South Sudan

Primary Science 8

Primary Science has been written and developed by Ministry of General Education and Instruction, Government of South Sudan in conjunction with Subjects experts. This course book provides a fun and practical approach to the subject of Science, and at the same time imparting life long skills to the pupils.

The book comprehensively covers the Primary 8 syllabus as developed by **Ministry of General Education and Instruction.**

Each year comprises of a Pupil's Book and teacher's Guide.

The Teacher's Guides provide:

- Full coverage of the national syllabus.
- A strong grounding in the basics of Science.
- Clear presentation and explanation of learning points.
- A wide variety of practice exercises, often showing how Science can be applied to real-life situations.
- It provides opportunities for collaboration through group work activities.
- Stimulating illustrations.

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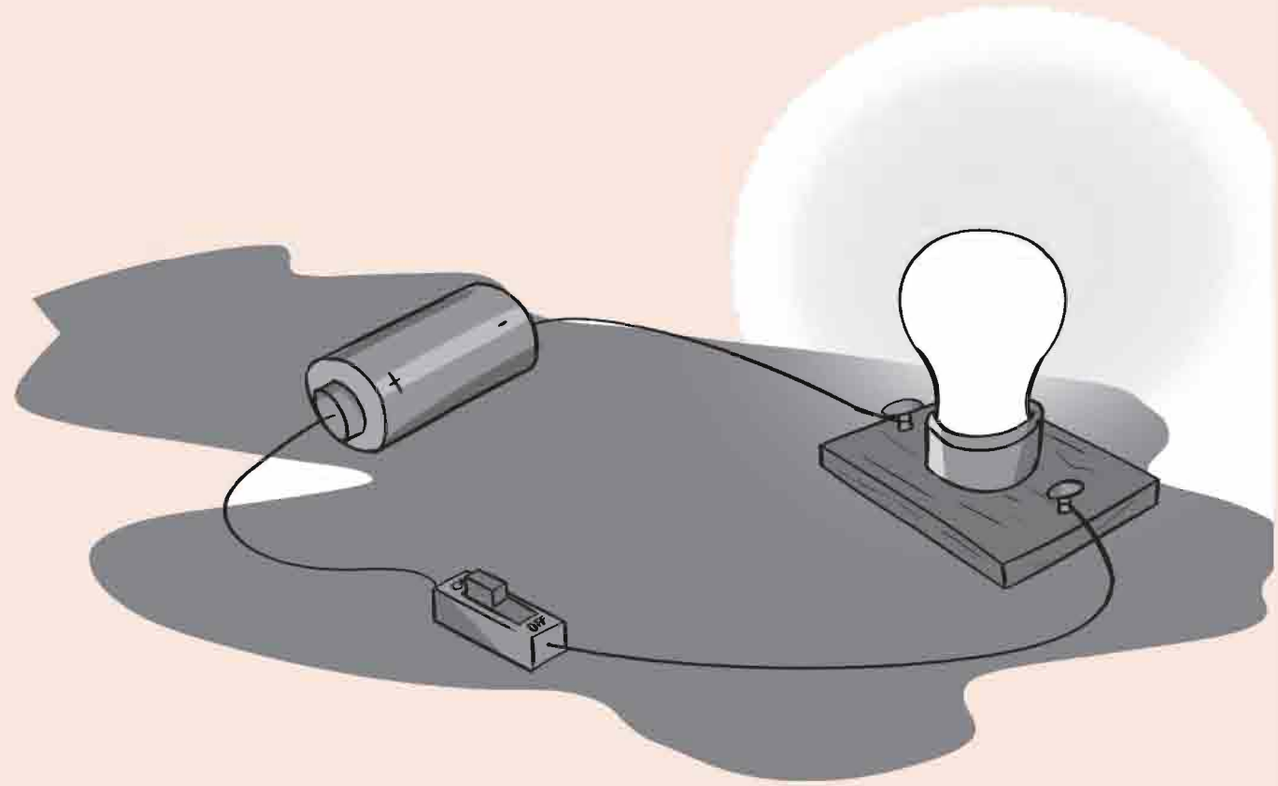
South Sudan

Primary Science 8

Teacher's Guide



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South Sudan

PRIMARY 8

Science

Teacher's Guide Book 8

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FOREWORD

I am delighted to present to you this Teacher's Guide, which is developed by the Ministry of General Education and Instruction based on the new South Sudan National Curriculum. The National Curriculum is a learner-centered curriculum that aims to meet the needs and aspirations of the new nation. In particular, it aims to develop (a) Good citizens; (b) successful lifelong learners; (c) creative, active and productive individuals; and (d) Environmentally responsible members of our society. This textbook, like many others, has been designed to contribute to achievement of these noble aims. It has been revised thoroughly by our Subject Panels, is deemed to be fit for the purpose and has been recommended to me for approval. Therefore, I hereby grant my approval. This Teacher's Guide shall be used to facilitate learning for learners in all schools of the Republic of South Sudan, except international schools, with effect from 4th February, 2019.

I am deeply grateful to the staff of the Ministry of General Education and Instruction, especially Mr Michael Lopuke Lotyam Longolio, the Undersecretary of the Ministry, the staff of the Curriculum Development Centre, under the supervision of Mr Omot Okony Olok, the Director General for Quality Assurance and Standards, the Subject Panelists, the Curriculum Foundation (UK), under the able leadership of Dr Brian Male, for providing professional guidance throughout the process of the development of National Curriculum, school textbooks and Teachers' Guides for the Republic of South Sudan since 2013. I wish to thank UNICEF South Sudan for managing the project funded by the Global Partnership in Education so well and funding the development of the National Curriculum, the new textbooks and Teachers' Guides. I am equally grateful for the support provided by Mr Tony Calderbank, the former Country Director of the British Council, South Sudan; Sir Richard Arden, Senior Education Advisor of DfID, South Sudan. I thank Longhorn and Mountain Top publishers in Kenya for working closely with the Ministry, the Subject Panels, UNICEF and the Curriculum Foundation UK to write the new textbooks. Finally, I thank the former Ministers of Education, Hon. Joseph Ukel Abango and Hon. Dr John Gai Nyuot Yoh, for supporting me, in my role as the Undersecretary, to lead the Technical Committee to develop and complete the consultations on the new National Curriculum Framework by 29 November 2013.

The Ministry of General Education and Instruction, Republic of South Sudan, is most grateful to all these key stakeholders for their overwhelming support to the design and development of this historic South Sudan National Curriculum. This historic reform in South Sudan's education system is intended to benefit the people of South Sudan, especially the children and youth and the future generations. It shall enhance the quality of education in the country to promote peace, justice, liberty and prosperity for all. I urge all Teachers to put this textbook to good use.

May God bless South Sudan. May He help our Teachers to inspire, educate and transform the lives of all the children and youth of South Sudan.

Deng Deng Hoc Yai, (Hon.)
Minister of General Education and Instruction, Republic of South Sudan

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Introduction

Book organisation

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

The main elements of Part 1 are:

- **Background in formation** t o t h e new curriculum – It gives a brief overview of the general requirements of the new South Sudan competence-based including the guiding principles, the competences the students are expected to acquire, crosscutting issues to be addressed during learning.
- **Basic requirements** for an effective Science lesson – It highlights the teacher and learner's roles for effective teaching and learning of Science, teaching and learning resources, grouping learners for learning and teaching methods

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

The main elements of each unit guide are:

- **Unit heading**
- **Unit syllabus**
- **Contribution to learner's competences**: The section explains how the unit/ topic will facilitate the learner to acquire to the specified competences. These competences will be discussed in detail later in the next section.
- **Cross cutting issues to be addressed**

  The section outlines the specific cross cutting issues that will be addresses through infusion as the learners do the activities and interacts with concepts planed for the unit This is meant to make the teacher conscious on and be on the look out for suitable opportunities through out the teaching and learning

process in the entire unit to address the cited cross cutting issues. These issues will be discussed in detail later in this section.

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

- **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 this unit. It also guides the teacher on how to find out that the learners posses them before they start learning the concepts in this unit, and how to help learners in case they do not posses them.
- **Suggested teaching and learning activities** – This section provides guidance to the teacher on how to facilitate students to learn by doing the activities outlined in the student's book. It also guides the teacher on how to assess the learning.

Background Information on the new curriculum

The aim of the South Sudan Competence-based curriculum is to develop in the learners competences 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.

(a) Learner's competences to be attained

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

1. ***Critical and creative thinking***

   Science lessons and activities facilitate learners to acquire these competences by giving then 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*

Science lessons and activities facilitate learners to acquire these competences by giving then opportunities to:

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

3. *Cooperation*

Science lessons and activities facilitate learners to acquire these competences by giving then opportunities to:

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

4. ***Culture and identity***

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

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

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

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

1. ***Environment and sustainability***

A well-conserved environment is obviously key to our health and survival. It is therefore important for the Science teacher to make use of the opportunities that arise in the process of teaching and learning Science 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 env ironment.

2. ***Peace education***

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

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

3. ***Life Skills***

Learners need to progressively acquire some skills abilities and behaviors

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

Basic requirements for an effective Science lesson

Teacher's role and basic skills for effective Science lesson

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

(a) Some of the key roles of the Science teacher include:

- Organising the classroom to create a suitable learning environment.
- Preparing appropriate materials for learning activities.
- Engaging students in variety of learning activities.
- Encouraging and accepting student autonomy and initiative.
- Allowing student responses to drive lessons, shift instructional strategies.
- Familiarizing themselves with learners understandings of concepts before sharing their own understandings of those concepts.
- Encouraging learners to engage in dialogue, both with the teacher and one another.
- Engaging students in experiences that pose contradictions to their initial hypotheses and then encouraging discussion.
- Providing time for learners to construct relationships and create metaphors.
- Using a variety of teaching and assessment methods.
- Adjusting instructions to the level of the learner.
- Nurturing learners' natural curiosity.
- Motivating learners to make them ready for learning.
- Coordinate learners' activities so that the desired objectives 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) Some of the key sk ills that the Science teacher should have include:

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

Learner 's role in learning Science

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 Science terms and representations in writing and talk.
- Engaging in lively public discussions in defence of their work and explanations.
- Applying their learning in real-life contexts.
- Reflecting critically about the processes and outcomes of their inquiries.

Teaching and learning resources

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

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

(a) Classroom as a learning environment

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

Classroom organisation

- It is important for the teacher to make the classroom an attractive and stimulating environment. This can be done by:
- Carefully arranging the furniture in the classroom in an organised way. to allow free movement of learners and the teacher.
- Putting up learning and teaching aids on the walls. Examples are wall charts, pictures and photographs.
- Displaying teaching models.
- Providing objects for play for example toys.
- Having a display corner in the classroom where learners display their work.
- Setting a corner for storing materials so as not to obstruct learners or distract them.
- Spreading out the learners evenly so that they do not interfere with one another's activities.
- Setting up the materials for the series of lessons or activities going on for a number of days or weeks in a location where they do not interfere with other daily activities

- Organizing the sitting arrangement such that learners face the lighted areas of the room.
- Choosing the most appropriate location for the teacher and the chalkboard such that they are visible to all learners and the teacher has a good view of all learners in the class.

(b) Apparatus and materials

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

When I hear I forget

When I see I remember

When I do I under sta nd

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

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

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

These include:

(i) Science Kit

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

(ii) Models

A model refers to a three-dimensional representation of an object and is usually much smaller than the object. Several models are available commercially in

shops. Examples of Science models include models of electric motors, hydraulic systems among others. These models can be purchased by schools for use during Science activities.

(iii) Resource persons

A resource person refers to anybody with better knowledge on a given topic area. Examples include health practitioners such as doctors, nurses and laboratory technologists, agricultural extension officers, environmental specialists among others. Depending on the topic under discussion, the teacher can 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.

(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. The teacher is therefore advised to improvise using locally available materials as much as possible.

