carbon IV oxide and other greenhouse gases.

Answers to Group Activity 4.13

(Refer to the Learner's Book page 118)

1. Study the photosynthesis and cellular respiration equation below.



What do you observe?

The amount of carbon IV oxide and water used in photosynthesis is equal to cellular respiration.

2. What does that mean to the carbon cycle?

Naturally it is balanced without human interference.

3. What do you think would happen if a plant was to be in this state for a long period of time? And why?

The plant would not grow or develop new structures and would eventually die because the cellular structure gain would be zero.

4. Suggest how nature avoids this condition?

As the day progresses the light intensity increases until the rate of respiration is less than the rate of photosynthesis.

5. Write an essay

Answers to Check your progress 4 c

(Refer to the Learner's Book page 119)

1. Breakdown of glucose in the body to produce energy
2. Oxygen gets reduced
3. (a) 38, (b) 28
4. Water, carbon dioxide, energy
5. Carbon dioxide used for photosynthesis
6. (a) Cytosol, (b) matrix
7. (a) water, carbon dioxide and energy. b. carbon dioxide and ethanol
8. Controlling rate of respiration
9. Utilisation of products and substates
10. (a) Glucose, (b) Acetyl CoA
11. Fermentation- bread, alcohol etc
12. Through the leaves
13. Release of stored energy in the body
14. Does not completely oxidise glucose
15. Breaking down of glucose, transition reaction, krebs cycle, electron transport
16. Utilisation of glucose, fatty acids and amino acids
17. Check learners comparisons
23. (a) 8616.2 kJ, 49.25kJ, (b) Humans beings
18. D
19. Anaerobic respiration of muscles
(c) Surface area to volume ratio
20. Check for correct calculation
21. Yes
22. Check for learners suggestions
23. (a) (i) 8616.2kJ
(ii) 49.25kJ
(b) Human beings
(c) Surface area to volume ratio

**UNIT
5****The digestive and circulatory system in animals**

Refer to Learner's Book page 121-158

Learn about	Key inquiry questions
<p>Learners should study digestive systems in humans, ruminants, insects, and fish, and know the role of digestive enzymes, and the chemical and physical processes during human digestion. They should know the functions of glands involved in the digestive process and explain peristalsis and how the structure of the human gut is adapted for the absorption of food. They should investigate the action of digestive enzymes e.g. action of amylase on starch, pepsin on white egg, or colloidal suspension of albumen and be able to explain their role in terms of biochemistry.</p> <p>Learners should know the main structures of circulatory systems in humans, birds e.g. the heart and blood vessels and know the different features of single and double circulation in animals. They should be able to explain how the anatomy of blood vessels, contributes to blood flow, the regulation of blood pressure and hormonal control. They should explain the functions of blood in humans for transport and disease control and investigate the factors heart rate.</p>	<ul style="list-style-type: none">• How does the process of digestion occur in animals?• How does the process of food assimilation occur within small intestine?• How does the chemical and physical process occur in the body?• What are the functions of glands, organs, which aid digestion?• Where in the body does most chemical digestion take place?• How do muscles move food through the digestive tract?• How does the heart regulate the rate of blood flow within the body of organisms?• Why are hormones necessary in controlling the rate of heart beat?• How does blood protect the body from diseases?

Learning outcomes		
Knowledge and understanding	Skills	Attitudes
<ul style="list-style-type: none"> • Explain the structure and function of the digestive and circulatory systems. • Explain the effect of exercise on heart beat. • Understand the important role of glands, and organs Describe the functions of the rhythmic movement of food. 	<ul style="list-style-type: none"> • Investigate the action of digestive enzymes. • Identify the role of chemical and physical processes of digestion. 	<ul style="list-style-type: none"> • Appreciate the role of blood in protecting the body from diseases.
<p>Contribution to the competencies:</p> <p>Critical and creative thinking: to analyse the process of food digestion, in terms of how enzymes convert the large molecules of bolus into small molecules for assimilation hence to be part of the body.</p> <p>Communication and co-operation: through working in groups to investigate.</p>		
<p>Links to other subjects:</p> <p>Chemistry: the breaking down of food into small particles (minute substances) by enzymes.</p> <p>Physics: the movement of food in the body requires some form of energy.</p>		

Introduction to the unit

The content in this unit is about digestive and circulatory systems of living things. It may be wise to remind the learner of what they learnt about digestion and blood circulation in primary level or secondary level one. You can do this by giving examples.

