SCIENCE AND ELEMENTARY TECHNOLOGY (SET)

PRIMARY SIX

(P6)

TEACHER'S GUIDE

EXPERIMENTAL VERSION

Adapted Edition

Kigali, 2022

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FOREWORD

Dear teacher,

Rwanda Basic Education Board is honoured to present to you the Primary 6 Science and Elementary Technology Teacher's Guide which serves as a guide to competence-based teaching and learning to ensure consistency and coherence in the learning of Science and Elementary Technology subject. The Rwandan educational philosophy is to ensure that learners achieve full potential at every level of education which will prepare them to be well integrated in society and exploit employment opportunities.

In line with efforts to improve the quality of education, the government of Rwanda emphasizes the importance of aligning teaching and learning materials with the syllabus to facilitate their learning process. Many factors influence what they learn, how well they learn and the competences they acquire. Those factors include the relevance of the specific content, the quality of teacher's pedagogical approaches, the assessment strategies and the instructional materials available. We paid special attention to the activities that facilitate the learning process in which learners can develop ideas and make new discoveries during concrete activities carried out individually or with peers. With the help of the teacher, learners will gain appropriate skills and be able to apply what they have learnt in real life situations. Hence, they will be able to develop certain values and attitudes allowing them to make a difference not only to their own life but also tothe nation.

This is in contrast to traditional learning theories which view learning mainly as a process of acquiring knowledge from the more knowledgeable person who is mostly the teacher. In competence-based curriculum, learning is considered as a process of active building and developing of knowledgeand understanding, skills and values and attitude by the learners whereconcepts are mainly introduced by an activity or situation that helps the learners to construct knowledge, develop skills and acquire positive attitudes and values.

In addition, such active learning engages learners in doing things and thinking about the things they are doing and they are encouraged to bring their own real experiences and knowledge into the learning processes. Inview of this, your role is to:

- Plan your lessons and prepare appropriate teaching and learning materials.
- Organize group discussions for learners considering the importance of social constructivism suggesting that learning occurs more effectively when the learners work collaboratively with more knowledgeable and experienced people.

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- Engage learners through active learning methods such as inquirymethods, group discussions, research, investigative activities and group and individual work activities.
- Provide supervised opportunities for learners to develop different competences by giving tasks which enhance critical thinking, problem solving, research, creativity and innovation, communication and cooperation.
- Support and facilitate the learning process by valuing learners' contributions in the class activities.
- Guide learners towards the harmonization of their findings.
- Encourage individual, peer and group evaluation of the work done in the classroom and use appropriate competence-based assessment approaches and methods.

To facilitate you in your teaching activities, the content of this teacher's guide is self-explanatory so that you can easily use it. It is divided in 3 parts:

The part 1: Explains the structure of this Teacher's guide and gives youthe methodological guidance;

The part 2: Gives the sample lesson plans as reference for your lesson planning process;

The part 3: Provides the teaching guidance for each concept given in the Pupil's book.

Even though this teacher's guide contains the answers to all activities given in the student's book, you are requested to work through each question and activity before judging learner's findings.

I wish to sincerely appreciate all people who contributed towards the development, translation and adaptation of this teacher's guide, particularly REB staff who organized the whole process from its inception. Special gratitude goes to translators, illustrators and designers who diligently worked to successful completion of this teacher's guide. Any comment or contribution would be welcome for the improvement of this teacher's guide for the next edition.

Dr. MBARUSHIMANA Nelson

Director General, REB

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ACKNOWLEDGEMENT

I wish to express my appreciation to all the people who played a major role in development of this Primary 6 Science and Elementary Technology Teacher's Guide. It would not have been successful without active participation of different education stakeholders.

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Finally, my word of gratitude goes to the Rwanda Basic Education Board staff particularly those from the Curriculum, Teaching and learning Resources Department (CTLRD) who were involved in the whole process of writing of this translated teacher's guide.

Joan MURUNGI

Head of Curriculum, Teaching and Learning Resources Department/ REB

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PART I: GENERAL INTRODUCTION

1.0. About the Teacher's guide

This book is a Teacher's guide for Primary Three Science and ElementaryTechnology subject. It is designed to accompany Pupil's book and intends to help teachers in the implementation of competence basedcurriculum specifically Science and Elementary Technology syllabus.

As the name says, it is a guide that teachers can refer to when preparing their lessons. Teachers may prefer to adopt the guidance provided but they are also expected to be more creative and considertheir specific classes' contexts and prepare accordingly.

1.1. The structure of the guide

This section presents the overall structure, the unit and sub-headingstructure to help teachers to understand the different sections of thisguide and what they will find in each section.

Overall structure

The whole guide has three main parts as follows:

Part I: General Introduction

This part provides general guidance on how to develop the generic competences, how to integrate cross cutting issues, how to cater for studentswith special educational needs, active methods and techniques of teachingScience and Elementary Technology and guidance on assessment.

Part II: Sample lesson plan

This part provides a sample lesson plan, developed and designed to help the teacher develop their own lesson plans.

Part III: Unit development

This is the core part of the guide. Each unit is developed following thestructure below:

Each unit is made of the following sections:

- **Unit title:** from the syllabus

- **Key unit competence**: from the syllabus

- **Prerequisites (knowledge, skills, attitudes and values)**

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This section indicates knowledge, skills and attitudes required for the success of the unit. The competence-based approach calls for connections between units/topics within a subject and interconnections between different subjects. The teacher will find an indication of those prerequisites and guidance on how to establish connections.

- Cross-cutting issues to be addressed

This section suggests cross cutting issues that can be integrated depending on the unit content. It provides guidance on how to comeup with the integration of the issue. Note that the issue indicated is a suggestion; teachers are free to take or add another cross-cutting issuetaking into consideration the learning environment.

- List of lessons

This section presents in a table the list of suggested lessons, lesson objectives copied or adapted from the syllabus and duration for each lesson.

- Teaching approach for each lesson

In this section, each lesson is developed by describing how it will be conducted in classroom. Note that it is a proposal which leaves the room to the teacher of adapting the lesson to the context of the class and school environment. Each lesson development shows the lesson objectives, teaching and learning materials, teaching and learning activities, conclusion of the lesson and assessment of the lesson.

- Additional information for the teacher

This part gives the teacher additional content and advanced knowledge onthe unit to be taught. Remember that the teacher must have more knowledgeand understanding beyond the content or topic in the syllabus and Pupil's book.

- Answers to End of unit assessment

This part provides answers or guidance to questions of the end of unit assessment in the Pupil's book and suggests additional questions and related answers to assess the key unit competence.

- Additional activities (remedial, consolidation and extended activities)

The purpose of these activities is to accommodate each learner (slow, average and gifted) based on end of unit assessment results.

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Structure of each lesson

Each lesson is made of the following sections:

Lesson title 1: ……

- Lesson objectives

- Teaching and learning resources

This section suggests the teaching aids or other resources needed in line with the activities to achieve the learning objectives. Teachers are encouraged to replace the suggested teaching aids by the available ones in their respective schools and based on learning environment.

- Teaching and Learning activities

This section provides a short description of the methodology and any important aspect to consider. It provides also answers to learningactivities with cross reference to Pupil's book.

- Assessment and Conclusion

This provides guidance on how to conduct assessment and support learners to make a conclusion or summary of what they learned.

Note: The guide ends with references.

1.2. Methodological guidance

1.2.1. Developing competences

Since 2015, Rwanda shifted from a knowledge based to a competence basedcurriculum for pre-primary, primary and general secondary education. For TTCs, it is in 2019 that the competence based curriculum was embraced. Thiscalled for changing the way of learning by shifting from teacher centered to a learner centered approach. Teachers are not only responsible for knowledge transfer but also for fostering pupil's learning achievement, and creating safe and supportive learning environment. It implies also that a learner has to demonstrate what he/she is able to do using the knowledge, skills, values and attitudes acquired in a given situation.

The competence-based curriculum employs an approach of teaching and learning based on discrete skills rather than dwelling on only knowledge or the cognitive domain of learning. It focuses on what learners can do rather than what they know. Learners develop basic competences through specific subject unit competences with specific learning objectives broken down into knowledge, skills and attitudes. These competences are developed through learning activities disseminated in learner-centered rather than the traditional instructive approach. The learner is evaluated against set standards to achieve before moving on.

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In addition to specific subject competences, learners also develop generic competences which are transferable throughout a range of learning areas and situations in life.

Below are examples of how generic competences can be developed in Scienceand Elementary Technology:

Generic competence	**Examples of activities that develop genericcompetences**
Critical thinking	These activities require learners to think critically about subject content. These may include: Work in groups in different ways e.g. taking turns,listening, taking decisions, Observe and analyse. Example: mark out areas in the school and get different groups to record livingthings like insects, people, animals, birds Discuss and give scientific reasons of phenomenon commonly known like sun shining, raining, changing colours for plants, e.t.c. Observe, record, interpret data recorded during experiments Identify and use the applications of Science and Elementary Technology concepts to solve problems of life and society
Research and Problem solving	Research using internet or books from the library Design a project for making toys and materials
Innovation and creativity	Create an experiment procedure to prove a point Making practice in different units - Conduct experiments with objectives, methodology,observations, results, conclusions - Identify local problems and ways to resolve them

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Cooperation, Personal and Interpersonal management and life skills	Work in Pairs Small group work Large group work
Communication	Telling a story related to the lesson of SET needed to be studied Presenting ideas verbally or in writing Reading a text related to SET
Lifelong learning	Take initiative to update knowledge and skills with minimum external support Cope with the evolution of knowledge and technology advances for personal fulfilment Seek out acquaintances more knowledgeable in areas that need personal improvement and development Exploit all opportunities available to improve knowledge and skills in SET.