(v) Scheduling learning activities and venues

Some of the activities suggested in the student's good planning and scheduling in order to get accurate results. An example is observing some effects of environmental factors on plant growth illustrated in unit 14. 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 Science activities suggested in the student's book are carried out in groups and therefore the teacher should place 2 or 3 desks against each other and then have a group of 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 the teacher is 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.

Lear in g 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 Science class has several advantages that include:

- The individual learner's progress and needs can easily be observed.
- The teacher-learner relationship is enhanced.
- A teacher can easily attend to the needs and problems of a small group.
- Materials that were inadequate for individual work can now be easily shared.
- 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 one method or approach to teaching that is appropriate to all lessons. A teacher should, therefore, choose wisely the method to use or a combination of methods depending on the nature of the topic or subtopic at hand.

Teaching methods

There are a variety of possible methods in which a teacher can help the 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/ field trips

(f) Teacher demonstration

(g) Experimentation/Research

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

- Particular group of 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 Science 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, the teacher encourages learners to find out answers to problems by themselves. The teacher does this by:

- Giving learners specific tasks to do.
- Giving learners materials to work with.
- Asking structure

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/class discussion or pair work

In this technique, the teacher and learners interact through question and answer sessions most of the time. The teacher carefully selects his/her 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 improve 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 the teacher or their peers. It may give them more confident learners a chance to dominate the others.

(d) Project method

In this approach, the teacher organises and guides 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. The teacher, using the project method, must ensure that the learners understand the problem to be solved and then provides them with the necessary materials and guidance to enable them carry out the study.

The main disadvantage of this method is that if a project is not closely supervised, 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 and nature walks

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

(f) Demonstration lessons

In a demonstration, the teacher shows the learners an experiment, an activity or a procedure to be followed when investigating or explaining a particular problem. The learners gather around the teacher where each learner can observe what the teacher is doing. It is necessary to involve the 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?

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

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

UNIT 1 The relationship between hygiene and diseases

Refer to learner's book page 1 to 19

Learn about	Key inquiry questions
Learners should apply their knowledge and experience of hygiene and diseases to personal and home sanitation, and food preservation. They should use charts showing how diseases are spread, discuss, plan and investigate by using internet for information. They should identify methods of food preservation and explain the scientific principles behind hygiene and diseases control, personal and home sanitation, and food preservation.	• Why is it important to apply the knowledge of hygiene and diseases to personal, home sanitation and food preservation? • How do personal hygiene, home sanitation and food preservation control diseases in a hygienic way? • How can we preserve our food? • How can a knowledge of science help us to improve personal and food hygiene?

Learning outcomes

Knowledge and understanding	Skills	Attitudes
• Apply knowledge of hygiene and disease to personal and home sanitation, food preservation •	• Investigate how to apply the knowledge of hygiene and diseases to personal, home sanitation and food preservation • Record and present their findings • Investigate the methods of food preservation	• Appreciate the importance of personal hygiene, home sanitation and food preservation • Promotes co-operation and team spirit when working in groups

Contribution to the competencies:
Critical and Creative thinking: the applications of knowledge about hygiene, diseases and home sanitation and food preservation methods Co-operation and Communication: observation during practical investigation
Links to other subjects: Life Skills: control of diseases

Introduction to the unit

This unit focuses on the application of hygiene and disease knowledge to personal and home sanitation and food preservation.

Note that learners have been introduced to importance of keeping the body clean and dangers of germs in Primary 2, care for and importance of clean environment in Primary 4 and the relationship between germs and sanitation in Primary 5. Link learners past knowledge and experience with the concept they will learn in this unit.

The concept in this unit is to enable learners control diseases in a hygienic way. Learners should also exhibit their appreciation of knowledge of science and how it helps to improve personal and food hygiene.

Health is a state of well being in body and mind. Health is normally threatened by the presence of germs in our environment. Home sanitation and practicing food hygiene practices can ensure health. This unit will enable learners to apply their prior knowledge of sanitation in eradicating diseases hygienically. They will investigate various methods of food preservation in their bid to keep off germs from food as a way of controlling diseases.

Competences to be attained

1. Co-operation

Encourage learners to work as a team through group discussions. Allow learners to freely interact with one another. Let them associate with one's culture and abilities through resources sharing and exchange of ideas. The principle of co-operation should be listening to understand but not listening to respond. All learners should be given equal opportunities.

2. *Communication*

During group discussion, encourage learners to share their opinions, suggestions and ideas freely. This way they will build on their language command as well as ability to participate in discussions. Ask them questions and give them a chance to attempt answering in the simplest way possible. This way, they will build on their confidence and soon develop the love and passion for the subject. Allow some room for learners to make mistakes and then correct them in nice way lest they will feel demoralized.

3. *Critical and creative thinking*

Use probing questions during the lessons to elicit critical thinking in learners. Help them develop a thinking culture as they try to relate the unit with the questions given to them. These questions should however trigger the idea of what they should expect from the unit. Use videos, pictures and photographs to make learners discuss the activities therein. Ask learners to come up with diagrams that illustrate learning aspects this encourages creativity.

4. *Culture and identity*

Make learners to research on ways in which they can use the knowledge acquired from the unit in improving the living conditions of their communities. The greatness of a nation lays in the ability of its people to integrate skills and knowledge with national development and growth. Learners should know that knowledge and culture are mutually inclusive

Cross cutting issues

1. *Environmental awareness and sustainability*

Learners should endeavor to keep and maintain a clean environment. By doing this they not only prevent diseases but also be aware of the importance the environment is for sustainability purposes.

2. *Peace and values of education*

Throughout the unit, learners are actively involved in discussing issues as a group. Learners should be made aware of the need to accommodate everyone's ideas and opinions. Through the discussions they will at times agree or disagree on issues at hand. They should be made to embrace the views of others and treat them as a learning process. Any form of intolerance should be highly condemned.

3. *Life skills*

The knowledge of hygiene and diseases is important in life. Learners should be sensitized on the need to maintain personal hygiene to prevent diseases. They should actively participate in communal activities such as: anti-jiggers campaign or cleaning exercises. Involve learners in activities that foster coherence, respect, gender inclusivity and patriotism.

Meaning of new words

- **Sanitation** – The general cleanliness of a person body and the surrounding.
- **Germs** – Micro-organisms that cause diseases.
- **Environment** – The surrounding of a living thing.
- **Food poisoning** - An illness of the stomach that is caused by micro organisms and chemicals
- **Aflatoxin** – A poisonous substance that occurs in grains that have been attacked by fungi.
- **Diagnose** – An exercise carried out by doctors to establish the presence of diseases in a person and the cause.
- **Brine** – A strong salt solution made to preserve food like meat.
- **Breeding** – Reproduction, ways in which organisms becomes many.

1.1 The importance of personal sanitation, home sanitation and food preservation

Refer to learner's book page 1-7

Importance of personal hygiene

Activity 1.1

Refers to learner's book page 1

In groups (communication and critical thinking skills)

1. Review what the learners already know from previous classes concerning hygiene and sanitation. Build on their knowledge to introduce the lesson.
2. Organise learners into convenient groups for a discussion.

3. Group learners into mixed groups to capture diversity in the classroom. The able and less able should be considered too.
4. Move from group to group as learners engage in the discussion. Point out issues to drive the discussion in the right direction.
5. Correct learners politely to achieve the lesson objectives. Be mindful of their ideas, suggestions and opinions on matters relating to personal hygiene.
6. Instruct learners to note down their discussion points.
7. Allow learners to choose one member from each group to do a class presentation of their findings.
8. Listen carefully to each presentation as you ask the class their opinions on each presentation.
9. The group members should be able to defend their findings when challenged by other groups.
10. Build on learner's presentation to explain how to apply the knowledge of hygiene and diseases to personal hygiene.
11. Ask learners to do the fun corner activity. This will bring about their creativity in coming up with captions and solutions to problems on personal hygiene. Let the class choose the learners with the best caption.
12. Summarise the lesson by asking learners to write notes about what they have learnt.

Assessment opportunities

Check whether the lesson objectives have been met by:

(a) Observation and listening

- During the group discussion observe and listen to each and every learner's contribution to the discussion as go to each group. Check for tolerance to others views, commitment and engagement.
- During class presentation look for language command, confidence in defending group findings and ability to convince.

(b) Conversation

Ask learners probing questions to test their knowledge on how to apply knowledge of hygiene and diseases previously leant to personal hygiene.

The learners should discuss the same issues as you gauge their knowledge.

(c) Product

Appraise each learner on:

- Their understanding of how to apply knowledge of hygiene and diseases to personal hygiene.
- How they use knowledge gained to assist others to practice good personal hygiene.

Home sanitation

Activity 1.2

Refer to learner's book page 3

In groups (communication and critical thinking skills)

1. Organise learners into convenient groups for this activity.
2. Provide each group with charts or blackboard diagrams showing how diseases spread.
3. Alternatively show the class a video or Internet videos if resources are available.
4. Each group should study the charts carefully and be able to identify how diseases are transmitted.
5. Each group should discuss how disease transmission is linked to personal hygiene and home sanitation.
6. Guide each group to prepare a news report that they will present in class.
7. Allow them the freedom of choosing group representative who will present the news report in a local language. Let them choose too the group with the best presentation.
8. Ask learners probing questions such as:
    - What is the need for home sanitation?
    - Does knowledge of disease and hygiene help us in home sanitation?

9. Use their presentation to explain how the knowledge of hygiene and disease is applied in home sanitation.
10. Organise for the learners to visit a children's home and help in cleaning and peer teach on personal hygiene and home sanitation methods.
11. Summarise the lesson by asking learners to write short notes on what they have learnt during the lesson.

Assessment opportunities

Check whether the lesson objectives have been met by:

(a) Observation

- During the group discussion observe and listen to each and every learner's contribution to the discussion. Check whether a learner articulates and share their ideas clearly to other group members.
- During class presentation, check for support from group members towards their representative.

(b) Conversation

Ask learners probing questions to test their knowledge on how to apply the knowledge of hygiene and diseases to home sanitation.

(c) Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of hygiene and diseases to home sanitation.
- How they use the knowledge gained to assist others to practice proper home sanitation.

Food safety

Activity 1.3

Refer to learner's book page 5

Individual Activity (communication)

1. Instruct learners to carry out a homework activity of checking food safety at home, in the shops and market place.
2. They should note down their findings and present the work to you for assessment.
3. Use their findings to have a class brainstorming session on the importance of maintaining hygiene when handling and storing food to prevent contamination and spoilage.
4. Encourage learners to contribute during the class discussion.
5. Ask learners to carry out the fun activity suggested. Let them be creative in the poster message about food poisoning.
6. Instruct learners to make a simple grain drier as outlined in the project activity.
7. End the lesson by instructing learners to attempt Check your progress 1.1.

Assessment opportunities

Check whether the lesson objectives have been met by:

Product

- Appraise each learner using his or her write up on food safety assignment. Check also their engagement during the class brainstorming session.
- Let learners pick out the best poster made by the learners in the fun activity and the best grain dryer too.
- Check if learners can attempt to answer all questions in the Check your progress 1.1.

Answer to check your progress 1.1

Refer to learner's book page 7

1. Food remains – given to animals or converted to manure

   Bottles and plastics- recycled

   Papers – burnt

2. Keeping clean through bathing, not sharing personal items, keeping nails short and wearing clean clothes.
3. D
4. Not to handle food. To avoid spread of germs to others.
5. To prevent dirtying their clothes.

1.2 Disease control through hygiene and food preservation

Importance of food preservation

Activity 1.4

Refer to learner's book page 7

Group Activity (communication)

1. Introduce the lesson by asking learners probing questions about the importance of food preservation.
2. Thereafter, organise learners into convenient groups of four for the discussion.
3. In the discussion group, learners should bring out importance of food preservation.
4. Steer each group to bring out the objective of the lesson.
5. Let each group choose one member to present their findings in class. The group representative should be rotational.
6. Use the presentation to have a class discussion on importance of food preservation.
7. Ask learner to do the activity suggested in the fun corner. Let learners compare their work.
8. Instruct learners to use the Internet using phones or computers to do the further activity on controlling diseases. They will write a report and compare their findings in class.
9. Ask learners probing questions such as how knowledge of diseases and hygiene can be used in food preservation.