Every body cell needs nourishment to synthesis new cell organelles and for energy too. The cells require that the food molecules are small enough to be able to move across the cell membrane by active transport, osmosis, diffusion, pinocytosis or phagocytosis.

This relationship is important so that learners start thinking how the different organ systems are inter-related. You should also motivate the learners and help them change their attitude towards Biology by making the subject interesting

and relevant to their lives. This unit has many instants when you can relate the concepts learnt to the learners' lives and bodies too. Make them see how digestion is occurring in their bodies and how blood is transporting the end products of digestion to the cells.

Cross-cutting issues

1. Environment awareness and sustainability

Emphasise to the learners that the environment is made up of both living and non-living things. Therefore, they should not destroy plants and kill animals during their practical studies instead they should try to conserve them because plants give off food they eat. Let them appreciate that the food they eat obtains its nutrients from the environment.

2. Peace education

Bring to the attention of the learners the need to accommodate other people's views during group discussions. Discipline should be observed at all times during group activities since some cases can make learners diverge from the main objectives.

3. Life skills

Emphasise to learners the need to be keen when doing practical work to avoid breakage of apparatus. This will reduce the cost of carrying out a practical experiment by avoiding buying new apparatus for the practical.

Competencies to be developed

1. Culture and identity

Encourage learners to embrace the fact that different people in the world have their traditional foods and cultures in relation to foods and we should accept the diversity of foods and cultures for harmonious living.

2. Critical and creative thinking

Guide the learners to discover for themselves as they work in groups, answer the probing questions and do more research on the topic. Encourage the learner to think critically and be creative. Critical thinking and creative thinking to analyse the process of food digestion, in terms of how enzymes convert the large molecules of boluses into small molecules for assimilation hence to be part of the body cells.

3. Communication and cooperation

The competence of communication comes as learners participate in pairs and group work and present their work to the rest of the class. Encourage all learners irrespective of their abilities to participate in group discussions and during presentation by asking questions. Convey ideas effectively through spoken and written English by applying appropriate grammar and relevant vocabulary.

5.1 Digestion in animals

(Refer to Learner's Book page 122)

Activity 5.1 (In groups, a pair or as a class)

This is a discussion lesson.

You will engage learners in a discussion regarding the activities and assessing inferences.

Suggested teaching and learning activities

1. Introduce the lesson by reminding the learners what they learnt in Secondary 2 about digestive systems. Elaborate more on different digestive systems to expand their knowledge.
2. Guide them to research on the different types of digestion and present their findings to the class.
3. Organise the learners into groups of five for Activity 5.1 and 5.2. Guide the learners to conduct the experiments observing high hygienic levels.
4. The learners should hold discussion of the questions in the activities.
5. Allow each group to do the presentation of their findings to enhance their communication skills and engage them in discussing their findings.
6. Guide learners to look at the diagrams of various digestive systems and discuss their adaptation features and roles.
7. Ask the students to label and give functions of the parts of different systems.

Lesson assessment

- Oral questions
- Written questions

5.2 Functions of associate organs

(Refer to Student's Book page 137)

Group Activity 5.3 (In groups, a pair or as a class)

This is a discussion lesson.

Suggested teaching and learning activities

1. Introduce the lesson by having the learner label printouts of the diagram of the associated organs and glands.
2. Guide them to identify their location and role in the body.
3. Ask the learners to draw and complete table 5.2 below.