1.2.2. Addressing cross cutting issues

Among the changes in the competence based curriculum is the integration of cross cutting issues as an integral part of the teaching/learning process as they relate to and must be considered within all subjects to be appropriately addressed. The eight cross cutting issues identified inthe national curriculum framework are: genocide studies, environment and sustainability, gender, Comprehensive Sexuality Education (CSE), Peace and Values Education, Financial Education, standardization Culture and Inclusive Education.

Some cross cutting issues may seem specific to particular learning areas or subjects but the teacher needs to address all of them whenever an opportunity arises. In addition, student should always be given an opportunity during the learning process to address these cross cutting issues both within and out of the classroom so as to progressively develop related attitudes and values.

Below are examples on how crosscutting issues can be addressed in Science and Elementary Technology:

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Cross-cutting issues	**Examples on how to integrate the cross-cutting issues**
Inclusive education	Involve all learners in all activities without any bias. Eg: Allow a learner with physical disability (using wheelchair) to take notes or lead the team during a task or an experiment.
Gender	Involve both girls and boys in all activities: No activity is reserved only to girls or boys. Teacher should ensure equal participation of both girls and boys during activities as well as during cleaning activities after practical tasks.
Peace and Values Education	During group activities, the teacher will encourage learners to help each other. During all teaching and learning activities, texts and examples used by the teacher should reflect promotion of peace and values among them at school and with others in society.
Standardizationculture	- Some lessons involve carrying out practical tasks. Instructions should be clear for learners to always check if they are using appropriate materials. - Through making quality work/objects which areattractive to the community.
Environment and sustainability	In order to avoid the environment pollution, before, during or after practical tasks, learners should avoid throwing wastes anywhere; special places or appropriate containers should be used. During field visits, learners should be reminded of not damaging or destroying environment components or of not throwing wastes in environment.
Financial Education	When making toys and objects for example, learners are encouraged to use well the resources by using the quantities that are just required. Using materials, tools and materials in proper way for safeguarding their durability Making different objects that can be sold.

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1.2.3. Attention to special educational needs specific to teaching and learning SET subject

In the classroom, pupils learn in different way depending to their learning pace,needs or any other special problem they might have. However, the teacher has the responsibility to know how to adopt his/her methodologies and approaches in order to meet the learning needs of each pupil in the classroom. Also teachermust understand that learners with special needs need to be taught differently or need some accommodations to enhance the learning environment. This will be done depending on the unit and the nature of the lesson.

In order to create a well-rounded learning atmosphere, teacher needs to:

- Remember that pupils learn in different ways so they have to offer a variety of activities (e.g. role-play, music and singing, word games and quizzes, and outdoor activities).
- Maintain an organized classroom and limits distraction. This will help learners with special needs to stay on track during lesson and follow instructions easily.
- Vary the pace of teaching to meet the needs of each learner. Some learners process information and learn more slowly than others.
- Break down instructions into smaller, manageable tasks. Learners with special needs often have difficulty understanding wordy or several instructions at once. It is better to use simple, concrete sentences in order to facilitate them understand what you are asking.
- Use clear consistent language to explain the meaning (and demonstrate or show pictures) if you introduce new words or concepts.
- Make full use of facial expressions, gestures and body language.
- Pair a learner who has a disability with a friend. Let them do things together and learn from each other. Make sure the friend is not over protective and does not do everything for the learner. Both learners will benefit from this strategy.
- Use multi-sensory strategies. As all pupils learn in different ways, it is important to make every lesson as multi-sensory as possible. Pupils with learning disabilities might have difficulty in one area, while they might excel in another. For example, use both visual and auditory cues.

Below are general strategies related to each main category of disabilities and how to deal with every situation that may arise in the classroom. However, the list is not exhaustive because each learner is unique with different needs and that should be handled differently.

Strategy to help learners with developmental impairment

The teacher should:

- Use simple words and sentences when giving instructions.
- Use real objects that the learner can feel and handle, rather than just working abstractly

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with pen and paper.

- Break a task down into small steps or learning objectives. The learner should start with an activity that s/he can do already before moving on to something that is more difficult.
- Gradually give the learner less help.
- Let the learner work in the same group with those without disability.

Strategy to help learners with visual impairment

The teacher should:

- Help learners to use their other senses (hearing, touch, smell andtaste) to play and carry out activities that will promote their learning anddevelopment.
- Use simple, clear and consistent language.
- Use tactile objects to help explain a concept.
- If the learner has some sight problem, ask him/her what they can see. Get information from parents/caregivers on how the learner manages their remaining sight at home.
- Make sure the learner has a group of friends who are helpful and who allow them to be as independent as possible.
- Plan activities so that learners work in pairs or groups whenever possible.

Strategy to help learners with hearing impairment

The teacher should:

- Set strategies to help learners with hearing disabilities or communication
- difficulties
- Always get the learners' attention before you begin to speak.
- Encourage the learners to look at your face.
- Use gestures, body language and facial expressions.
- Use pictures and objects as much as possible.
- Ask the parents/caregivers to show you the signs they use at home for communication. Use the same signs and encourage other learners to also use them.
- Keep background noise to a minimum.

Strategies to help children with physical disabilities or mobility difficulties

The teacher should:

- Adapt activities so that learners who use wheelchairs or other mobility
- aids, or other learners who have difficulty moving, can participate.
- Ask parents/caregivers to assist with adapting furniture e.g. The height of a table may need to be changed to make it easier for a learner to reach it or fit their legs or wheelchair under.

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- Encourage peer support. Friends can help friends.
- Get advice from parents or a health professional about assistive devices.

1.2.4. Guidance on assessment

Each unit in the Teacher's guide provides additional activities to help learners achieve the key unit competence. Results from assessment inform the teacher which learner needs remedial, consolidation or extension activities. These activities are designed to cater for the needs of all categories of learners; slow, average and gifted respectively.

Assessment is an integral part of teaching and learning process. The main purpose of assessment is for improvement. Assessment for learning/ Continuous/ formative assessment intends to improve learners' learning and Teacher's teaching whereas assessment of learning/summative assessment intends to improve the entire school's performance and education system in general.

Continuous/ formative assessment

It is an ongoing process that arises out of interaction during teaching and learning process. It includes lesson evaluation and end of sub unit assessment. This formative assessment plays a big role in teaching and learning process. The teacher should encourage individual, peer and group evaluation of the work done in the classroom and uses appropriate competence-based assessment approaches and methods.

In Primary Three, formative assessment principle is applied through application activities that are planned in each lesson to ensure that lesson objectives are achieved before moving on. At the end of each unit, the end of unit assessmentis formative when it is done to give information on the progress of learners and from there decide what adjustments need to be done. Assessment standards are taken into consideration when setting tasks.

Summative assessment

The assessment done at the end of the term, end of year, is considered as summative. The teacher, school and parents are informed on the achievementof educational objectives and think of improvement strategies. There is also end of level/ cycle assessment in form of national examinations.

1.2.5. Pupils' learning styles and strategies to conduct teaching and learning process

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There are different teaching styles and techniques that should be catered for. The selection of teaching method should be done with the greatest care and some of the factors to be considered are: the uniqueness of subjects, the type of lessons, the particular learning objectives to be achieved, the allocated time to achieve the objective, available instructional materials, the physical/sitting arrangement of the classroom, individual learner's needs, abilities and learning styles.

There are mainly four different learning styles as explained below:

a) Active and reflective learners

Active learners tend to retain and understand information best by doing something active with it, discussing or applying it or explaining it to others. Reflective learners prefer to think about it quietly first.

b) Sensing and intuitive learners

Sensing learners tend to like learning facts while intuitive learners often preferdiscovering possibilities and relationships. Sensors often like solving problems by well-established methods and dislike complications and surprises; intuitive learners like innovation and dislike repetition.

c) Visual and verbal learners

Visual learners remember best what they see (pictures, diagrams, flow charts, time lines, films, demonstrations, etc.); verbal learners get more out of words (written and spoken explanations).

d) Sequential and global learners

Sequential learners tend to gain understanding in linear steps, with each step following logically from the previous one. Global learners tend to learn in large jumps, absorbing material almost randomly without seeing connections, and then suddenly "getting it."

1.2.6. Teaching methods and techniques that promote theactive learning

The different learning styles mentioned above can be catered for, if the teacher uses active learning whereby learners are really engaged in the learning process.

What is Active learning?

Active learning is a pedagogical approach that engages students in doing things and thinking about the things they are doing. In active learning, learners are encouraged to bring their own experience and knowledge into the learning process.

The role of the teacher in active learning

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- The teacher engages learners through active learning methods such as inquiry methods, group discussions, research, investigative activities and group and individual work activities.
- He/she encourages individual, peer and group evaluation of the work done in the classroom and uses appropriate competence-based assessment approaches and methods.
- He provides supervised opportunities for learners to develop different competences by giving tasks which enhance critical thinking, problem solving, research, creativity and innovation, communication and cooperation.
- Teacher supports and facilitates the learning process by valuing learners' contributions in the class activities.

The role of learners in active learning

Learners are key in the active learning process. They are not empty vessels to fill but people with ideas, capacity and skills to build on for effective learning.

A learner engaged in active learning:

- Communicates and shares relevant information with other learners through presentations, discussions, group work and other learner- centered activities (role play, case studies, project work, research and investigation).
- Actively participates and takes responsibility for their own learning.
- Develops knowledge and skills in active ways.
- Carries out research/investigation by consulting print/online documents and resourceful people, and presents their findings.
- Ensures the effective contribution of each group member in assigned tasks through clear explanation and arguments, critical thinking, responsibility and confidence in public speaking.
- Draws conclusions based on the findings from the learning activities.