10. End the lesson by asking learners to attempt check your progress 1.2.
11. Organise for a visit to a food factory and observe how products are preserved and stored.

Assessment opportunities

(a) Observation and listening

During the group discussion observe and listen to each and every learner's contribution to the discussion as go to each group. Check for tolerance to others views, commitment and engagement.

(b) Conversation

Ask learners probing questions to test their knowledge on importance of food preservation. The learners should also talk among themselves on the same issues to gauge their knowledge.

(c) Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of hygiene and diseases to food preservation.
- How they use the knowledge gained to assist others to practice proper food preservation methods.
- How they do Internet research and creativity in come up with cartoon strips in the fun corner.

Answers to check your progress 1.2

Refer to learner's book page 9

1. By maintaining personal hygiene, home sanitation and by practicing proper food preservation methods.
2. To prevent contamination or getting cold.
3. Babies do have a weak immune system, which cannot withstand germs.

1.3 Food preservation methods

Traditional and modern food preservation methods

Activity 1.5

Refer to learner's book page 9

Individual Activity (communication and cooperation)

1. Instruct learners to do research in their locality on how people preserve food.
2. Guide them to come up with a questionnaire to use during the research.
3. They should record their findings in a table format.
4. They will hand their report to you for assessment.
5. Use their findings to have a class discussion on the various methods of food preservation.

Activity 1.6

Refer to learner's book page 11

Class work (communication and cooperation)

1. Organise for a resource person (Public health official) to talk to the class about food preservation methods or a visit to a food storage facility nearby.
2. Help learners come up with a questionnaire they will use to engage the officers in charge.
3. Steer learners' interest to the lesson objectives.
4. They will write a report, which, they will compare with others in class.
5. Expound on their findings to discuss the various storage methods for preserving food.

Activity 1.7

Refer to learner's book page 14

Individual work (communication and cooperation)

1. Instruct learners to visit a nearby shopping centre after school.
2. They will observe and record how market women and men preserve their vegetables and fruits in the open-air market.

3. They will also visit shops that sell cold drinks and ask questions on methods of preservation and write a report.
4. Thereafter they will do a comparison on the methods used in class.

Activity 1.8

Refer to learner's book page 16

Class work (communication and cooperation)

1. Organise to take learners to a big butchery or hotel to observe how food is preserved.
2. Learners should observe how food is preserved and ask questions to the authority concerned.
3. They will note down their findings and present it in class.
4. Use their findings to have a class discussion on food preservation methods.
5. End the lesson by instructing learners to carry out the activity suggested in the fun corner. They will report back to the class their findings.
6. Learners should go further and investigate food preservation methods using Internet.
7. Instruct learners to attempt Check your progress 1.3.

Assessment opportunities

(a) Observation and listening

- During group discussions observe and listen to each and every learner's contribution. Check for tolerance to others views, commitment and engagement.
- During class tours and resource person talks, observe learners' engagement and participation in the discussions, their curiosity to learn new things and words.

(b) Conversation

- Ask learners probing questions to test their knowledge on importance of food preservation methods.
- The learners should also talk among themselves on the same issues to gauge their knowledge.

(c) Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of hygiene and diseases to food preservation methods.
- How they use the knowledge gained to assist others to improve how to preserve food at home.
- Their ability to use the Internet to research.

Answers to Check your Progress 1.3

Refer to learner's book page 18

1.

Method		Principles
(a)	Drying	Dehydrating food
(b)	Use of honey	keeps of germs and air
(c)	Salting	Dehydrating germs

2. Lack of electricity, expensive method
3. To make food stay longer without spoiling.

1.4 Importance of science knowledge in improving personal and food hygiene

Importance of science

Activity 1.9

Refer to learner's book page 18

Class work (communication and cooperation)

1. Introduce the lesson by asking probing question such as:
   - Do you think we can improve sanitation using science knowledge?
   - How will you use your knowledge and skills to improve personal hygiene, home sanitation and food preservation?
2. Thereafter, let learners organise for a class debate. They will divide themselves into two groups. Each group to choose key speakers and a secretary to note down the points.

3. Listen as the debate is taking place, interject occasionally to steer the debate to the lesson objectives.
4. At the end of the class debate, harmonize all points raised with a class discussion.
5. Give learners the suggested further activity to do. They will present a report to you for assessment.
6. Use their presentation to explain some of the diseases we can get due to poor hygiene and sanitation.
7. End the lesson and unit by instructing learners to attempt Check your progress 1.4.

Assessment opportunities

(a) Observation

During group discussion observe and listen to each and every learner's contribution to the discussion.

(b) Product

Appraise each learner on:

- Their understanding of importance of science knowledge in improving personal and food hygiene.
- How they use the knowledge gained to assist others.
- Their ability to use the Internet to research.

Answers to check your progress 1.4

Refer to learner's book page 19

1.
   - Sensitise the community on the need for personal and home sanitation measures to prevent diseases.
   - Use better methods of food preservation.

UNIT 2 Reproduction and sustainability

Refer to learner's book page 20 - 44

Learn about	Key inquiry questions
Learners should investigate in pairs and small groups to understand how reproduction takes place in mammals and birds through a study of second hand material. They should investigate how ovulation occurs and the effect of day length on egg production in some birds and identify signs of ovulation in mammals, and what constitutes effective pre- and post-natal care in humans through discussion with mothers or midwives. They should work in groups to find out, discuss and write about the conditions for a sustainable environment and make a group presentation to the class.	• How does reproduction take place in mammals and birds? • Why should there be effective pre-and post-natal care in humans? • What are the conditions for a sustainable environment for species?

Learning outcomes		
Knowledge and understanding	**Skills**	**Attitudes**
• Explain how reproduction takes place in mammals and birds • Describe effective pre- and post-natal care in humans	• Investigate how the reproduction takes in mammals and birds • Observe, draw and label the structures of reproductive systems	• Appreciate the importance of reproduction in mammals and birds • Show curiosity about their investigation of pre- and post- natal care in humans

	• Record and present their findings	• Show genuine interest as they investigate how reproduction takes place in mammals and birds
Contribution to the competencies: Critical and Creative thinking: how reproduction takes place in both mammals and birds and effective pre- and post-natal care in humans and the structure and functions of the nervous system Co-operation and Communication: observation and investigation in groups		
Links to other subjects: Life Skills: Reproduction Environment and Sustainability: a sustainable environment		

Introduction to the unit

This unit deals with reproduction in animals and birds. Note that the learners at this level have learnt about animals in previous grades. In grade 4 they learnt about grouping of animals, dependency and conservation of animals. Take advantage of this and link it to what they are going to learn in this unit.

The concept in this unit is to enable the learners to understand the process of reproduction and its importance in ensuring continuity of generation. Let learners understand facts about reproduction to break the ambiguity of "Where do young ones come from"?

Reproduction is the key body process that ensures continuity of generations, without reproduction life can come to an end. Different animals reproduce differently. Some animals give birth while others lay eggs. This unit will equip learners with knowledge and skills about reproduction. It will enable the learners to appreciate both the male and the female animals for their role in ensuring continuity of generations. It will help the learners develop a positive attitude towards both genders.

Competences to be attained

1. Co-operation

   Encourage learners to work as a team through group discussions. Allow learners to freely interact with one another. Let them associate with one's culture and abilities through resources sharing and exchange of ideas. The principle of co-operation should be listening to understand but not listening to respond. All learners should be given equal opportunities.

2. Communication

   During group discussion, encourage learners to share their opinions, suggestions and ideas freely. This way they will build on their language command as well as ability to participate in discussions. Ask them questions and give them a chance to attempt answering in the simplest way possible. This way, they will build on their confidence and soon develop the love and passion for the subject. Allow some room for learners to make mistakes and then correct them in nice way lest they will feel demoralized.

3. Critical and creative thinking

   Use probing questions during the lessons to elicit critical thinking in learners. Help them develop a thinking culture as they try to relate the unit with the questions given to them. These questions should however trigger the idea of what they should expect from the unit. Use videos, pictures and photographs to make learners discuss the activities therein. Ask learners to come up with diagrams that illustrate learning aspects this encourages creativity.

4. Culture and identity

   Make learners to research on ways in which they can use the knowledge acquired from the unit in improving the living conditions of their communities. The greatness of a nation lays in the ability of its people to integrate skills and knowledge with national development and growth. Learners should know that knowledge and culture are mutually inclusive

Cross cutting issues

1. Environmental awareness and sustainability

   Learners should be aware that for species sustainability the environmental

conditions must be favourable. Reproduction in animals and plants depends on the environment, therefore conservation of the environment is paramount.

2. Peace and values of education

   Learners should be made aware of the need to accommodate everyone's ideas and opinions. Through the discussions they will at times agree or disagree on issues at hand. They should be made to embrace the views of others and treat them as a learning process. Any form of intolerance should be highly condemned.

3. Life skills

   Learners should appreciate the importance of reproduction in life for sustenance.

Meaning of new words

- **Reproduction** - The process by which a living thing gives rise to a young one of its own kind.
- **Fusion** - Joining of male and female sex cells.
- **Fertilisation** - the fusion of male and female gametes
- **Zygote**-The first cell in the development of a living thing that forms when a male and a female sex cell fuses.
- **Embryo** - A mass of cells that forms when the zygote divides itself
- **Foetus** - A mass of cells with features of the organism such as zygote divides itself.
- **Womb** – also known as uterus. A place where the baby grows in females.
- **Placenta** - A disc shaped organ that forms at the point where the embryo implants itself.
- **Amnion** - A sac that contains amniotic fluid
- **Implantation**-The attachment of the embryo to the uterus wall.
- **Gestation** -The period from conception to birth
- **Parturition** -The process of birth.

2.1 Mammals and their common characteristics

Refer to learner's book page 20

Activity 2.1

Refer to learner's book page 20

Individual work (Communication)

1. In previous classes learners have been taught about animals and their characteristics. Review what they know about mammals and its characteristics.
2. Instruct each learner to carry out the activity as outlined in the learner's book. They should attempt to list characteristics of mammals.
3. Choose a learner to read their findings to the rest of the class. Correct where necessary.
4. Instruct learners to attempt Check your progress 2.1.

Assessment opportunities

Product

Check whether learners can list common characteristics of mammals.

Answers to Check your progress 2.1

Refer to learner's book age 21

1. They all have mammary glands.
2. Mammary glands and take care of their young ones.
3. C
4. Internal fertilisation. In mammals sperms and ova meet and fuse internally.

2.2 Reproduction in mammals

Activity 2.2

Refer to learner's book page 22

Group work (Cooperation)

1. Organise learners into convenient groups.

2. Provide each group with reference materials or take them to the school or public library.
3. Let them carry out the research on reproduction in mammals. Each group will compile a report.
4. Allow the groups to choose a representative to present the group's report. Correct where appropriate.
5. Use learners' presentation reports to have a class discussion on reproduction in mammals.

Activity 2.3 and 2.4

Refer to learner's book pages 22 and 24

Group work (Cooperation)

1. Organise learners into convenient groups; consider resource availability.
2. Provide each group with picture charts or models of the male or female reproductive parts.
3. Instruct learners to observe the diagrams or models and make a drawing of the same in their notebook.
4. They should identify the parts and label them too.
5. They should go ahead and discuss the functions of the various parts and note them in their notebooks.
6. Choose learners randomly to do a presentation of their findings.

Activity 2.5

Refer to learner's book page 26

Pair work (Cooperation)

1. Provide learners with reference materials or the Internet if available. Let them carry out a research on male and female gametes as outlined in the learners book.
2. Thereafter, allow learners to compare their findings.
3. Use their findings to have a class discussion on gametes as learners take notes.