Table 5.2: Digestive gland or organ and its role in digestion

Gland/Orgy name	Digestive function
Stomach	
Duodenum	
Illeum	

4. Ask learners to predict, in groups, what would happen if a particular gland or organ was surgically removed or if a duct got blocked. For example, removal of the gall bladder results would in lipid indigestion and duodenum ulcers. This question would lead to critical thinking and may be appreciation of the importance of these organs or glands in digestion.
5. Let them share their findings to the class.

Lesson assessment

- Oral questions
- Written questions

Answers to Check your progress 5a

(Refer to the Learner's Book page 140)

1. a) A- Nasal cavity: air passage
B- Upper jaw: hold teeth
C- Tongue: forming a bolus/swallowing food/ mixing the food in the mouth.
D- Liver: synthesis bile juice/assimilation of most of the end products of digestion.
E- Gall bladder: storage of bile juice.
F- Bile duct: conveys bile to the duodenum.
G- Ascending colon: extraction of water
H- Caecum: connects the small intestine to the colon.
I- Appendix: a haven of beneficial bacteria.
J- Oesophagus: conveys food boluses to the stomach.
K- Stomach: site of protein digestion and food physical digestion (churning).
L- Pancreas: secretes pancreatic enzymes and blood sugar regulation hormones (insulin and glucagon).
M- Duodenum: site for protein, starch and lipid digestion.
N- Descending colon: storage of fecal material to be egestion.
P- Rectum: storage of fecal material before egestion.
Q - Anus sphincter: controlling egestion.
- b) Encourage the learners to read through the topic to find the content to fill for: region of alimentary, digestive gland, digestive juice produced, enzymes in the juice, class of food acted upon, and end substance produced.
2. This question wants the students to learn how to label biological diagrams with straight horizontal plain lines using a pencil and write the labels using ink. State the functions alongside the label.

3. Same as question 2
4. Same as question 2
5. Same as question 2
6. This question wants the learner to think critically and create knowledge of comparing the digestive systems of the different organisms.
7. The question wants the learner to use the glossary at the end of the unit and draw distinguishing features of different digestive systems.
8. To break it down and enable respiration process

5.3 Circulatory system

(Refer to Learner's Book page 141)

Activity 5.4 (In groups, a pair or as a class)

- This is a discussion lesson that will involve active participation by the learners.
- You are therefore required to get the various materials in advance.

Suggested teaching and learning activities

1. Guide learners to carry out Activity 5.19 on taking the pulse rate of their desk mates, recording and drawing an inference.
2. In pairs, let them role play doctor and patient as they take the pulse rates.

5.4 Blood circulation in humans and birds

(Refer to Learner's Book page 145)

Group Activity 5.5 (In groups, a pair or as a class)

This requires active participation by the learners to make posters and play, assess the learners' inferences from the activity.

Suggested teaching and learning activities

1. Lead the learners to create the flashcards for the game.
2. Encourage them to record the game activities in their notebooks. This will make them understand how blood circulation in human and in birds works and be able to follow the flow regardless of the starting point in the heart.

Lesson assessment

Oral questions

Written questions

Draw and label

5.5 Blood components and functions

(Refer to Learner's Book page 155)

Individual Activity 5.6

This is an observational lesson that will involve active participation by the learners.

You will engage learners in observing Fig.5.29 guide a discussion and assess learners' inferences.

Suggested teaching and learning activities

You will begin the lesson using the Activity 5.16. Encourage the learners to observe the photograph and make interpretations.

Lesson assessment

Oral questions

Written questions

Drawing and labelling

Answers to Check your progress 5b

(Refer to the Student's Book page 158)

1. Use this link to answer this question;<https://study.com/academy/lesson/carbon-dioxide-transport-in-the-blood.html>

Describe the functions of blood plasma.

2. Use this link to answer this question: <https://study.com/academy/lesson/what-is-blood-plasma-function-components.html>

3. Answer is in page 156 and 157 of the Learner's Book.



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