Some active techniques that can be used in Science and Elementary Technology

The teaching methods strongly emphasised in the competence Based Curriculum (CBC) are active methods. Below are some active techniques that apply in sciences:

A. Practical work/ experiments:

Many of the activities suggested in the Science and Elementary Technology curriculum as well as in the Pupil's book are practical work or experiments.

Practical work is vital in learning Science and Elementary Technology; this method gives the learner the opportunity to implement a series of activities and leads to the development of both cognitive and hands-on skills. The experiments and questions given should target the developmentof the following skills in learners: observation, recording and report writing,

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manipulation, measuring, planning and designing. Most of experiments or practical activities suggested in the syllabus of SET are developed in step by step guidance in a booklet called **"SET Practical activities user guide"** to be used while facilitating such practical activities.

A practical lesson/Experiment is done in three main stages:

- **Preparation of practical lesson/ experiment:** Checking materials to ensure they are available and in a good state; try the task before the lesson; think of safety rules and give clear instructions.
- **Performance of practical lesson/ experiment:** Sitting or standing arrangement of learners; introduction of the experiment: aims and objectives; setting up the materials; performing the experiment; write and record the data.
- **Discussion:** Observations and interpreting data; make generalizations and assignment: writing out the experiment report and further practice and research.

In some cases, demonstration by the teacher is recommended when for examplethe experiment requires the use of sophisticated materials or very expensive materials or when safety is a major factor like dangerous experiments and it needs specific skills to be learnt first.

In case your school does not have enough science kit materials, experiments can be done in groups but make sure every learner participates.

B. Project work

Science and Elementary Technology teachers are encouraged to sample and prepare project works and engage their learners in, as many as possible. Learners in groups or individually, are engaged in a self-directed work for an extended period of time to investigate and respond to a complex question, problem, or challenge. Projects are based on real-world problems that capture learners' interest. This technique develops higher order thinking as the learners acquire and apply new knowledge in a problem-solving context.

C. Field trip

One of the main aims of teaching Science and Elementary Technology inRwanda is to apply its knowledge for development. To achieve this aim we need to show to learners the relationship between classroom science lessons and applied sciences. This helps them see the link between science principles and technological applications.

To be successful, the field visit should be well prepared and well exploited after the visit:

Before the visit, the teacher and learners:

- agree on aims and objectives
- gather relevant information prior to the visit

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- brainstorm on key questions and share responsibilities
- discuss materials needed and other logistical and administrative issues
- discuss and agree on accepted behaviours during the visit
- Visit the area before the trip if possible to get familiar with the place

After the visit

When learners come back from trip, the teacher should plan for follow-up. The follow-up should allow learners to share experiences and relate them to the prior science knowledge.

Alternate Teaching Approach

The 5Es

This "5Es" is a constructivist approach based on the idea that learners learn best when they participate in activities that give them opportunities to work things out for themselves. As the names suggests, there are five phases: engage, explore,explain, elaborate and evaluate.

1. Engage

In this phase:

- Teachers engage learners in activities that capture their interests and
- stimulate curiosity,
- Learners raise questions,
- Teachers verify learners' prior understandings of the topic,
- Learners compare ideas.

2. Explore

In this phase learners undertake hands-on activities where they:

- Experience the phenomenon or concept,
- Explore the questions they have raised, test their ideas and solve problems.

3. Explain

Only after learners have had opportunities to explore, they have opportunities to:

- Compare their ideas with scientific explanations,
- Use scientific terminology,
- Construct explanations that can be justified using information collected.

4. Elaborate

In this phase learners have opportunities to:

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- Apply what they have learnt to new contexts,
- Develop a deeper understanding of the problem or phenomenon as they discuss and compare ideas.

5. Evaluate

In this phase learners and the teacher:

- Look for evidence of changes in learners' ideas, beliefs and skills,
- Evaluate what learners know and can do.

Example of the 5Es teaching and learning approach

Phase of teachingand learning approach	Examples of teaching and learning activities	Sample Questions
1. Engage Create interest Reveal personal ideasand beliefs	Brainstorming, concept mapping, developing questions, demonstrations, asking open-ended questions.	What do you mean by . . .?Tell me more about . . .? I find that hard to understand: tell me .....? What makes you think . . .? How do you know . . .? How did you find out about that idea?
2. Explore Explore questionsand test learner's ideas	Prioritise class questions, group tasks, investigations, test ideas, research.	How are you going to . . .? How will you be able to tell . . .? Is that the question you really want toask . . .? What will you do when. . .? It might be a good idea to think about. .... ? How will you know it.... ? What do you need to find out more about.... ? Why are you doing it that way .... ? How will you be sure it is a fair test ....? How did you arrive at that idea.....?

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3. Explain Compare Ideas Construct explana- tions and justify themin terms of observa- tions and data	Reporting, group discus- sion, gathering information.	What do you think others might think about this . . .? How is that idea different to . . .? Some people say . . . Does that fit with your idea . . .? How did you arrive at that idea . . .?How will you be able to tell . . .?
4. Elaborate Apply concepts and explanations in new contexts	Further practical work, videos, debates, research.	Same as the *explore* phase. How could you verify that . . .?What will happen if . . .?

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5. Evaluate Gather evidence of changes in learners' ideas, beliefs and skills	Refining concept maps, responding to open-ended questions, reflection.	How have your ideas changed . . .? How is that different to . . .? It seems you are not sure about . . . Do you have any questions about . . .? What have you found out? What else do we need to know . . .? What else might you do to be really sure of that. . .?

Main steps for a lesson in active learning approach

All the principles and characteristics of the active learning process highlighted above are reflected in steps of a lesson as displayed below. Generally, the lesson is divided into three main parts whereby each one is divided into smaller steps to make sure that learners are involved in the learning process. Below are those main parts and their small steps:

1) Introduction

Introduction is a part where the teacher makes connection between the current and previous lesson through appropriate technique. The teacher opens short discussions to encourage learners to think about the previous learning experience and connect it with the current instructional objective. The teacher reviews the prior knowledge, skills and attitudes which have a link with the new concepts to create good foundation and logical sequencing.

2) Development of the new lesson

The development of a lesson that introduces a new concept will go through the following small steps: discovery activities, presentation of learners' findings, exploitation, synthesis/summary and exercises/application activities, explained below:

❖ **Discovery activity**

Step 1

- The teacher discusses convincingly with learners to take responsibility of their learning
- He/she distributes the task/activity and gives instructions related to the task (working in groups, pairs, or individual to instigate collaborative learning, to discover what is to be learnt.)

Step 2

- The teacher allows the learners to work collaboratively on the task.
- During this period the teacher refrains to intervene directly on the task.
- He/she then monitors how the learners are progressing towards thetask to be done and boost those who are still behind (but without communicating to them)

❖ **Presentation of learners' findings**

- In this section, the teacher invites representatives of groups to present the learners'

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productions/findings.

- After three/four or an acceptable number of presentations, the teacher decides to engage the class into discussion about the learners' findings.
- **Discussion on the learners' findings.** The teacher asks the learners to evaluate the findings citing the ones that are correct, incomplete or false.
- Then the teacher judges the logic of the learners' findings, corrects those which are false, completes those which are incomplete, and confirms those which are correct.

❖ **Institutionalization (summary/conclusion/ and examples)**

The teacher summarises the learnt content and gives examples which illustrate the learnt content.

❖ **Exercises/Application activities**

- Exercises of applying processes and products/objects related to covered unit/sub-unit
- Exercises in real life contexts
- Teacher guides learners to make the connection of what they learntto real life situations. At this level, the role of teacher is to monitor the fixation of process and product/object being learnt.

3) Assessment

In this step the teacher asks some questions to assess achievement of instructional objective. During assessment activity, learners work individually on the task/activity. The teacher avoids intervening directly. In fact, results from this assessment inform the teacher on next steps for the whole class andindividuals. In some cases, the teacher can end with a homework assignment.

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PART II. SAMPLE LESSON PLAN

School Name:…… **Teacher's name:** ……..

	Term	Date	Subject	Class	Unit Nº	Lesson Nº	Duration	Class size
	I	30 /9/2022	SET	P6	1	1 of 7	80 minutes	40

	Type of Special Educational Needs tobe catered for in this lesson and number of learners in each category	• Learners with low vision (2) • Learners with hearing problems (3) • Learners with language difficulties (4) • Intellectually challenged learners (5) • Bright learners (3)
	Unit title	Mechanics and blacksmith tools
	Key Unit Competence:	To be able to use and maintain mechanics and blacksmith tools safely.
	Title of the lesson	Common mechanics tools
	Instructional Objective	Through a garage visit to observe mechanics at work and by practising using mechanics tools such as spanners, pliers, screw drivers, mechanics hammer among others and further, by watching the video through the video link provid-ed, learners should accurately discover the role of various mechanics tools andthe role mechanics play in the society and properly use and maintain the tools.
	Plan for this Class (location:in / outside)	• Individual research work on who a mechanic is. • Academic trip to a garage to witness use of mechanics tools. • Group work (group size should depend on the number of learners in the class and their abilities). • Watching a video in class.
	Learning Materials (for all learners)	• Common mechanics tools such as spanner, pliers, screw driver, hack saw, mechanics hammer, etc. • Charts showing mechanics tools and their uses • Videos on mechanic's tools and their uses or video link: • https://www.youtube.com/watch?v=NF9dQt74O3g • VCDs or DVDs and player and TV Screen (For showing the video) • Computers connected to the internet • Projector (for projecting the video)