Activity 2.6

Refer to learner's book page 27

Individual work (Cooperation)

1. Instruct learners to carry out the activity as outlined in the learner's book.
2. Let them use the diagrams in learners book page 27 to describe the process of fertilisation.
3. They will answer the questions and share their findings with the class.
4. Use chalkboard diagrams to explain the fertilisation process as learners take notes.

Activity 2.7

Refer to learner's book page 28

Group work (Cooperation and communication)

1. Organise learners into convenient groups.
2. Guide learners in their groups to compare the changes in the two diagrams in the learner's books during the development of the foetus.
3. They will discuss the changes and note down in their notebooks.
4. Challenge them to draw the next two stages in the process of foetus development.
5. Each group should discuss how the developing child gets its food and disposes waste. They should talk about the structures involved.
6. Let them choose one representative to do a class presentation.
7. Build on their presentation to explain the development stages of foetus. Use diagrams and pictures to illustrate this.

Activity 2.8

Refer to learner's book page 32

Class work (Communication and cooperation)

1. Organise for a resource person (a nurse or a midwife) to talk to the learners about the process of birth.
2. Guide learners to prepare a questionnaire they will use for engaging the resource person.

3. Instruct learners to write short notes during the talk.
4. Check learners' work for assessment.
5. Instruct learners to attempt Check your progress 2.2

Assessment opportunities

(a) Observation and listening

- During group discussions observe and listen to each and every learners contribution to the discussion. Check for sharing of ideas, commitment to group work and relevancy to the topic of discussion.
- Observe learners when engaging with the resource person, they should be engaging and participate in the discussions. They should also display curiosity in learn new things and words.

(b) Conversation

- Ask learners probing questions to test their knowledge, understanding and appreciation of the reproduction process.
- The learners should also brainstorm among themselves on the same issues to gauge their knowledge.

(c) Product

Appraise each learner on:

- Their understanding and attitude towards reproduction and the process involved.
- How well they draw diagrams and label the parts correctly.
- Their ability to use the Internet and reference books to do research.

Answers to Check your progress 2.2

Refer to learner's book page 34

1. (a) Ovulation
   (b) Fertilisation
   (c) Uterus – development of the embryo
   (d) Copulation, Provides passageway for birth, Serves as passageway for cevical mucus, menstrual fluid and other secretions
2. Produces ova (alternately) monthly.

2.3 Ovulation

Activity 2.9

Refer to learner's book page 35

Individual work (Communication)

1. Provide learners with reference materials or the Internet if available.
2. Guide learners to do research on the process of ovulation in females.
3. They will write a report and compare their findings with other class members.
4. Build on their presentation to explain the process of ovulation in females as they write short notes.

2.4 Reproduction in Birds

Activity 2.10

Refer to learner's book page 36

Class work (Communication and cooperation)

1. Arrange for learners to visit a nearby chicken farm. Alternatively learners can do this activity at home.
2. The learners should monitor a brooding hen till it hatches. They should observe and record its behaviour. This is a project activity that will run for about a month. It should be planned in advance.
3. Provide learners with picture charts or video of the process of reproduction in birds.
4. They will use the materials provided to learn about reproduction in birds.
5. Each learner will write a report and share their findings with the class.
6. Build on their findings to explain reproduction in birds.
7. Instruct learners to do the fun corner activity suggested. They will pick the best-drawn picture and hang in the class notice board.
8. Learners should attempt Check your progress 2.3.

Assessment opportunities

Product

Check each learners project report on reproduction in birds.

Answers to Check your progress 2.3

Refer to learner's book page 38

1. Both male and female gametes must be involved in reproduction.
2. iii, ii, i, iv, v
3. To provide warmth required by the developing embryo.

2.5 Characteristics of good childcare and support

Activity 2.11

Refer to learner's book page 39

Pair work (Communication and cooperation)

1. Organise a visit to a health centre where expectant and nursing mother are attended.
2. Let learners have a talk with the nurse or midwife.
3. Guide learners in coming up with a questionnaire to use during the visit to a health centre.

   Caution: The learners should avoid touching things and surfaces to avoid contracting diseases.

   Note: Alternatively provide learners with a chart, pictures of expectant and nursing mother or an immunisation card.
4. Give learners worksheet of blank immunisation schedule. Ask learners to use their immunisation card to fill. Below is a sample immunisation schedule. Each learner will fill his or her immunisation details. Let them compare what they have with the table below.

Age	Diseases	Vaccines
Birth	Tuberculosis Polio	B.C.G OPVI

6 weeks	Polio Diptheria Pertusis Tetanus	OPV II DPT I
10 weeks	Polio Diptheria Pertusis Tetanus	OPV III DPT II
14 weeks	Polio Diptheria Pertusis Tetanus	OPV IV DPT III
9 months	Measles Yellow fever	Anti measles Anti yellow fever

5. Ask learners probing questions concerning prenatal and postnatal care and the importance of immunisation.
6. Build on their findings to explain the importance of immunisation, prenatal and postnatal care.
7. Ask learners to carry out the fun corner activity in pairs. Let them be creative.
8. Instruct learners to attempt Check your progress 2.4.

Assessment opportunities

Product

Assess learners' attitude towards the need for immunisation, prenatal and postnatal care.

Answers to check your progress 2.4

Refer to learner's book age 41

1. (a) Prenatal care is care given before the mother gives birth. It is important because:

- The mother is advised about the diet to take.
- She is warned against taking drugs and medicines without the doctor's advice.
- The babies' position and health is checked.
- She is advised about hygiene during pregnancy.
- The health of the mother is checked. She is immunized against tetanus too

(b) Post-natal care is care given to the mother and her child after delivery.

- The mother is advised on her diet and that of the child.
- She is advised about her hygiene and that of the baby.
- She is advised about the immunization schedule for the child.
- The health of the mother and the child is checked.
- The mother is advised on the importance of breast milk and if she is HIV positive she is advised not to breast feed but give the child alternative milk.

2. The health of the mother and child at risk.

2. 6 Conditions for a sustainable environment

Activity 2.12

Refer to learner's book page 41

Class work (Critical thinking)

1. Provide learners with picture charts or video that shows diversity in plants and animals.
2. Each learner will study the pictures to identify the components of the environment (biotic and abiotic factors).
3. Guide them to identify and pick out the components from the picture charts and video if available.
4. Build on their findings to have a class discussion on ways of sustaining the environment as they write short notes.
5. Ask learners to carry out the fun corner activity. What was their experience?
6. Instruct learners to attempt Check your progress 2.5.

Assessment opportunities

Product

Check if learners are able to identify and explain environmental components and ways of sustaining the environment.

Answers to Check your progress 2.5

Refer to learner's book page 44

(a) Across

1. Plant
2. Air
3. Maize
3. Lake

(b) Down

1. Pollination
3. Animals
3. Water

UNIT 3

Interdependence between Plants and Animals

Refer to learner's book page 45 - 62

Learn about	Key inquiry questions
Learners should understand the processes of respiration and photosynthesis by developing on their prior learning about energy production and use. They should understand that respiration takes place in the cells of all living things and involves the breakdown of food using oxygen to liberate energy and produce carbon dioxide as a bi-product. They might compare this with burning and understand that humans breath in air containing oxygen and exhale air with a high carbon dioxide level.They should know that the reverse process of photosynthesis occurs in green plants in which carbon dioxide and water are converted to sugars which form the basis of all other carbon products. This represents the most significant difference between animals and plants. Learners should carry out practical investigations to inform their understanding of these processes, and develop an understanding about the carbon cycle and the interdependency of living organisms.	• Why is it important to understand the processes of respiration and photosynthesis? • How would you differentiate between plants and animals? • How do we explain interdependency between plants and animals? • How do the processes of respiration and photosynthesis relate to each other?

Learning outcomes		
Knowledge and understanding	**Skills**	**Attitudes**
• Understand the processes of respiration and photosynthesis • Describe the differences between plants and animals • Explain interdependence between plants and animals	• Compare the different characteristics of plants and animals • Design simple tests to find out how different conditions effect photosynthesis • Record and present findings.	• Show curiosity about how the processes of respiration and photosynthesis occur • Appreciate the interdependence between plants and animals • Co-operation and team work spirit while working in groups
Contribution to the competencies: Critical and Creative thinking: the processes of respiration and photosynthesis, the differences between plants and animals, and interdependence between plants and animals Co-operation and Communication: observation and investigation		
Links to other subjects: Environment and Sustainability: interdependence		

Introduction to the unit

Learners have studied plants and animals before. In Primary 4 they learnt about grouping animals based on feeding habits, how organisms depend on each other, conservation of plants and animals and dangers of destroying forest and killing wild animals and its impact on human life. Link what they are learning with their past experience about plants and animals. The concept in this unit is to enable learners to understand the importance of respiration and photosynthesis, differentiate plants from animals and understand how plants and animals depend on each other and to know how photosynthesis is related to respiration. This topic is linked to environment and sustainability.

Interdependency ensures sustainability in the environment. Organisms depend on each other for survival. They may depend on each other for food, habitat and shade and medicine. Understanding the importance of interdependency will enable learners to take care of the environment and therefore ensures sustainability. The information in this unit will help the learner to develop a positive attitude toward all organisms in the environment. They will also appreciate all the process that takes place in the bodies of organisms.

Competences to be attained

1. Co-operation

   Allow learners to freely interact with one another. Let them associate through resources sharing and exchange of ideas. The principle of co-operation should be listening to understand but not listening to respond. All learners should be given equal opportunities.

2. Communication

   During group discussion, encourage learners to share their opinions, suggestions and ideas freely. This way they will build on their language command as well as ability to participate in discussions. Ask them questions and give them a chance to attempt answering in the simplest way possible. This way, they will build on their confidence and soon develop the love and passion for the subject. Allow some room for learners to make mistakes and then correct them in nice way lest they will feel demoralized.

3. Critical and creative thinking

   Use probing questions during the lessons to elicit critical thinking in learners. Help them develop a thinking culture as they try to relate the unit with the questions given to them. These questions should however trigger the idea of what they should expect from the unit. Use videos, pictures and photographs to make learners discuss the activities therein. Ask learners to come up with diagrams that illustrate learning aspects this encourages creativity.

4. Culture and identity

   Make learners research on ways in which they can use the knowledge acquired from the unit in improving the living conditions of their communities. The greatness of a nation lays in the ability of its people to integrate skills and

knowledge with national development and growth. Learners should know that knowledge and culture are mutually inclusive

Cross cutting issues

1. Environmental awareness and sustainability

   Learners should be aware that plants and animals depend on each other for survival and both living and non-living things too sustain each other. Therefore, the environmental conditions need to be favourable for their sustenance. Its upon everyone to take care of the environment.

2. Peace and values of education

   Throughout the unit, learners are actively involved in discussing issues as a group. Learners should be made aware of the need to accommodate everyone's ideas and opinions. Through the discussions they will at times agree or disagree on issues at hand. They should be made to embrace the views of others and treat them as a learning process. Any form of intolerance should be highly condemned.

3. Life skills

   Learners should appreciate the importance of plants and animals and their interdependence.

Meaning of new words

- **Photosynthesis** – the process by which green plants make their own food.
- **Respiration** – the process by which food is chemically 'burnt' using oxygen to release energy.
- **Energy** – ability to do work
- **Exhale** – breath out
- **Inhale** – breath in
- **Cell** – the smallest unit of an organisms
- **Oxidation** – chemical burning of food
- **Interdependency** – the dependency of organisms upon each other for survival
- **Chlorophyll** – the green colouring matter in plants.
- **Organism** – a living thing.

3.1 The process of respiration

Refer to learner's book page 45

Activity 3.1 and 3.2

Refer to learner's book page 45 and 46

Class work and in pairs (Communication, cooperation and critical thinking)

1. Introduce the lesson by asking learners probing questions about respiration. Thereafter, engage learners in some small exercises in class or outside the class.
2. Instruct learners to note their breathing rate and discuss why there is change.
3. Provide learners with textbooks for reference or computers with Internet if available.
4. Guide learners in a class discussion using the questions in the activity.
5. Each learner to write a report.
6. Ask learners in groups to study the diagram shown in the learner's book page 46 and answer the questions.
7. Allow learners to choose a member to do a class presentation of their findings.
8. Let learners choose two members to role-play the conversation in class as the rest listen carefully.
9. Thereafter, have a class discussion concerning the role-play.
10. Build on their understanding to explain the process of respiration as they take short notes.
11. Ask learners to be creative when doing the suggested activity in the fun corner. They will choose the best and funny diagram drawn.
12. End the lesson by instructing learners to attempt Check your progress 3.1.
13. Encourage learners to join environmental club and participate in conservation activities

Assessment opportunities

(a) Observation and listening

During class discussions, check each learner's participation and contribution. Look for sharing ideas, commitment to class activity and cooperation.

Observe learners as they listen to the role-play. They should display curiosity in learning new things and words.

(b) Conversation

- Ask learners probing questions to test their attitude, understanding and appreciation of the respiration process.
- The learners should also brainstorm among themselves on the same issues to gauge their knowledge.

(c) Product

Appraise each learner on:

- Their curiosity towards the process of respiration.
- How well they interpret the respiration equations correctly.
- Their ability to use the Internet and reference books to do research.

Answers to check your progress 3.1

Refer to learner's book page 49

1. More, less
2. Carbon dioxide, oxygen
3.

Respiration	Reactants	Products
Respiration	Oxygen	Carbon dioxide
Photosynthesis	Carbon dioxide, sun light	Oxygen

4. To provide the body with the much needed oxygen for respiration.

3.2 The process of photosynthesis

Activity 3.3 and 3.4

Refer to learner's book pages 50

Class and group work (Communication, cooperation and critical thinking)

1. Introduction the lesson by reviewing what the learners know about plants and photosynthesis.

2. Ask learners to name parts of a green plant and their function. Display a chart of a green plant and ask pupils to identify the parts marked with letters.
3. Have a class discussion on photosynthesis as learners ask each other questions on the same.
4. Thereafter, ask learners to group themselves according to availability of resources to do the experiment.
5. The learners should assist you in collecting materials. Use locally available materials and improvise where possible.
6. Guide learners in carrying out the procedure as outlined in their books.
7. Instruct them to use the study questions to discuss and write a report of their findings.
8. Let each group choose a representative to do a class presentation.
9. Build on their presentations to explain the process of photosynthesis in details.
10. Ask learners to do the Further Activity suggested in the learner's book. They will present their findings in class. Have a class discussion on the same.
11. Instruct learners to attempt Check your progress 3.2.
12. Encourage learners to participate in tree planting. Ask the learners to share their knowledge and skills with community members.

Assessment opportunities

(a) Observations

Check each learner during the group activity to observe his or her attitude and skills during the experiment. They should display willingness to learn, participate and cooperate.

(b) Conversation

Ask learners to brainstorm as they carry out the experiment and study questions.

(c) Product

Each learner should be able to describe the process of photosynthesis.

Answers to Check your progress 3.2

Refer to learner's book page 53

1. A
2. When carbon dioxide is in excess the rate of photosynthesis will increase to a certain level.
3. The glucose is used in respiration, or converted into starch and stored. Oxygen is produced as a by-product which is released.
4. (a) The rate of photosynthesis increases with increase in the amount of carbon dioxide and temperature levels.

   (b) Enables the farmer to increase his or her yield.

3.3 Relationship between photosynthesis and respiration

Activity 3.5

Refer to learner's book page 54

Group work (Communication and critical thinking)

1. Organise learners into groups.
2. Let them study the diagram provided.
3. Guide them in discussing the relationship between photosynthesis and respiration as in the diagram.
4. Allow them to choose one member to present the group findings.
5. Build on their presentations to explain the difference between photosynthesis and respirations as they take notes.
6. Instruct learners to attempt Check your progress 3.3.

Assessment opportunities

Product

Learners should be able to differentiate between photosynthesis and respiration.

Answers to check your progress 3.3

Refer to learner's book page 55

Across

1. Carbon dioxide
3. Photosynthesis
4. Respiration

Down

2. Atmosphere
5. Oxygen

3.4 The difference between plants and animals

Activity 3.6

Refer to learner's book page 56

Pair work (Communication, cooperation and critical thinking)

1. Ask learners to state the characteristics of plants and animals based on their past experience. Show them diagrams, pictures and videos if available.
2. Let learners' pair up to carry out this activity.
3. Guide them in using the questions in their books during their discussion.
4. Ask learners to state the characteristics that are not common.
5. Build on their findings to discuss the difference of plants and animals as they take notes.

Activity 3.7

Refer to learner's book page 57

Class debate (communication)

1. Ask learners to divide into two groups.
2. Allow them to choose their debating representatives and two members to record their points.
3. Listen to their arguments during the debate and interject occasionally to direct the proceedings in the right direction.

4. Thereafter, instruct learners to do the further activity suggested in the learners book and report their findings to you.
5. Instruct learners to attempt Check your progress 3.4.

Answers to Check your progress 3. 4

Refer to learner's book page 58

1. Animals move to look for food, mates and shelter. Run away from predators and unfavourable conditions.
2. Senses and cellular structure

3.5 Interdependence between plants and animals

Activity 3.8

Refer to learner's book page 58

Group work (Cooperation and critical thinking)

1. In groups, guide learners in studying the food pyramid diagram and answering questions as outlined in the activity.
2. Each group will write a report and present it to you for assessment.
3. Use their findings to have a class discussion on interdependence between plants and animals.
4. Give learners the suggested further activity and fun corner.
5. Organise a visit to a farm where bees are kept. Ask learners to find out the reason for bees in the farm.
6. End the lesson by instructing learners to attempt Check your progress 3.5.

Assessment opportunities

(a) Observations

Check each learner during the group activity, class discussions and debate to observe their attitude. They should display willingness to learn, participate and cooperate.

(b) Conversation

Ask learners to brainstorm on the study questions. This way they get to learn from each other.

(c) Product

Learners should be able to give the characteristics of plants and animals, and describe the interdependence between plants and animals.

Answers to Check your progress 3.5

Refer to learner's book page 62

1. Check for a well-drawn and explained diagram.
2. It is used as food, fodder, dye and source of energy.
3. Nature will not function and life will stop on earth.
4. Pollination and manure, food and shade.

UNIT 4

Weather and Climate

Refer to learner's book pages 63 - 89

Learn about	Key inquiry questions
Learners should revisit their prior learning and experience of weather and develop a scientific understanding about how weather occurs as a result of changes in air pressure caused by differential heating of the planet by the sun and the movements of water in the oceans. They should work in groups to carry out investigations about the relationship between temperature, pressure and the volume of air and explain this in terms of particles, and the mass flow of air from areas of high to low pressure. They should explore the notion of a vacuum and its stability and properties, such as an insulator used in conservation of heat, and use their knowledge to explain how heat is lost from the surfaces of objects and animals and how it can be conserved by insulation, and in the case of animals by fur and feathers. This may not be an issue in South Sudan but it is important where the weather is more variable and often wet and cold. Learners should use their scientific knowledge to explain how the weather and climate change determine human activities in different parts of Africa and the world generally. In particular they should explain the scientific principles behind the conservation of water and how this might be improved to sustain human activity.	• How do we differentiate between weather and climate? • How does weather and climate affect land use and human population in South Sudan? • Why is there concern about water and its conservation? • How can we explain the relationship between temperature, pressure and volume of air? • Why is there no life in vacuum?

Learning outcomes		
Knowledge and understanding	**Skills**	**Attitudes**
• Explain the environmental concern about water and describe conservation strategies • Differentiate between weather and climate; describe their effects on land use and human populations • Explain the relationship between temperature, pressure and volume of air, the concept of a vacuum • Describe how heat is conserved	• Investigate the relationship between temperature, pressure and volume of air by: • Observing carefully • Predicting what might happen • Using appropriate measures • Collecting and presenting results appropriately in writing or drawing • Interpreting results accurately • Reporting findings appropriately	• Appreciate the relationship between temperature, pressure and the volume of the air • Show curiosity about the differences between weather and climate and how it affects land use and human population • Co-operation and team work spirit
Contribution to the competencies: Critical and Creative thinking: water conservation strategies, weather and climate and how it affects land use and human populations as well as the relationship between temperature, pressure and volume of air Co-operation and Communication: group working		
Links to other subjects: Environment and Sustainability: climate change		

Introduction to the unit

Note that learners at this level have already been taught about weather in Primary 5 and 6. While in Primary 5 the learners were taught how to construct simple weather

instruments and the aspects that they measure and how wind is formed and its importance. In Primary 6 the learners were taught about the water cycle and how weather affects human activities. The concept in this unit is to enable learners have a better understanding of the relationship between weather and climate and how they affect land use and population in South Sudan. Show curiosity on the need to conserve water and appreciate the relationship between temperature, pressure and volume of air.

Proper knowledge on weather and climate is very important because they directly or indirectly affect our day-to-day activities such as the clothes we wear. The weather and climate of a place determines the type of crops to be grown. This unit will help the learners to understand the need to conserve water and develop interest in conserving water e.g. help clean water bodies, mulch crops in their school garden etc. The learner will realise that preventing pollution of water and other parts of the environment will prevent diseases such as water borne diseases. The unit will enable the learners explain how changes in temperature, pressure and volume of air affects weather and climate

Competences to be attained

1. Co-operation

   Let learners associate with one's culture and abilities through resources sharing and exchange of ideas. The principle of co-operation should be listening to understand but not listening to respond. All learners should be given equal opportunities.

2. Communication

   During group discussion, encourage learners to share their opinions, suggestions and ideas freely. This way they will build on their language command as well as ability to participate in discussions. Ask them questions and give them a chance to attempt answering in the simplest way possible. This way, they will build on their confidence and soon develop the love and passion for the subject. Allow some room for learners to make mistakes and then correct them in nice way lest they will feel demoralized.

3. Critical and creative thinking

   Use probing questions during the lessons to elicit critical thinking in learners.

Help them develop a thinking culture as they try to relate the unit with the questions given to them. These questions should however trigger the idea of what they should expect from the unit. Use videos, pictures and photographs to make learners discuss the activities therein. Ask learners to come up with diagrams that illustrate learning aspects this encourages creativity.

4. Culture and identity

   Make learners research on ways in which they can use the knowledge acquired from the unit in improving the living conditions of their communities. The greatness of a nation lays in the ability of its people to integrate skills and knowledge with national development and growth. Learners should know that knowledge and culture are mutually inclusive

Cross cutting issues

1. Environmental awareness and sustainability

   Learners should be aware that weather and climate affects land use and human populations. They should therefore, strive to conserve the environment for a better future.

2. Peace and values of education

   Throughout the unit, learners are actively involved in discussing issues as a group. Learners should be made aware of the need to accommodate everyone's ideas and opinions. Through the discussions they will at times agree or disagree on issues at hand. They should be made to embrace the views of others and treat them as a learning process. Any form of intolerance should be highly condemned.

3. Life skills

   Learners should appreciate the importance of weather and climate to the environment.

Meaning of new words

- **Weather** – it is the daily changes that occur in the environment.
- **Climate** – it is the observation of the weather of a place over a long period of time usually between 30 and 35 years.
- **Atmosphere** – the air that surrounds the earth.