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References	Pupil's book for Science Elementary Technology and ICT for Primary 6, computer with internet connection and any other relevant reference textbook.		
Timing foreach step	**Description of teaching and learning activity** Learners observe mechanics at work and watch the videoand discover the various mechanics tools and their uses as the teacher guides them.		**Generic competences and cross cutting issues to be addressed plus a short explanation**
	Teacher activities	**Learner activities**	
Introduction(10 minutes)	Asks learners to study the picture on page 1 of their books and to statewhat is going on. Asks learners to suggest a solution to the problem situ-ation in the picture.	Study the picture and states what ishappening which is: *The picture shows a public service vehi-cle with a flat tyre. The driver is trying to replace the tyre but he cannot do it.The passengers inside the vehicle are complaining of getting late.The driver is stranded as he is not a mechanic.* *He is using a wrong tool (hammer) toremove the wheel.* Gives a solution to the problem situation as - the driver should be trained on the basics of mechanics and mechanics tools and their uses.	**a) Generic competences** ***1. Critical thinking and problemsolving skills*** This competence will be developed as learners study thepicture and give solutions to theproblem situation. ***2. Co-operation and interpersonal management andlife skills*** This competence will be developed as learners freely participate in the discussions regarding the problem situation. **b) Cross-cutting issues** ***1. Peace and values education*** As learners discuss why the driver has to accommodate thepassenger views. ***2. Standardisation culture*** The problem situation may have come about as a result of counterfeit tyre. Stress the needto always buy original products.

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Developmentof the lesson (50 minutes)	Guides learners to carry out research on who a mechanicis and the tools he/ she uses and asks them to write a report. Takes learners to a nearby garage to observe mechanics at work.They shouldnote down how eachtool is being used and draw it in their notebooks. Shows learners a video of mechanics at work. Assists learners to form groups depending on the class size and abilityof learners. Asks learners to discuss, write a report and present what	Carry out research and writes a report. Sample report A mechanic is a person whorepairs, assembles, maintainsor fixes spoilt vehicles. He/ she uses tools such as pliers, hammer, spanner, screw driv-er, hack saw an screw jack. Mechanics work in a garagewhere they name a special room for storing their tools.They are important in our society because they help to repair spoilt and worn out vehicles and make us able touse them safely again. Visits a nearby garage, observes mechanics at workand note down the tools the mechanics are using andtheir uses. Practice using the various mechanics tools. Watch the video, listen andcomment about the video. Form groups according toteacher instructions	**a) Generic competences** *1. Co-operation and interpersonal management and life skills* As learners engage one anotherduring group discussions. *2. Research skills* As learners find out the meaning of the word mechanic and the variousmechanics tools and their uses. *3. Communication in official language* As learners do presentations in English and as they share during group discussions. *4. Lifelong skills* By practicing using mechanics tools, learners gain pre-requisite skills thatwill come in handy in their lives if they were to become mechanics. **b) Cross-cutting issues** 1. **Environment, climate changeand sustainability** The oils and other chemicals that come from machines when not disposed of well, cause pollution. Caution learners against disposing ofthese wastes anyhow. 2. **Gender education** Emphasize to learners the fact thatboth men as well as women can earn a living by becoming either a mechanic. 3. **Peace and values education** Caution learners against using toolsas weapons to hurt others. 4. **Standardization culture** Warn learners against use of counterfeit materials and products. 5. **Inclusive learning** Allow all learners to participate equally irrespective of their gender,physical disability or mental challenges.

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	they saw during the garage visit or in the video.	Discuss and write a report and does a presentation to the rest of the class.	

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<table>
<tr>
<td>Conclusion:
(20 minutes)

a) Summary</td>
<td>Asks a volunteer to come and summarise what they have learnt inthis lesson.</td>
<td>Listens to the fellow learnerand takes short notes.

Summary notes
A mechanic is a person who assembles, repairs or fixes vehicles. He or she uses tools such as spanner, pliers, screw driver among others to repair the vehicle. Common mechanicstools and their uses are given in the table below.
<table>
<tr><th>Tool</th><th>Use</th></tr>
<tr><td>Spanner</td><td>Fastening nutsand bolts</td></tr>
<tr><td>Hack saw</td><td>Cutting metals</td></tr>
<tr><td>screw driver</td><td>Driving screws</td></tr>
<tr><td>Screw jack</td><td>Lifting vehicles</td></tr>
<tr><td>Pliers</td><td>Holding objects</td></tr>
</table></td>
<td>a) Generic competences

1. Communication in officiallanguage
As the volunteer learner does presentation in English to the rest ofthe class.

2. Peace and values education
Emphasise to learners the impor- tance of accommodating other peo-ple’s views.They should not overly criticise the presenter even if he/shemakes mistakes.</td>
</tr>
<tr>
<td>b)Assessment</td>
<td>Recaps by highlighting the main points on who a mechanic isand the tools theyuse and correctingthe learner who volunteered. (Refer
to pupils book pages2-7 for the facts).

Gives oral questions to assessachievement of lesson objectives. The questions mayinclude:

Sample questions:
1. Who are mechanics?
2. Which tools do mechanics use?</td>
<td>Listens to thecorrects the taken during
presentation
Learners ansquestions:
Answers toquestion

1. People who repair/assemble/fix spoilt vehicles.
2. Spanners,screwdriver, hammer, pliers,etc</td>
<td>a) Cross-cutting issues1.Inclusive learning
Any learner should be chosen to do the presentation irrespective oftheir abilities.

2. Gender education
Both boys and girls should be given equal opportunity to present to therest of the class</td>
</tr>
</table>

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	3. What role do mechanics playin our lives?	3. They repair broken down vehicles making transportation from one place to another possible.	

Teacher self-evaluation	Some learners had problems using the mechanics tools. Further garage visits will bearranged for them to improve on their skills of using the tools.

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PART III: UNIT DEVELOPMENT

UNIT 1: MECHANICS AND BLACKSMITH TOOLS

1.1. Key unit competence

To use and maintain mechanics and blacksmith tools safely

1.2. Prerequisite

This unit is about mechanics and blacksmiths tools. Remember that learners at this level have already interacted with tools before. For example, in Primary 4, they learnt about agricultural tools, their safe use and maintenance. While in Primary 5, they learnt about carpentry and masonry tools. Take advantage of this and link what they learn here with theirpast experiences about these tools.

Further,inform leaners that the conceptsin this unit can be applied in woodworkand metalwork. Let learners understandthat when they continue and further their education in this area, they may become mechanical or civil engineers.

1.3. Introductory activity and guidance

❖ **Guidance on the introductory activity**

This topic is about mechanics andblacksmith tools, their uses and maintenance.

- Ask learners to look at the picture on page 1 (Fig 1.1) and let them discuss what they see.
- Let them brainstorm in five minutes to discover what is taking place in the picture of the introductory activity.
- Ask them questions under the picture and try to orient their answers to the right ones.
- What topics do they think this unit will include based on the picture?
- Give time for some brainstorming and after share the main sub-units.
- Guide the learners to discover that it is important to learn mechanics as a way of getting out of such situations

❖ **Answers to the introductory activity**

2. It shows a passenger vehicle with a flat tyre. The driver is trying to repair it buthe is stranded and does not know what to do. He is using a wrong tool (hammer)to remove the tyre. The passengers on the other hand are becoming impatientwith him.
3. A person who repairs machines and vehicles is called **a mechanic.**
4. Mechanics commonly use spanners, pliers, hammers, screw drivers, metal saws, drills and many others

1.4. List of lessons

#	Lesson title	Learning objectives	Number of periods: 8
1	The common Mechanics tools	Identify and explain the uses of mechanics tools	2

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2	Use and maintenance of mechanics tools	Explain the use and maintenance of mechanics tools	1
3	Dangers and precautions when using mechanics tools	Identify potential dangers of using mechanics tools and ways of preventing them	1
4	The common Blacksmith tools	Identify and explain the uses of Blacksmith tools	1
5	Use and maintenance of blacksmith tools	Explain the use and maintenance of Blacksmith tools	1
6	Dangers and Precautions when using blacksmith tools	Identify potential dangers of using Blacksmith tools and ways of preventing them	1
7	Assessment	Demonstrate the achievement of key unit competence and lessons objectives	1

Teaching approach for each lesson

1.4.1. The common Mechanics tools

a) Learning objectives

Identify and explain the uses of mechanics tools

b) Teaching resources

- Common mechanics tools such as spanner, pliers, screw driver, hacksaw, etc
- Photographs showing mechanics tools and their uses.
- Videos on mechanics tools and their uses.
- VCD or DVD player.
- Charts of common mechanics tools on manila papers to be in case youdo not have charts on the mechanics tools.

c) Learning activities

❖ **Guidance to the activity 1.1**

- Lead the learners to visit a mechanics workshop or garage nearby.
- When in the garage, the learners should identify the various mechanics tools and practice using them.
  Note: If there is no nearby mechanics workshop or garage to visit, try to borrow various mechanics tools and bring them in classroom to demonstrate them. You may even use the charts or flash cards of various mechanics tools.
- Let learners ask probing questions such as: Who is a mechanic?, What do mechanics use to dotheir work?, What do we call places wheremechanics work from?

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- Let learners observe how the various tools are being used. They can come up with a table like the one in activity 1.1
- Let learners practice using the different tools.
- Let one of the mechanics at the workshop guide them. You should be in hand to guide them too in order to reduce chances of injuries.
- Again, in case there is no garage nearby, you may show learners a video on mechanics at work. Let them watch the video carefully and list down the various tools being used and their uses.