- **Pressure** – the force that is exerted by a substance e.g. air pressure is the force that air exerts either between in a closed containers or in the atmosphere.
- **Global warming** – a condition brought about by increase in amount of heat on earth due to increase in amount of carbon dioxide on earth.
- **Photosynthesis** – it is the process by which green plants make their own food in the presence of sunlight and carbon dioxide.
- **Malnutrition**- it is nutritional deficiency disease that is brought about by lack of enough of a balanced diet (total starvation).
- **Conservation** – using something sparingly and in a way that it is not wasted in any way
- **Mulching** – spreading dry grass or leaves on the soil to completely cover it , it mainly reduces the amount of soil , water wasted through evaporation.
- **Irrigation** – it is the artificial supply of water to crops in the absence of rainfall.
- **Molecules** – are small particles that make up all matter. Liquids, solids and gases
- **Vacuum** –A space that does not have any matter. It has no solid, liquid or gases.

4.1: Differences between weather and climate

Activity 4.1 and 4.2

Refer to learner's book pages 63 and 64

Group and individual work (communication)

1. Start the lesson by reviewing what the learners already know about weather and climate.
2. Show them pictures of weather instruments; let them identify the weather instruments and the aspect they measure.
3. With the help of the chart and chalkboard drawings ask learners to identify signs of different aspects of weather.
4. Take the learners out into the school environment and ask them to record some weather changes in the atmosphere.
5. Provide learners with a set of data on temperature for a particular area. Guide learners as they carry out the activity as outlined in the learner's book.

6. Let each group find for themselves the difference between weather and climate and note their findings as required.
7. Allow each group to choose a representative to do a class presentation of their findings.
8. Build on their presentation to explain the difference between weather and climate.
9. Instruct learners to learn and recite the poem to the class and school.
10. Ask learners to do the activity suggested in the fun corner and compare their findings.
11. Learners should do the further activity suggested in the learner's book. They should compare their findings in class.
12. Instruct learners to attempt Check your progress 4.1.

Assessment opportunities

Product

Check if learners are able to differentiate between weather and climate by asking probing questions such as:

- What is the difference between weather and climate?
- What sign can you use to predict a possibility of heavy rain falling?
- What causes global warming?

Answers to Check your progress 4.1

Refer to learner's book page 69

1. (a) Temperature
   (b) Rain
   (c) Strength of wind
   (d) Wind direction
   (e) Air pressure
2. (a) False
   (b) True
   (c) False

3. (a) Sunny and partly cloudy

   (b) Rainny

   (c) Rainny and thunder storm

   (d) Calm

4. The sun is always overhead in the equator

5. (i) True

   (ii) False

   (iii) False

6. The temperatures are generally high throughout the year with a dip during the rainy season.

   The rains are spread across the year with the peak around the months of April to October.

4.2 How weather and climate affect land use and human population South Sudan

Activity 4.3

Refer to learner's book pages 70

Class work (communication and cooperation)

1. With the help of charts, pictures, photographs, newspapers, magazine cuttings, videos (where possible), lead the learners in understanding how weather and climatic changes affect land use and subsequently human population in South Sudan.

2. Help the learner's in realising how weather and climate changes are associated with natural disasters such as drought, famine, floods and human population in South Sudan.

3. Organise for a resource person (meteorologist) to give learners a talk about weather and climate in South Sudan.

4. Ask learners to prepare a questionnaire they will use when engaging the resource person.
5. Instruct them to take notes and thereafter compare them.
6. Lead learners in a discussion on the effects of floods, famine on human population in South Sudan.
7. Review the lesson by asking probing questions to find out if the objectives were achieved. For example:
   (a) Does the weather and climate affect land use in an area?
   (b) What is the main economic activity do the people of South Sudan engage in?
   (c) List down two factors that are likely to affect human population of a place.
   (d) Name three diseases that are likely to be caused by floods

Answers to probing questions

   (a) Yes the type of crops and the animals kept in an area sorely depend on weather and climate and large agriculture entirely depend on weather and climate.
   (b) A large population of South Sudan mainly depend on agriculture however a small percentage depends on livestock.
   (c) Floods, food insecurity may be due to famine
   (d) Cholera, bilharzia, malaria

8. Instruct learners to attempt Check your progress 4.2.

Assessment opportunities

Product

Check if learners are able to explain how weather and climate affect land use and human population in South Sudan.

Answers to check your progress 4.2

Refer to learner's book page 73

1.

T	E	A	V	A	S	S	A	C	P	Q	**R**
S	**U**	**N**	**F**	**L**	**O**	**W**	**E**	**R**	E	R	**I**
A	I	S	O	R	G	H	U	M	A	X	**C**
Y	A	H	I	J	M	L	K	I	N	N	**E**
A	M	A	S	N	O	M	E	L	U	O	P
E	G	G	P	L	A	N	T	L	T	I	Q
T	**O**	**B**	**A**	**C**	**C**	**O**	B	E	A	N	S
S	E	S	A	M	E	**C**	**O**	**T**	**T**	**O**	**N**
C	B	A	**B**	**A**	**N**	**A**	**N**	**A**	S	D	A
P	C	F	V	U	R	S	T	N	Z	G	S
E	W	X	Y	E	E	F	F	O	C	M	N

2. D

3. (i) Immigration of people

   (ii) Disease out breaks

   (iii) Soil erosion

   (iv) Malnutrition and high mortality rate due to lack of food

4. (a) False

   (b) True

   (c) True

5. Lack of enough postures for livestock due to lack of enough rainfall.

6. Check for a variety of workable ideas and suggestions.

4.3 Conservation of water

Activity 4.4

Refer to learner's book page 74

Individual work (communication and cooperation)

1. Give learners homework as outlined in the learner's book. Instruct them to carry out a research in their neighborhood on water conservation methods.
2. They will record their findings and compare them with others in class.
3. Thereafter, have a class discussion on water conservation methods as they take notes.
4. Ask learners to do the activity suggested in the fun corner.

Activity 4.5

Refer to learner's book page 78

Group work (communication and cooperation)

1. Organise learners into groups to carry out the activity.
2. Let them discuss concerns about water and its conservation.
3. Move from group to group to make sure the subject topic is adhered to.
4. Ask learners to draw a pie chart of water usage at home and do a comparison with the one shown in their book.
5. Build on their findings to discuss importance of water conservation.
6. Conclude the lesson by asking probing questions such as:
    - Do you think conserving water is important?
    - Is there any need to prevent water pollution?
    - Do you harvest rainwater in your homes?
    - What is the role of mulching in water conservation?

Assessment opportunities

(a) Observations

Check each learner during the group activity and class discussions to observe their attitude. They should display willingness to learn, participate and cooperate.

(b) Conversation

Ask learners to discuss ways of conserving water. This way they get to learn from each other.

(c) Product

Learners should be able to describe water conservation methods and its importance.

Answers to check your progress 4.3

Refer to learner's book page 80

1. a) False b) False c) True
2. D
3. Increase in population
4. Check for good suggestions
5. This will allow water to run down into the soil and reach the roots of the plant without too much excess water lost to evaporation. Watering in the early morning will also make the water available to the plants throughout the day so that the plants will be able to deal better with the heat of the sun.

4.4 Relationship between temperature, pressure and volume of air

Activity 4.6

Refer to learner's book page 81

Group work (communication, cooperation and critical thinking)

1. Provide learners with materials needed for the experiment. They will assist you in collecting some of the materials locally.
2. Guide learners as they conduct experiments that will enable them discover the relationship between temperature, pressure and volume of air as in the

learner's book.

3. Each group will present its findings to the class.
4. Build on their presentation to have a class discussion. Use graphs and diagrams to enhance the learning experience.
5. Ask learners to carry out the fun corner activity suggested.
6. Wind up the lesson by asking probing questions randomly to find out if the learners understood the concept for example:
   (a) How is wind formed?
   (b) How is air temperature related with the volume of air?
   (c) How does changing the volume of air affect the air temperature?
   (d) Explain briefly the relationship between temperature, pressure and volume of air.

Answers to probing questions

(a) Wind is formed when air moves from a region of high pressure to a region of low-pressure.

(b) When the temperature of air is increased, the air expands, this means that the volume of the air increases. When the temperature is decreased, the air contracts which means that its volume decreases.

(c)
- When the volume of air in a closed container is increased, its pressure increases. When the volume decreases the pressure decreases.
- When the volume of air in the atmosphere increases the pressure decreases and vice versa.

(d) When the temperature of air in the atmosphere is increased its volume increases, this decreases its pressure.

7. Instruct learners to attempt Check your progress 4.4.

Assessment opportunities

Product

Check if learners are able to describe the relationship between temperatures, pressure and air volume.

Answer to Check your progress 4.4

Refer to learner's book page 85

1. (a) Volume is the space that matter occupies.

   (b) Temperature is the hotness or coldness of a substance.

   (c) Pressure is the force that matter exerts on a certain area in other words pressure is force per unit area.

2. (a) False

   (b) False

   (c) True

   (d) True

   (e) True

3. B

4. When water is heated it turns into vapour, which expands. The expansion will cause the sealed container to burst.

5. When you increase pressure volume reduces.

4.5 Vacuum

Activity 4.7

Refer to learner's book page 86

Group Activity (Critical thinking)

1. With the help of charts and chalkboard drawings, lead the learners to discover that matter is anything that has weight and occupies space. In the process they will realise that a vacuum is a space that does not have any matter.

2. Let the learners realise that plants and animals cannot survive without water (Liquid), oxygen or carbon dioxide (air). Which are deficient in vacuum, the reason as to why there can be no life in a vacuum.

3. Provide materials for the activity and let learners carry out the activity as outlined in their books.

4. Thereafter have a class discussion on vacuums.

5. Encourage learners to wear heavy jackets whose inside is lined with fur, wool or cotton during the cold weather. Fur, wool, cotton insulates us against heat loss when it is cold.
6. Find out if the objectives were achieved by asking probing questions such as:
   (a) Why do whales have a thick layer of fat covering their skin?
   (b) What is the purpose of the layer of clay that is found in an improved charcoal stove?
   (c) Explain how the vacuum in a vacuum flask prevent loss of heat.
   (d) How does tea in a cup lose heat?

Answers to probing questions

(a) The thick layer of fat prevents loss of heat since fat is a poor conductor of heat. (Insulator).

(b) Clay is a poor conductor of heat (insulator) therefore prevents loss of heat to the atmosphere.

(c) The vacuum having no matter prevents loss of of heat through conduction or convection as there is no solid or liquid.

(d) Tea in a cup loses heat by conduction, radiation and convection

Answer to check your progress 4.5

Refer to learner's book page 88

1. A
2. D
3. D
4. C
5. Radiation

UNIT 5

Acids, Bases and Indicators

Refer to learner's book pages 90 - 101

Learn about	Key inquiry questions
Learners should investigate the properties and uses of acids, bases and indicators through practical activities. They should develop an understanding about pH as a measure of acidity and design fair tests to find out the acidity of and action of weak acids on common substances such as baking soda. They may design fair tests to find out whether more acid changes reactions. They should know about risk assessment and safety rules when handling chemicals, and take appropriate safety precautions.	• How do we identify the properties of acids, bases and indicators? • How could we classify common substances as acids and bases? • How can we use indicators to find out the strength of an acid? • How do we use indicators to determine acidity and find the neutral point?

Learning outcomes		
Knowledge and understanding	**Skills**	**Attitudes**
• Describe common properties and uses of acids and bases; the uses of indicators	Investigate acids and bases and the use of indicators by: • Observing carefully • Predicting what might happen	• Show curiosity about the uses of acids, bases and indicators • Appreciate the properties and uses of acids, bases and indicators

	• Using appropriate measures • Collecting and presenting results appropriately in writing or drawing • Interpreting results accurately • Reporting findings appropriately	• Co-operation and team work spirit
Contribution to the competencies: Critical and Creative thinking: the common properties and uses of acids, bases and indicators Co-operation and Communication: investigation and discussion		
Links to other subjects:		

Introduction to the unit

It is important to note that learners have come across acids and bases in their day-to-day activities. They have used in previous investigations substances such as lemons, oranges, ash, antacids and flowers. These substances will be important as they carry out the activities in this unit.

Link their past experience with such materials in what they are learning in this unit. Let the learners understand that by gaining knowledge and skills about acids and bases they may become teachers, pharmacists or industrialists. Give them examples of situations and experiences where acids, bases and indicators are applied in life.

The knowledge of properties of substances such as acid and bases is important in ensuring safety. Some substances have properties that have negative effect on both living and non-living things, for example, acidic substances kills living organisms and corrodes things like iron sheets.

In this unit learners will carry out investigations on properties of acids, bases and indicators. They will therefore gain knowledge and skills to enable them classify substances as acidic or basic. The information will help the learners to take precautions when dealing with such substances.

Competences to be attained

1. Co-operation

   Encourage learners to work as a team through group discussions. Allow learners to freely interact with one another. Let them associate with one's culture and abilities through resources sharing and exchange of ideas. The principle of co-operation should be listening to understand but not listening to respond. All learners should be given equal opportunities irrespective of their abilities. Ensure each learner enjoys the learning experience.

2. Communication

   During group discussion, encourage learners to discuss in English. This way will build on the command for the language as well as ability to participate in other discussions. Ask them questions and give them a chance to attempt answering in the simplest way possible. This way, they will build on their confidence and soon develop the love and passion for the subject. Allow some room for learners to make mistakes and then correct them in nice way lest they will feel demoralized.

3. Critical and creative thinking

   Introduce the unit by posing general questions to the learners they try to look for the answers to these questions, you will make them develop a thinking culture as they try to relate the unit with the questions given to them. These questions should however trigger the idea of what they should expect from the unit. Present photographs and make learners discuss the activities in that photograph, they give out their findings and you will be building a thinking habit in them.

4. Culture and identity

   Make learners to research on ways in which they can use the knowledge acquired from the unit in improving the living conditions of their communities. The greatness of a nation lays in the ability of its people to integrate skills and knowledge with national development and growth. Learners should know that knowledge and culture are mutually inclusive.

Cross cutting issues to be incorporated

1. Environmental awareness and sustainability

   Acids and bases affect our environment significantly by altering it. These alterations may be beneficial in some cases, while in others, maybe harmful.

   Acids and bases occur naturally in the environment, most commonly in the soil and water.

   Depending on the presence of acids and bases, soils may be acidic, basic or neutral. Therefore affect organisms that prefer such environments. This also affects the type of plants that can grow in that environment. Similarly water in natural streams can also be acidic, basic or neutral. Affecting life of organisms in it.

2. Peace and values of education

   Throughout the unit, learners are actively involved in discussing issues as a group. Learners should be made aware of the need to accommodate everyone's ideas and opinions. Through the discussions they will at times agree or disagree on issues at hand. They should be made to embrace the views of others and treat them as a learning process. Any form of intolerance should be highly condemned.

3. Life skills

   A well-maintained atmosphere equals a fulfilling life. Learners should be sensitized on the need to conserve our environment. They should actively participate in activities such as: National tree planting day, National cleaning day. Learners should be made to understand the need to embrace one another regardless of their cultural background or nationality. Involve them in activities that foster coherence, respect, gender inclusivity and patriotism.

New words and the meanings

- **Acid** – a substance that neutralises a base.
- **Base** – a substance that neutralises an acid.
- **Indicator** – a chemical that is used to find out whether a substance is an acid or base.
- **Concentrated** – strong
- **Diluted** – weak

- **Litmus** – a type of an indicator.
- **Neutral point** – a point where a substance in neither an acid nor a base.
- **Corrosive** – ability to erode a surface.
- **Antacid** – a type of a medicine that neutralises an acid.
- **pH** – the degree of acidity or alkalinity a substance has.

5.1 Properties of acids, bases and indicators

Refer to learner's book page 90

Activity 5.1

Refer to learner's book page 90

Pair Activity (Critical thinking)

1. Let learners be in pairs to discuss the questions as outlined in the learner's book.
2. Guide each pair in coming up with properties of acids and bases.
3. Thereafter, let each pair to compare their findings with other pairs in class.
4. Use their findings to have a class discussion on properties of acids and bases using examples.

Activity 5.2

Refer to learner's book page 92

Group Activity (Cooperation)

1. Ask learners to collect the materials required for the experiment.
2. Let learners in groups to carry out the experiment as outlined.
3. Check on each group to see the progress.
4. Use their findings to explain the properties of acids and bases.

Activity 5.3 and 5.4

Refer to learner's book pages 93 and 94

Pair and group Activities (communication)

1. Ask learners probing questions about how to tell if a substance is an acid and base.

2. Let them discuss this in pairs using the suggested questions about indicators.
3. Provide them with books and other reference materials or computers with Internet if available.
4. Instruct them to record their findings in a table format as shown in their books.
5. Build on their presentation to discuss properties of indicators as they write short notes.
6. Ask learners to carry out the fun corner activity suggested. Assess their work accordingly.
7. Instruct learners to attempt Check your progress 5.1.

Assessment opportunities

Product

Check if learners are able to describe and identify common properties of acids, bases and indicators.

Answer to check your progress 5.1

Refer to Learner's book page 95

1. (i) False

   (ii) True

   (iii) True

   (iv) True

   (v) True
2. C
3. C
4. A

5.2 Using an indicator to find the strength of an acid

Activity 5.5

Refer to learner's book page 96

Group Activity (Cooperation and critical thinking)

1. Assist learners in collecting materials needed for the experiment.

2. In groups, let learners use the outlined procedures to carry out the experiment.
3. Assist them where necessary.
4. Each group will present their findings in class.
5. Use their findings to expound on the importance of acids.
6. Ask learners to carry out the fun corner activity as suggested in their books.
7. Instruct learners to attempt Check your progress 5.2

Assessment opportunities

Product

Learners should be able to use indicators to determine the strength of acids and bases.

Answer to Check your progress 5.2

Refer to Learner's book page 99

1. Tooth paste, Ash, baking soda
2. Acid, X
3. (i) True
   (ii) True
   (iii) True
4. B
5. B
6. Concentrated, diluted
7. Strong

5.3 Uses of acids and bases

Refer to learner's book page 100

Activity 5.6

Refer to learner's book page 100

Group Activity (Critical thinking)

1. Tell each learner to do the activity as outlined in the learner's book.
2. Thereafter, they will compare their findings with others in class.

3. Have a class discussion based on their findings as they write short notes.
4. Ask learners to do the fun corner activity suggested.
5. Instruct learners to visit the school garage or any garage around. Talk to the driver. Ask him or her to show you where he or she puts the acid in the battery and what it is used for.
6. Give them homework of investigating the application of acid and bases at home.

Answers to Check your progress 5.3

Refer to learner's book page 101

1. Applying a basic substance as a toothpaste
2. Lime
3. (a) Heartburn

   (b) Take an antacid

UNIT 6

Sound and Light

Refer to learner's book page 102 - 113

Learn about	Key inquiry questions
This unit provides an opportunity to learners to talk about their experiences at home and their previous lesson. Therefore, they should be encouraged to work in pairs or small groups and produce group and individual written work. Learners should use their prior learning and experience to explain how light and sound travel as waves and develop new learning about how the structures of the eyes and ears are able to capture light and sound and convert it into electrical signals. They should relate this to the structure of the nervous system in vertebrates which creates a link between receptors and muscles. They should develop an understanding of the brain as a central 'computer' which can generate signals leading to responses, and how nerves and the brain constantly learn through practice. They should experiment with a pin-hole camera and use this to explain how the eye works.	• How reasonable is the parallel between human eye and pinhole camera? • How might sounds of different pitch and volume be perceived by the human ear? • Why is it that we have two ears and two eyes? • How might a knowledge of nerves help us to explain how we learn?

Learning outcomes

Knowledge and understanding	Skills	Attitudes
• Understand the parallel between the human eye and a pin-hole camera	• Construct a simple pinhole camera to investigate the parallel between the human eye and a pinhole camera	• Co-operation and team work spirit while constructing a pinhole camera

• Understand how sound is produced and how the human ear perceives it • Understand the structure and function of the nervous system	• Demonstrate how sound is produced and perceived by the human ear	• Genuine interest about how sound is produced and perceived by the human ear
Contribution to the competencies: Critical and Creative thinking: constructing a pinhole camera and investigating how sound is produced and perceived by the human ear as well as during their observations of constellation and galaxies Co-operation and Communication: during team work		
Links to other subjects:		

Introduction to the unit

Learners at this level have learnt about light and sound in previous grades. In Grade 4 and 6 they learnt how light travel, why light travel through some materials and not in others and why we need light. They also learnt the concept of reflection and refraction. Link their past knowledge of light and sound to what they are learning in this unit.

The concept in this unit is to enable the learners to understand the parallel between the human eye and pinhole camera, understand how sound is produced and perceived by the ear and the structure of the nervous system.

Sound and light are forms of energy. Sound is produced when things vibrate. When the vibrations to and fro are many a high sound is produced. Very high sound can destroy the eardrum. Light is another form of energy. Some sources of light such

as the sun, firefly and glowworms are natural. Other sources of light such as fire, candles and gas lamps are artificial.

This unit will help the learners to appreciate their organs of sight and hearing. It will enable the learners to realize that the brain controls all body actions

Competences to be attained

1. Co-operation

   Encourage learners to work as a team through group discussions. Allow learners to freely interact with one another. Let them associate with one's culture and abilities through resources sharing and exchange of ideas. The principle of co-operation should be listening to understand but not listening to respond. All learners should be given equal opportunities.

2. Communication

   During group discussion, encourage learners to share their opinions, suggestions and ideas freely. This way they will build on their language command as well as ability to participate in discussions. Ask them questions and give them a chance to attempt answering in the simplest way possible. This way, they will build on their confidence and soon develop the love and passion for the subject. Allow some room for learners to make mistakes and then correct them in nice way lest they will feel demoralized.

3. Critical and creative thinking

   Use probing questions during the lessons to elicit critical thinking in learners. Help them develop a thinking culture as they try to relate the unit with the questions given to them. These questions should however trigger the idea of what they should expect from the unit. Use videos, pictures and photographs to make learners discuss the activities therein. Ask learners to come up with diagrams that illustrate learning aspects this encourages creativity.

4. Culture and identity

   Make learners research on ways in which they can use the knowledge acquired from the unit in improving the living conditions of their communities. The greatness of a nation lays in the ability of its people to integrate skills and knowledge with national development and growth. Learners should know that knowledge and culture are mutually inclusive

Cross cutting issues

1. Environmental awareness and sustainability

   Learners should be aware that loud noise is not good for animals' health and well being.

2. Peace and values of education

   Throughout the unit, learners are actively involved in discussing issues as a group. Learners should be made aware of the need to accommodate everyone's ideas and opinions. Through the discussions they will at times agree or disagree on issues at hand. They should be made to embrace the views of others and treat them as a learning process. Any form of intolerance should be highly condemned.

3. Life skills

   Learners should appreciate the importance of the sense organs.

Meaning of new words

- **Translucent** – a material allowing some light to pass through.
- **Reflex action** - an involuntary and nearly instantaneous movement in response to a stimulus
- **Nerves** – conduct impulses in the body.
- **Pitch** – the quality of sound.
- **Receptor** – an organ or cell able to respond to light, heat and transmit an impulse.
- **Stimuli** – a thing or event that evokes a specific functional reaction in an organ or tissue

6.1 The pinhole camera

Activity 6.1

Refer to learner's book page 102

Group Activity (Critical thinking)

1. Review briefly what learners know about light from Primary 4 and 6.
2. Thereafter, place the items for making a pinhole camera on the table and ask learners to identify them.