N.B: The activity 1.1 and 1.2 may be done in the same time.

❖ **Answers for learning activities**

❖ **Answer to activity 1.1**

1. Spanners, pliers, hammers, screw drivers, metal saws, drills , bench vice and many others
2. Mechanics commonly use spanners, pliers, hammers, screw drivers, metal saws, drills and many others

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

1.4.2. Use and maintenance of mechanics tools

a) Learning objectives

- Explain the use and maintenance of mechanics tools
- Store mechanics tools properly and practice maintaining them.

b) Teaching resources

- Common mechanics tools such asspanner, pliers, screwdriver, hacksaw, etc
- Toolbox
- Grease and oil
- Sandpaper
- Photographs showing mechanicstools and their maintenance

c) Learning activities

❖ **Guidance to the activity 1.2**

- Lead the learners to visit a mechanics workshop or garage nearby.
- Let learners observe how the various tools are being used. They can come up with a table like the one in activity 1.2
- Let learners practice using the different tools.
- Let one of the mechanics at the workshop guide them. You should be in hand to guide them too in order to reduce chances of injuries.

EXPERIMENTAL VERSION

- In case there is no garage nearby, show learners a video on mechanics at work. Let them watch the video carefully and list down the various tools being used and their uses.

N.B : The activity 1.1 and 1.2 may be done in the same time.

❖ **Guidance to the activity 1.3 and 1.4**

- This lesson introduces learners to maintenance of mechanics tools and their safe storage.
- Obtain things such as grease, oil, sand paper and toolbox used to maintain tools.
- Ask learners to observe carefully the pictures on the activity 1.3 and 1.4 and discuss what is taking place in the pictures.
- Let learners write a short note and present their findings
- Provide the mechanics tools you have at school and ask learners to try to maintain and store them.

❖ **Answers for learning activities**

❖ **Answer to activity 1.2**

The challenges encountered are to recognize the tools, to know their uses and how to use them.

❖ **Answer to activity 1.3**

In picture A, the mechanics tools are being maintained using oil and in picture B tools are being repaired.

❖ **Answer to activity 1.4**

The mechanics tool is being thoroughly cleaned, dried using a clean piece of cloth in order to store either in a cool and dry place or in a toolbox.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

1.4.3. Dangers and precautions when using mechanics tools

a) Learning objectives

- Identify potential dangers of using mechanics tools and ways of preventing them
- Handle mechanics tools safely

b) Teaching resources

- Toolbox
- Protective clothing such as gloves,mouth masks, goggles, overall, etc
- First aid kit.

c) Learning activities

❖ **Guidance to the activity 1.5 and 1.6**

- Bring the various protective clothing in class and ask learners what they are used for.

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- This is a case study involving learners comparing risks mechanics encounter when they do NOT use protective clothing.
- Let them look at the pictures andstate what is going on.
- Let the learners recall the visit they made to the mechanics workshop/garage in Activity 1.1.
- Let them say what they observed the mechanics putting on and why.
- Facilitate learners to summarise the lesson byhighlighting the '**dos**' and '**don'ts'** while in a mechanic workshop.
- Emphasize the fact that prevention is better than cure; therefore, learners should always take precautions in their daily lives.

❖ **Answers to the activity 1.5**

The danger observed in the picture is by using a moving hammer the mechanic is being hit the finger and the blood fall.

❖ **Answers to the activity 1.6**

Wear protective clothing such as **overall, mouth masks, gloves, gumboots** among others to protect us as we work.

❖ **Answers to the application activity (Self-test) 1.1**

In the student's book, the application activity is called self-test**.**

1. If there were no mechanics to repair or fix the broken down machines, life would be very difficult because everything that isused need maintenance and repair.
2. (a) Spanner and screw jack
   (a) Spanners
   (b) Natural
3. (a) Bench vice
   (b) A drill
   (c) Wheel spanner
4. The dangers that we face in a mechanics workshop include:
   - Being hit by a moving object.
   - Cuts or burns on our skin whileusing the tools
   - Dangerous chemicals gettinginto our eyes, nose or mouth.
5. Mechanics protective clothes include: overalls, gloves, boots andhelmets.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

1.4.4. The common Blacksmith tools

a) Learning objectives

Identify and explain the uses of Blacksmith tools

b) Teaching resources

EXPERIMENTAL VERSION

- Common blacksmith tools such as hammer, anvil, bellows, pincers,tong, etc.
- Photographs showing blacksmith tools and their uses.
- Videos on blacksmith tools and their uses.
- VCD or DVD player

c) Learning Activities

❖ **Guidance to the activity 1.7 &1.8**

- Allow learners to carry out the research in groups on who ablacksmith is and his/her role in the society. Let them write a report ontheir findings and share with the rest of the class.
- At this point, you can clarify whoa blacksmith is and his/her role in the society.
- Next, lead the learners to visit a blacksmith workshop nearby. While in the workshop, the learners should identify the variousblacksmith tools and practice using them.
- Let learners ask probing questions such as: Who is a blacksmith?, What is the importance ofblacksmiths in our society?, What do blacksmiths use to dotheir work? What do we call places whereblacksmiths work from?
- Let the learners observe how thevarious tools are being used.
- Let them practice using the different tools.
- Let one of theblacksmiths at the workshop guidethem. You should be at hand to guide them too in order to reducechances of injuries.
- If there is no blacksmith workshop nearby, show learners a video on blacksmiths at work and list down the various tools being used and their uses.
- Wind up the lesson by inviting one learner to give a summary of the lesson then highlight common blacksmith tools and their uses as learners take short notes.

❖ **Answers for learning activities**

❖ **Answer to activity 1.7**

Blacksmith commonly use anvils, bellows, pincers and hammers

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

1.4.5. Use and maintenance of blacksmith tools

a) Learning objectives

- Explain the use and maintenance ofBlacksmith tools
- Store Blacksmith tools properly and practice maintaining them.

b) Teaching resources

EXPERIMENTAL VERSION

- Common blacksmith tools such asanvil, bellows, pincers, tongs, etc
- Toolbox
- Grease
- Oil
- Sandpaper
- Photographs showing blacksmithtools and their maintenance.

c) Learning activities

❖ **Guidance to the activity 1.9**

- This is an activity involving learners comparing a situation where a hammer or macheteis left outside overnight and the other is stored safely in the house.
- Let them observe the two tools and compare what has happenedand why.
- Let the learners recall the visit they made to the blacksmiths workshop in Activity 1.7. Let themsay the methods they observed being used to maintain the tools.
- Demonstrate how to maintain some of the tools.Give the learnersa task to practice maintenance ofpractices on tools.
- Guide the learners to form groupsand answer the following questions:

  (i) Which of the tools should be maintained by oiling or greasing?

  (ii) Name the tools that are supposed to be wiped and kept in a dry place.

  (iii) Which of the tools are supposedto be sharpened, wiped and kept in a dry place?

  (iv) Why do you think that we are not supposed to throw or drop thetools?
- Wind up by highlighting the mainpoints as learners write short notes.

❖ **Guidance to the activity 1.10**

- Ask learners to form groups and observe carefully the pictures on the activity 1.10
- Let them describe how blacksmith tools are stored in the picture.
- Let learners write a short note and present their findings

❖ **Answers for learning activities**

❖ **Answer to activity 1.9**

1. When the oil is applied on the anvil and blacksmith hammer to prevent them to develop rust as the way to maintain Blacksmith tools.
2. The hammer left outside develops rust because the hammer left outside had water on it which made it possible for rusting to occur.

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❖ **Answer to activity 1.10**

Blacksmith tools in the picture are cleaned, wiped dry and stored by hanging them on a wall.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

1.4.6. Dangers and Precautions when using blacksmith tools

a) Learning objectives

- Identify potential dangers of using Blacksmith tools and ways of preventing them
- Use blacksmith tools safely
- Maintain adequately blacksmith tools

b) Teaching resources

- Toolbox
- Protective clothing such as gloves, mouth masks, googles, overall, etc.
- First aid kit

c) Learning activities

❖ **Guidance to the activity 1.11&12**

- Bring the various protective clothing in class and ask learners what they are used for.
- This is a case study involving learners comparing risks blacksmith encounter when they do not use protective clothing.
- Let them look at the pictures and describe the danger shown in the picture in activity 1.11 and describe how they can dress appropriately in a blacksmith workshop to avoid accidents in activity1.12.
- Let the learners recall the visit they made to the blacksmith workshop in Activity 1.7.
- Let them say what they observed the blacksmith putting on and why.
- Facilitate learners to summarise the lesson by highlighting the '**dos**' and '**don'ts'** while in a blacksmith workshop.
- Emphasize the fact that prevention is better than cure; therefore, learners should always take precautions in their daily lives.

❖ **Answers for learning activities**

❖ **Answer to activity 1.11**

The danger shown in the picture is that the blacksmith is working and dangerous metal particles getting in the eyes.

❖ **Answer to activity 1.12**

To avoid accidents in blacksmith workshop we should wear **protective clothing** such as overall, mouth masks, gloves, and gumboots to protect us as we work.

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❖ **Answer to the application activity 1.2**

1. Blacksmith's hammer, bellows, anvil, pincers or tongs and the borerer.
2. We use, rat traps, billhooks, machetes, knives.
3. We wear goggles when dealing with blacksmith activities forprotection against dangerous objects that can get into our eyes, also seeing in fire directly with our eyes may destroy our eye lenses

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

1.5. Additional information for the teacher

Types of mechanics tools

There are quite several mechanics tools. What is covered at this level are the most basic tools. In fact, every area of specialization in mechanics has its own set of tools. For example, we have

- Engine specialists' tools.
- Autobody repair tools.
- Diagnostic tools.
- Lifting equipment and jacks.
- Tyre repair tools.

Details of these tools will be coveredby learners when they specialise or take a course in Mechanics

Blacksmith techniques

Learners already have an idea of the tools blacksmiths use. However, they have no idea about the techniques blacksmiths use. Here are some:

- **Drawing** - this refers to hammering a piece of metal tomake it longer and thinner.
- **Tapering** - this is making the end of an iron metal pointed.
- **Bending** - this refers to bendinga metal in a particular way toserve a particular purpose.
- **Upsetting** - this means poundingthe end of an iron metal ontoitself to make it thinner; thereby increasing its cross-section.
- **Spreading** - this refers to hammering iron bar to make it wider and thinner.
- **Punching** - this is the act of creating a hole in a piece of ironmetal. A tool called punch with pointed end is used.
- **Slitting** - this refers to creatinga slit in a piece of a metal.
- **Twisting** - this is meant tocreate aesthetic value. The iron bar is twisted when still hot to make it look attractive.

1.6. End unit 1 assessment (Unit Test 1)

EXPERIMENTAL VERSION

A. Guidance to end unit assessment

- The end unit assessment is called "Unit Test " in the student book, on Page 17-18.
- Select some questions in the "Unit Test 1" and Ask learners those questions to know if they can identify mechanics and blacksmith tools, their roles and describe dangers of mechanics tools and ways of avoiding them. Give remedial questions to weak learners.
- Listen to learners as they make presentations on the mechanics and blacksmith tools, their uses, maintenance and dangers of misusing them. Pay attention to ways by which they avoid being injured while using mechanics and blacksmith tools.
- Request learners to answer all questions of the Unit Test 1 during their self study and when they are at home.

B. Answers to end unit 1 assessment (Unit Test)

1. (a) Mechanics repair, assemble and maintain machines also mechanics help to repair broken down tools and machines, this may make lifeless expensive.

(b) Blacksmith hit hot metals to give them desired shapes thus making tools that we use inagriculture for farming andother utensils that we use at home. Blacksmiths make traps that are used to control pestslike rats, monkeys and mice. They also make tools such as hoes, billhooks, scatters thatare used in farming.

2.

Tools	Use
Bellows	Blowing air into the fire
Drill	Making holes into metals
Bench vice	Holding metals when being cut
Spanner	Fastening and loosening nuts
Blacksmith hammer	Hitting metals to them desired shapes

3. Mutoni should be advised not to undermine any type of job as all jobs act as sources of income for families and the society as whole.
4. To avoid dangers like accidents and pollution that can affect their health.
5. The mechanic in the picture is not putting on protective clothingwhich puts him at a risk of getting
6. Hoes, knives, and cooking pans
7. Ensure that each learner brings the tools and exercises maintenance practices on them

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such as keeping them safely, cleaning, oiling/greasing moving parts

1.7. Additional activities

1.7.1. Remedial Activities

1. A blacksmith uses…….to soften metals.
2. Some mechanics tools that I knoware……., ……and……...
3. Which blacksmith tools do you know?
4. We should…….all tools after use.
5. Who is a mechanic?

1.7.2. Answers to remedial activities

1. Fire
2. Spanner, screwdriver, pliers, hacksaw, bench vice, etc.
3. Hammer, anvil, bellow, pincers,tongs, etc.
4. Wash
5. Somebody who repairs or maintains tools/machines.

1.7.3. Consolidation activities

1. What is the importance ofmechanics in our society?
2. Mention different methods used to maintain mechanics tools?
3. What would happen to tools if theywere not properly maintained?
4. Mention different dangers that we face while working in a mechanics workshop?
5. What should happen in the garageto safeguard the lives of people working in the garage?
6. What are the main tools used byblacksmiths?

❖ **Answers to consolidation activities**

1. Mechanics repair or give service to machines that have broken down, mechanics save our money to avoid buying new machines all the times
2. The tools can be maintained by oiling, greasing and cleaning and wiping.
3. If the tools are not properly maintained,they rust and get damaged
4. These include:
    a. Being hit by a moving object.

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b. Cuts or burns on our skin whileusing the tools.

c. Dangerous chemicals gettinginto our eyes, nose or mouth.

5. Such measures include:

- Getting protective gear for every one working in the garage like overalls, goggles, boots, helmets and others.
- Using the tools carefully to avoidinjury.
- Dispose of dangerous chemicalssafely so they cannot affect the lives of people.

6. Blacksmith commonly use anvils, bellows, borerer and hammers

❖ **Extended activities**

1. Given a chance between a mechanic and a blacksmith, which one would you become? Why?
2. Explain how mechanics interfere with the environment.
3. Discuss the advantages of blacksmiths in the society.

❖ **Answers to extended activities**

1. The answer can be either of the two. Assess reasons given by the learner to see if the advantages/ benefits of each are well captured.Some include: Blacksmiths producehand tools that are useful inAgriculture, for domestic use, etc. Mechanics is well paying, is a service that humanity cannot do without due to breakdown natureof machines, etc.
2. Oil and grease from garages polute the environment. Also, if not recycled, vehicle parts are an eyesore to the environment in general.
3. Produce hand tools that are useful in Agriculture, for domestic use, etc.They also help in recycling metalswhich would cause environmentalpollution.

UNIT 2: SIMPLE MACHINES

2.1. Key unit competence

To classify simple machines and levers

2.2. Prerequisites

The content in this unit is about types of simple machines, their categories and safety precautions to take while using simple machines. It may help to remind learners what they learnt in previous unit on mechanics and blacksmith tools. Also, remind them about what they learnt under agricultural, carpentry and masonry tools in primary 4 and 5. Let them understandthat these are tools majority of which are examples of simple machines. It may also help to differentiate between these simple machines and complex or heavy machinery used in agriculture and industry.

Finally let learners understand the factthat concepts learnt in this unit concept in this unit can be applied in physics and other areas such as woodworkand metalwork. Let learners know that when they continue and further their education in this area, they may become mechanical or civil engineers.

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2.3. Introductory activity and guidance

❖ **Guidance on the introductory activity**

- Ask learners to look at the picture and let them discuss what they see.
- Let them brainstorm in five minutes to answer the questions of the introductory activity.
- What topics do they think this unit will include based on the picture?
- Give time for some brainstorming and after share the main sub-units.
- Guide the learners to discover and suggest some of the simple machines that can be used at the site instead.
- Let learners compare situations when simple machines are used and when they are not used andmake conclusions on which is better.

2.4. List of lessons

#	Lesson title	Learning objectives	Number of periods: 10
1	Definition and difference between simple machine and other materials /tools	– Define simplemachines – Draw and labelthe different simple machines	2
2	Types and characteristics of simple machines	– Identify different types and simple machines – Make patterns of simple machines and levers based on their characteristics	2
3	Introduction to Levers	- Define what a lever is and give examples.	2
4	Classes of levers	– Outline classes of levers – Categorize simple machines according totheir classes	2
5	Dangers and Safety in the use of simple machines	– Safe handling ofdifferent simple machines /levers – Explain the potential dangers of using of simple machines andhow to prevent them	1
6	**Assessment and remediation**	- Demonstrate the achievement of key unit competence and lessons objectives	1

Teaching approach for each lesson

2.4.1. Lesson 1: Definition and difference between simple machine and other materials /tools

a) Learning objectives

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– Define simple machines
– Draw and label the different simple machines

b) Teaching resources

- Common simple machines such as saw, hammer, bottle opener, wheelbarrow, pulleys, etc
- Photographs or charts showing simple machines.

c) Learning activities

❖ **Guidance to the activity 2.1**

- By now, learners have a rough idea of what simple machines are from the demonstration in introduction of the unit. Build on this and put learners in pairs.
- Let the learners carry out the activities in turns this case study.
- Guide them to discuss in groups how easy work becomes when someone uses a simple machine compared to using bare hands as demonstrated in the illustrations.
- Guide them to discover what a simple machine is based on their discussions which is ' anything that enables people to do work easily and with little effort'.
- With your guidance let the learners identify the simple machines they use in their daily lives

❖ **Answers for learning activities**

❖ **Answers to the introductory activity**

2. It is not easier because it requires much effort.
3. To move the materials easily we should use simple machines like wheelbarrow, and pulleys

❖ **Answers to the activity 2.1**

The girl at picture B finds the work easier by moving the load using a wheelbarrow because she is using less effort.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

2.4.2. Lesson 2: Types and characteristics of simple machines

a) Learning objectives

- Identify different types and simple machines
- Make patterns of simple machines and levers based on their characteristics

b) Teaching resources

- Common simple machines such as saw, hammer, bottle opener, wheelbarrow,

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pulleys, etc

- Photographs/ charts showing simple machines

c) Learning activities

❖ **Guidance to the activity 2.2**

- Guide learners to carry out thisactivity in groups.
- Give them sample simple machines toobserve. Let them try using them. They should then discuss whetherthey used the machines in the sameway? You may also take learners for a tour of a nearby workshop to see the various machines in use.
- Build on their findings andintroduce the six types of simple machines i.e. levers, wheel & axle, pulleys inclined planes, wedges and screws.
- Narrow down to each type of simple machine and demonstrate how it is used. Let learners try using the machines as well.
- You may then put learners into groups to discuss how each simple machine is used, write a report and present to the rest of the class.