3. Display a chart of a pinhole camera. Ask learners to identify the parts of a pinhole camera and material used as indicated.
4. Demonstrate how to make a pinhole camera. Then allow learners to make their own.
5. Using their own pinhole camera and ask learners to observe an image.
6. Alternatively organise a visit to a photo studio and observe the use of cameras and development of photographs.
7. Instruct learners to investigate using Internet ways of improving a pinhole camera. Make the presentation in class.

Activity 6.2

Refer to learner's book page 103

Class Activity (conversation and cooperation)

1. Remind learners what they learnt about the pinhole camera and the eye briefly.
2. Organise for a resource person (optician) to talk to the learners about the structures and functions of the eye.
3. Ask learner to prepare a questionnaire they will use to engage the resource person.
4. Alternatively you can show learners pictures, diagrams or models of the eye.
5. Instruct learners to take notes during the activities.

6.2 Differences between pinhole camera and the human eye

Activity 6.3

Refer to learner's book page 103

Class Activity (Critical thinking)

1. Display a chart of the human eye or model and ask learners to observe and name the parts.
2. Ask learners to place their pinhole camera on their tables.
3. Guide learners in finding the similarities between pinhole camera and the eye.
4. Ask them to record their findings in a table format.

5. Build on their findings to draw the similarities between a human eye and the pinhole camera.
6. Instruct learners to attempt Check your progress 6.1.

Assessment opportunities

(a) Observations

- Check each learner during the group activity; class discussions and class talk to observe their attitude.
- Observe learners skills during construction of the pinhole camera. They should display willingness to learn, participate and cooperate.

(b) Conversation

Ask learners to discuss how to make a pinhole camera and the structure and functions of the eye. This way they get to learn from each other.

(c) Product

Learners should be able to draw parallelism in similarities and differences of the human eye and the pinhole camera.

Answers to check your progress 6.1

Refer to learner's book page 105

1. Check for a well drawn labelled diagram:
   (a) Retina
   (b) Pupil
   (c) Optical nerves
2. The brain assist in flipping the images for us, so we do not struggle with inversion.
3. Optical nerves
4. (i) B
   (ii) D
   (iii) C

6.3 The structure of human ear and sound perception

Activity 6.4

Refer to learner's book page 106

Individual Activity (communication)

1. Introduce the lesson by reviewing what the learners know about the ear as they learnt in grade 5.
2. Give learners homework to observe and compare animals and human ears.
3. Alternatively give learners pictures of animals, they should describe the ears and compare with theirs.
4. Allow learners time to compare their findings with the rest.

Activity 6.5

Refer to learner's book page 106

Group Activity (communication)

1. Display a chart of the human ear and ask the learners in groups to name the parts.
2. Animate a discussion about the functions of parts of the ear.
3. Ask learners to investigate using the Internet how the ears perceive sound.
4. From their findings, explain how the ear perceives the sound as they write short notes.
5. Instruct learners to attempt Check your progress 6.2.

Assessment opportunities

Product

Check whether learners understand how sound is produced and how the human ear perceives it.

Answers to check your progress 6.2

Refer to learner's book page 109

1. (a) Outer ear- captures vibrations

   (b) Ear drum - vibrates

(c) Brain- determines pitch

(d) Small bones- acts as levers

(e) Auditory nerve- transmit impulse

2. Pitch is the highness or lowness of sound while volume is loudness or softness of the sound.

6.4 The nervous system

Activity 6.6

Refer to learner's book page 110

Class Activity (Communication, cooperation and critical thinking)

1. Let learners carry out activities suggested to understand how the nervous system works.
2. Guide them in each step while asking probing questions.
3. Let learners discuss the suggested questions and write a report.
4. Choose one member to do a class presentation.
5. Build on their presentations to have a class discussion on the nervous system as they take short notes.
6. Organise with the school management or a nearby farm to carry out a feeding program for farm animal. Let learners feed animal at the same time everyday for two weeks then observe their behaviour when the feeding time reaches.
7. Ask learners to draw the suggested fun corner activity. Allow them to choose the best captioned.
8. Instruct learners to attempt Check your progress 6.3.

Assessment opportunities

(a) Observations

Check each learner during the group activity and class discussions to observe their attitude.

Learners should display willingness to learn, participate and cooperate.

(b) Conversation

Ask learners to discuss how the nervous system works. This way they get to learn from each other.

(c) Product

Learners should understand the structure and function of the nervous system.

Answers to Check your progress 6.3

Refer to learner's book page 113

1. Reflex action of the nervous system
2. (a) Jumped as always

   (b) Conditioned reflex
3. Reflex action
4.

Reflex action	Condition reflex
Sneezing, blinking an eye	Riding a bicycle, salivation

UNIT 7

Electromagnetism

Refer to learner's book pages 114 - 125

Learn about	Key inquiry questions
Learners should revisit their prior learning about magnetism and polarity. In groups they should create electrical circuits with torch batteries and investigate how to create temporary magnets in iron nails. They should measure the strength of the magnets by the number of paper clips it will hold and design fair tests to investigate whether the number of turns of wire round the nail or the number of linked torch batteries influence the magnet strength. They should consider the applications of electromagnets as switches or in electric motors and dynamos.	• How do we make an electro-magnet? • How can we change the strength of an electro-magnet? • How can we apply our knowledge of particles to explain magnetism?

Learning outcomes		
Knowledge and understanding	**Skills**	**Attitudes**
• Explain how magnets can be made from electricity and the applications of electro-magnetism	• Observe carefully • Design a fair test to solve a simple problem • Predict what might happen if one variable is changed	• Value devices that use electro-magnets.

	• Use appropriate measures • Collect and present results appropriate in writing or drawing • Interpret results accurately • Report findings appropriately	
Contribution to the competencies: Critical and Creative thinking: demonstrate how magnet can be made to make electricity and its applications Co-operation and Communication: during practical work		
Links to other subjects:		

Introduction to the unit

Learners at this level have learnt about electricity and magnetism in Primary 4. Link their past experience about magnetism with what they are learning in this unity is to enable the learners to understand how to make electromagnets, how to increase or decrease electromagnetism using electricity. Let learners understand that by expanding their knowledge and skills about electromagnets they can be able to solve problems in their day-to-day lives.

Electromagnetism is a form of energy. Energy is the ability to do work; energy is transformed from one form to another in order to put it in use. In an electromagnet, chemical energy is transformed into electrical energy which is then is transformed in to electromagnetic energy.The electromagnetic energy is used in switches, electrical motors transformers and dynamos. This topic will help the learners appreciate energy and participate in energy conservation.

Competences to be attained

1. Co-operation

   Encourage learners to work as a team through group discussions.Allow learners to freely interact with one another. Let them associate with one's culture and

abilities through resources sharing and exchange of ideas. The principle of co-operation should be listening to understand but not listening to respond. All learners should be given equal opportunities.

2. Communication

   During group discussion, encourage learners to share their opinions, suggestions and ideas freely. This way they will build on their language command as well as ability to participate in discussions. Ask them questions and give them a chance to attempt answering in the simplest way possible. This way, they will build on their confidence and soon develop the love and passion for the subject. Allow some room for learners to make mistakes and then correct them in nice way lest they will feel demoralized.

3. Critical and creative thinking

   Use probing questions during the lessons to elicit critical thinking in learners. Help them develop a thinking culture as they try to relate the unit with the questions given to them. These questions should however trigger the idea of what they should expect from the unit. Use videos, pictures and photographs to make learners discuss the activities therein. Ask learners to come up with diagrams that illustrate learning aspects this encourages creativity.

4. Culture and identity

   Make learners research on ways in which they can use the knowledge acquired from the unit in improving the living conditions of their communities. The greatness of a nation lays in the ability of its people to integrate skills and knowledge with national development and growth. Learners should know that knowledge and culture are mutually inclusive

Cross cutting issues

1. Environmental awareness and sustainability

   Learners should be aware the health hazards of magnets are being actively researched. There is currently no clear evidence of negative health impacts from exposure to static magnetic fields. This is because the magnitude of magnetic fields decreases with distance. Many instruments have internal shielding which reduces the strength of the field.

2. Peace and values of education

   Throughout the unit, learners are actively involved in discussing issues as a group. Learners should be made aware of the need to accommodate everyone's ideas and opinions. Through the discussions they will at times agree or disagree on issues at hand. They should be made to embrace the views of others and treat them as a learning process. Any form of intolerance should be highly condemned.

3. Life skills

   Learners should appreciate the importance of the sense organs.

Meaning of Key Words

- **Electromagnet** – a temporary magnet made using electricity.
- **Dynamo** – a small generator fitted in bicycles to produce electricity.
- **Circuit** – the path through which electric current flows.
- **Kinetic energy** – energy in motion.
- **Transformation** – to change from one form to another.
- **Magnetism** – force that is caused by the motion of electrically charged particles.
- **Induction** – a way of creating magnetism.
- **Dry Cell** – torch batteries that contain chemical energy.
- **Coil** – turn round an object on another.
- **Series connection** – a method of connecting dry cells in such a way that positive terminal is connected to negative terminal.

7.1: Making an electromagnet

Refer to learner's book page 114

Activity 7.1 and 7.2

Refer to learner's book pages 114 and 115

Group Activity (communication, cooperation and critical thinking)

1. Introduce the lesson by reminding the learners what they learnt in Primary 4

about electricity and magnetism.

2. Display the materials on the table and ask learners to name them. They will use the materials to make circuit connections and record their observations.
3. Let them go ahead and try making an electromagnet as outlined in the learner's book.
4. Assist them where necessary with the circuit connections.
5. Allow them to discuss and compare their findings in class.
6. Build on their discussion to explain electromagnets.
7. Give learners the further activity and fun corner activity suggested in the learner's book.
8. Learners should compare their findings with others in class.
9. Organise a trip to an electronic shop, let learners ask questions about the uses of electromagnets.
10. Instruct learners to attempt Check your progress 7.1.

Assessment opportunities

Product

Check if learners are able to identify the components of an electromagnet and are able to connect a circuit properly.

Answer to check your progress 7.1

Refer to learner's book page 118

1. True
2. It loses its magnetism
3. Chemical energy
4. a). Chemical-electrical-electromagnetic and kinetic

   b) The identified mistake was an insulated wire was used in the experiment.
5. Increasing the number of cell and increasing the number of coils

6. Having or showing poles like in magnets.

7.2 Changing the strength of an electromagnet

Activity 7.3

Refer to learner's book page 118

Group Activity (communication, cooperation and critical thinking)

1. Organise learners into groups.
2. Provide them with materials required for the experiment. They can help you collect some of the materials.
3. Let learners carry out the experiment as outlined in the learner's book.
4. They will record their findings and make a class presentation.
5. Use their findings to explain how to change the strength of an electromagnet.
6. Instruct learners to attempt Check your progress 7.2.

Answer to Check your progress 7.2

Refer to learner's book page 121

1. Increasing the number of coils and cells.
2. There would be no magnetism.
3. True
4. (a) Series

   (b) Reducing the number of cells or winding wires on the nail.

   (c) Increasing the number of cells and winding wires on the nail.

   (d) Disconnecting the wire
5. In series connection, the amount of voltage is higher since it is the total voltage of all cells, while in parallel connection the amount of voltage is equivalent to voltage of one cell

7.3 Application of electromagnetism

Activity 7.4

Refer to learner's book pages 122

Individual work (communication)

1. Remind the learners what they learnt in the previous lesson about making electromagnets.
2. Using a chart of things that use electromagnet ask learners to name the items on the chart.
3. Discuss with learners application of electromagnets as they write short notes.
4. Instruct learners to attempt check your progress 7.3

Answer to Check your progress 7.3

Refer to learner's book page 124

1.

	A	B	
A	Computer	To lift loads	B
B	Crane	To produce sound	D
C	Television	To produce electricity	E
D	Radio	To store information	A
E	Bicycle dynamo	To direct beam of light	C
F	Train	To ring	G
G	Electric bell	To move	F

2. To produce electricity
3. Electromagnetic energy
4. (a) Crane (b) computer (c) electric bell (d) radio