❖ **Answers for learning activities**

❖ **Answers to the activity 2.2**

The simple machines shown in the picture are windlass, screwdriver, metallic saw, pulleys, ladder, and wheelbarrow.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

2.4.3. Lesson 3: Introduction to Levers

a) Learning objectives

- Define what a lever is and give examples.

b) Teaching resources

- Sea-saw
- Crowbar
- Two stones (one large, another small)

c) Learning activities

❖ **Guidance to the activity 2.3&2.4**

- Let learners play on a see saw as directed in this activity.
- Let them say why one person goes down and another up.
- Guide them to assemble the crowbar and the stones as shown. Letthem try using the crowbar to lift the big stone.

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- At this point, you can bring out the concept of fulcrum, load andeffort. Guide them to understand what each means and how they interrelate.
- Let learners answer questions 4 in this activity. You can then guide them into discovering what a lever is and show them the Figure 2.2 on page 23.
- Let them draw it in their exercise books and label thevarious parts.

❖ **Answers for learning activities**

❖ **Answers to the activity 2.4**

1.a) The boy goes down because the effort he is applying to the lever is greater than that applied by the girl.

b) If the boy changes the position toward the girl, she will start to move down.

2.Using a crowbar is easier to move the stone than to lift it.

3.a) Effort is Y

b) Load is W

c) Pivot or fulcrum is the small stone under the crowbar

d) Crowbar is a lever beam

4.A lever is made up of effort, fulcrum and load.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

2.4.4. Lesson 4: Classes of levers

a) Learning objectives

- Outline classes of levers
- Categorize simple machines according totheir classes

b) Teaching resources

- Common simple machines such ascrowbar, hammer, bottle opener, wheelbarrow, fishing rod, scissors, pliers, etc.
- Photographs or charts showing various levers and their parts.

c) Learning activities

❖ **Guidance to the activity 2.5**

- Obtain some simple machines such as crowbar, hammer, bottle opener, wheelbarrow, fishing rod, scissors, pliers, etc. You can also ask learners to bring some form home.
- You may introduce this lesson by reminding learners what they learnt in the previous lesson. Ask them to draw parts of a lever intheir exercise books
- Guide learners to carry out thisactivity in pairs. Give them a hammer, a tin opener and a

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spade.Let them try using them. They should then discuss the questionsafter the activities.

- Guide them to draw a diagram indicating the positions of effort, fulcrum and the load.
- Build on their diagrams and introduce the concept of the classesof lever i.e. first class, second class and third class levers.
- Narrow down to each class and demonstrate how using the various machines. Let learners try using the machines as well.
- You should then guide learners into discovering which class oflever the machine belongs to. Let learners find out other examples of machines in that class.
- Wrap up this lesson by bringing the simple machines to class and learners practising using them and grouping them.
- Highlight key points as learners take summary notes.

❖ **Answers for learning activities**

❖ **Answers to the activity 2.5**

1. **i)A**: the effort is applied at the end
   B: the effort is applied at the end
   C: the effort is applied in the middle
   ii)A: the turning point is in the middle
   B: the turning point is at one end
   C: the turning point is at the end
   iii) **A**: the load is applied at the end
   B: the load is applied in the middle
   C: the load is applied at the end
2. Facilitate the learners to draw the pictures
3.

ass of levers	amples
rst class levers	aw hammer,tin opener, scissors, pincers, a see saw, pliers,beam balance,crowbar,shears
cond class levers	aper cutter, a nutcracker, a wheelbarrow and a bottle opener
ird-class levers	nnis racket, fishing rod, baseball bat, the human arm, a broom, tweezers, a spade

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

2.4.5. Lesson 5: Dangers and Safety in the use of simple machines

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a) Learning objectives

- Safe handling of different simple machines/levers
- Explain the potential dangers of using of simple machines andhow to prevent them

b) Teaching resources

- Common simple machines such as saw, hammer, bottle opener, wheelbarrow, pulleys, etc
- Photographs/ charts showing simple machines

c) Learning activities

❖ **Guidance to the activity 2.6&2.7**

- Guide learners to carry out these activities in groups.
- Let Learners brainstorm on what they think are the dangers associated with the simple machines and how to avoid them. Let them come up with a list in their notebooks.
- Build on their findings Summarise the lesson by highlighting the **do's** and **dont's** while handling simple machines

❖ **Answers for learning activities**

❖ **Answers to the activity 2.6**

Some dangers that we face when using simple machines are:

- We can get **pricked** by pointed parts of the machines.
- Machines with sharp edges can **cut** our skin.
- We can **fall** when using inclined planes such as ladder.
- We can get **hurt** while using machines like bicycle.

❖ **Answers to the activity 2.7**

To avoid the dangers associated with the use of simple machine we should:

- Always be **careful** when using simple machines to avoid accidents.
- Always **wear protective** clothing when using simple machines.
- Wear protective clothing include overalls, goggles, gumboots, gloves, mouth and nose masks among others.

❖ **Answers to the application activity 2.1**

1. A lever is a rigid bar which balances on a fixed point called a**pivot** (fulcrum), the force applied to the lever is called **effort** andthe resistance to which the force isapplied is called the **load**.

2. X – Effort

   Y – Load

   Z – Fulcrum

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3. (a) When the fulcrum is in betweenthe load and the effort.
   (b) When the load is in betweenthe fulcrum and the effort.
   (c) When the effort is in betweenthe fulcrum and the load.
4. Inclined plane

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

2.5. Additional information for the teacher

Throughout history, human beings have developed a number of devices that help them make-work easier. The notable of these are known as the "six simple machines" which are the wheel and axle, the lever, the pulley, the screwand the wedge. Most simple machines work under the principle of mechanicaladvantage.

Archimedes discovered the principle of mechanical advantage (MA) which is given by the formula:

MA = Force(out) / Force(in)

It is therefore a ratio of the force produced by a machine to the force applied to it.

Simple machines are devices that canmake a tough job easier by enabling aperson to apply less force or to applyforce in the direction that is easierto manipulate. Each machine affects the direction or the amount of effortneeded to do work.

Most mechanical machines such asautomobiles or power tools are madeup of hundreds of parts. However, nomatter how complex a machine is it iscomposed of some combination of thesix simple machines above.

2.6. End unit 2 assessment (Unit test)

A. Guidance to the end unit assessment

- **The end unit assessment is called "Unit Test " in the pupil's book, at Page 33-34.**
- Select some questions in the "**Unit Test 2**" and Ask learners those questions to classify simple machines and levers.
- Give remedial questions to weak learners.
- Request learners to answer all questions of the Unit Test 2 during their self study and when they are at home.

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B. Answers to the end unit 2 assessment

1. The invention of simple machines by early human beings helped us to become civilized and live a simpler life than before. People are now able to do work more easily.
2. Open bottles of soda or beer, fishing with fishing rods, opening doors, pulling water from well and moving on stairs.
3. Door handle, a steering wheel, and a windlass.
4. Wheel and axle
5.

1st class levers	2nd class levers	3rd class levers
Pliers	Wheel barrow	Tongs
Pair of scissors	Nut cracker	Tweezers

6. Parts of the body which act as levers are the human arms and the legs.
7. The roads are meandering; this is to create an inclined plane on the hill so that it can be easy to go up hill. Otherwise, it would be very difficult to go up the hill if the road is to be constructed straight upwards.
8. Screws and bolts are used to hold and join pieces of metals or wood together. Screws are also used in car jacks.
9. Simple machines, especially those with sharp edges should be used carefully because they can cause injury and cuts to our bodies.
10. First class
11. (a) True (b) True
    (c) False (d) False
    (e) True
12. D
13. Third class lever
14. Simple objects which we use to make work easier. They reduce force required to do the work, change direction of force and increase efficiency.
15. Spade, hoe, wheelbarrow, hammer, saw, crowbar, etc
16. To create an inclined plane of sorts. This helps to reduce amount of energy required to climb uphill.
17. A lever is a rigid bar which balances on a fixed point called a pivot (fulcrum), the force applied to the lever is called effort and the resistance to which the force is applied is called the load.

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18. X – Effort
    Y – Load
    Z – Fulcrum
19. Inclined plane

2.7. Additional activities

❖ Remedial Activities

1. A…… makes work easier.
2. Some examples of simple machinesinclude……..,……..and……..
3. Which are the six classes of simplemachines?
4. A lever belongs to either……..,……..or……class.
5. A windlass is an example of a ……. machine.

❖ Answers to remedial activities

1. Machine.
2. Wheelbarrow, tin opener, bottle opener, nut cracker, pair of scissors,fishing road, etc.
3. Levers, wheel & axle, pulley, screw, wedge, inclined plane.
4. First, second or third class.
5. Wheel and axle.

❖ Consolidation activities

1. How would you determine whethera machine belongs to first, second or third class?
2. Name the three types of pulleys.
3. What is a wheel and axle?

❖ Answers to the consolidation activities

1. By determining the position of fulcrum, effort or load. In the first class levers, the fulcrum is between the load and effort. In second class levers, the load is between the effort and thefulcrum and in third class levers, the effort is between the fulcrum and the load.
2. Single fixed, movable and block and tackle.
3. The wheel and axel is a simple machine that has two wheels, a large wheel and a smaller wheel fixed together.

❖ Extended activities

1. Why is it not recommended for you to open a bottle using your teeth?
2. Compare and contrast a windlass and a staircase.
3. What is the difference between block and tackle pulley and a movable pulley?

❖ Answers to extended activities

1. We may break our teeth.

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2. A windlass is an example of a wheeland axle; a staircase has steps andis an inclined plane.

3. Movable moves; block and tackle is fixed.

UNIT 3: OBJECTS PRODUCTION

3.1. Key unit competence

To make toys, utility and learning objects

3.2. Prerequisites

This topic is about production of toys,various utility items and learning aids. Specifically, learners will be required to model animal toys and make motorcycletoy using wires. Already, learners have an idea of how these are done givenin Primary 4 they modeled a doll usingclay and made a bicycle using wires. Capitalise on the knowledge and skillsthey acquired during these lessons toadvance the acquisition of skills in this area. Also, make learners understandthat the concepts in this unit are closelyrelated to Knitting in Home Science and Pottery in Arts and crafts. Let learners understand that when they continue and further their education in this area, they may become porters or craftsmen.

3.3. Guidance on the introductory activity

- Ask learners to look at the picture and let them discuss what they see.
- Let them brainstorm in five minutes to answer the questions of the introductory activity.
- What topics do they think this unit will include based on the picture?
- The picture shows school children admiring expensive toys outside a toyshop. They cannot afford them! Help learners to discover that they can easily make simple affordable and good-looking toys for themselves using locally available materials.

3.4. List of lessons

#	Lesson title	Learning objectives	Number of periods:12
1	Making toys using clay	- Explain how to make different toys using clay - To handle and manipulateproperly various materials to make toys using clay	2
2	Making toys using wires	- Explain how to make motorcycles using wires - To handle and manipulate properly wires to make various objects	1
3	Making socks in threads	- Explain how to make socks in threads	1

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		- To handle and manipulate properly threads to make socks	
4	Making scarf in threads	- Explain how to make scarf in threads - To handle and manipulate properly threads to make scarf	2
5	Making hat in threads	- Explain how to make hat in threads - To handle and manipulate properly threads to make hat	1
6	Making gloves in threads	- Explain how to make gloves in threads - To handle and manipulate properly threads to make gloves	1
7	Making regular polygons in paper	- Explain how to make regular polygons in paper - To handle and manipulate properly papers to make regular polygons	1
8	Making solids in paper	- Explain how to make solids in paper & manila paper. - To handle and manipulate properly paper & manila paper to make solids	1
9	Maintenance of utility and learning objects	- Identify the ways of maintaining utility and learning objects produced - Maintain efficiently utility and learning objects	1
10	**Assessment and remediation**	- Demonstrate the achievement of key unit competence and lessons objectives	1

Teaching approach for each lesson

3.4.1. Lesson 1: Making toys using clay

a) Learning objectives

- Explain how to make different toys using clay
- To handle and manipulateproperly various materials to make toys using clay

b) Teaching resources

- Clay or plasticine
- Water

c) Learning activities

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❖ **Guidance to the activity 3.1&3.2**

- Guide learners to form groups depending on class size and their abilities. Let them carry out the activity in their groups, the learners should consider the following questions:
    1. *What do we need whenmodelling?*
    2. *What steps should we gothrough?*
    3. *How can we make our toymore beautiful?*
    4. *How can we make our toystronger?*
    5. *What design can we give our toy to look different from others?*
- Let the learners model the toys with these questions in mind. They should write down the stepsthey followed to model in their notebooks.
- Summarise by highlighting the main points in modelling using clay.
- Organise for learners to carry outfurther activity on page 39 of theirbook.
- Learners can then use the toys for playing after which, they should keep them safely at the science corner of their classroom.

❖ **Answers for introductory**

2. The picture shows school children admiring expensive toys outside a toyshop.
3. Pupils are advised to make their own toys using different materials.

❖ **Answers to activity 3.1&3.2**

Guide and facilitate learners to make the toys in activity 3.1 and 3.2.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

3.4.2. Lesson 2: Making toys using wires

a) Learning objectives

- Explain how to make motorcycles using wires
- To handle and manipulate properly wires to make various objects

b) Teaching resources

- Materials for making toys such as wires, old slippers, rubber bands, used vehicle/bicycle tubes, bottle tops, scissors, pliers, etc.
- Photographs or charts showing simple toys.

c) Learning activities

❖ **Guidance to the activity 3.3**

- Guide learners to form groups depending on class size and theirabilities. Let them carry out the activity in their groups. In these groups the learners can consider the following questions:
    1. *What do we need when makingtoy using wires?*
    2. *What steps should we gothrough?*

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3. *How can we make our toy morebeautiful?*
4. *How can we make our toystronger?*
5. *What design can we give our toy to look different from others?*

- Let the learners make the toys withthe above questions in mind. They should write down the steps theyfollowed to make the toy in theirnotebooks.
- Ask learnersto follow the steps of activity 3.3 to make their ownmotorcycle. They should make as strong and as attractive as possible.
- Summarise by highlighting the main steps in making motorcycleusing wires.
- Learners can then use the toys for playing after which, they should keep them safely at the science corner of their classroom.

❖ **Answers to activity 3.3**

Guide and facilitate learners to make the motorcycle in activity 3.3 using wires

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

3.4.3. Lesson 3: Making socks in threads

a) Learning objectives

- Explain how to make socks in threads
- To handle and manipulate properly threads to make socks

b) Teaching resources

- Materials such as threads, weavinghooks or needle, pieces of clothes,pair of scissors, razor blade orlancelet.
- Photographs or charts showing various utility objects.

c) Learning activities

❖ **Guidance to the activity 3.4**

- Guide learners to form groups depending on class size and theirabilities. Tell them to make socks
- In their groups, let them consider the following questions:

1. *What do we need?*
2. *How can we make socks?*
3. *How can we make it look good?*
4. *Which colours can we use tomake it look different from others?*

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- Let the learners make the socks with the above questions inmind. They should write down the steps they followed to make the socks in their notebooks.
- Summarise by highlighting the main steps in making socks.
- Learners can then use the socks for playing after which, they should keep them safely at thescience corner of their classroom.
- You can wrap the lesson by givinglearners a project of making other utility objects.

❖ **Answers to activity 3.4**

Guide and facilitate learners to make the socks in activity 3.4 using threads

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

3.4.4. Lesson 4: Making scarf in threads

a) Learning objectives

- Explain how to make scarf in threads
- To handle and manipulate properly threads to make scarf

b) Teaching resources

- Materials such as threads, weavinghooks or needle, pieces of clothes,pair of scissors, razor blade orlancelet.
- Photographs or charts showing various utility objects.

c) Learning activities

❖ **Guidance to the activity 3.5**

- Guide learners to form groups depending on class size and theirabilities. Let them identify one utility object out of the ones shown.
- In their groups, let them consider the following questions:

1. *What do we need?*
2. *How can we make scarf?*
3. *How can we make it look good?*
4. *Which colours can we use tomake it look different from others?*

- Let the learners make the scarf with the above questions inmind. They should write down the steps they followed to make the scarf in their notebooks.
- Summarise by highlighting the main steps in making scarf.
- Learners can then use the scarf for playing after which, they should keep them safely at thescience corner of their classroom.
- You can wrap the lesson by givinglearners a project of making other utility objects.

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❖ **Answers to activity 3.5**

Guide and facilitate learners to make scarf in activity 3.5 using threads.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

3.4.5. Lesson 5: Making hat in threads

a) Learning objectives

- Explain how to make hat in threads
- To handle and manipulate properly threads to make hat

b) Teaching resources

- Materials such as threads, weavinghooks or needle, pieces of clothes,pair of scissors, razor blade orlancelet.
- Photographs or charts showing various utility objects.

c) Learning activities

Let learners follow the steps of activity 3.5 to make the hat in threads and guide them using the guidance of activity 3.5.

3.4.6. Lesson 6: Making gloves in threads

a) Learning objectives

- Explain how to make gloves in threads
- To handle and manipulate properly threads to make gloves

b) Teaching resources

- Materials such as threads, weavinghooks or needle, pieces of clothes,pair of scissors, razor blade orlancelet.
- Photographs or charts showing various utility objects.

c) Learning activities

Let learners follow the steps of activity 3.5 to make the gloves in threads and guide them using the guidance of activity 3.5.

3.4.7. Lesson 7: Making regular polygons in paper

a) Learning objectives

- Explain how to make solids in paper & manila paper.
- To handle and manipulate properly paper & manila paper to make solids

b) Teaching resources

- Materials such as ruler, pencil, pairof compass, manila paper, razor blade (lancelet) or pair of scissors,photographs or charts showing various utility objects.

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c) Learning activities

❖ **Guidance to the activity 3.6**

- Guide learners to form two groups.
- In their groups,let them consider the following questions to do the activity 3.6:

1. *What do we need?*
2. *What steps should we gothrough?*
3. *How can we cut out the nets and join them to form regular polygons?*

- Let learners make the solids following the steps given.
- Summarise by highlighting the main steps in making *regular polygons*.
- wrap up this lesson by giving learners additional work of making other polygons and present the finishedproduct for assessment.

❖ **Answers to activity 3.6**

Guide and facilitate learners to make regular polygons in activity 3.6 using manila paper.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

3.4.8. Lesson 8: Making solids in paper

a) Learning objectives

- Explain how to make solids in paper & manila paper.
- To handle and manipulate properly paper & manila paper to make solids

b) Teaching resources

Materials such as ruler, pencil, pairof compass, manila paper, razor blade (lancelet) or pair of scissors,photographs or charts showing various utility objects.

c) Learning activities

❖ **Guidance to the activity 3.7**

- Guide learners to form two groups.
- In their groups,let them consider the following questions to do the activity 3.7 :

1. *What do we need?*
2. *What steps should we gothrough?*
3. *How can we cut out the nets and join them to form solids?*

- Let learners make the regular polygons following the steps given.
- Summarise by highlighting the main steps in making learning aids.
- Wrap up this lesson by giving learners additional work of making learning aids and present the finishedproduct for assessment.

❖ **Answers to activity 3.7**

Guide learners and correct them accordinglyas they make the objects. Advise learners to be as creative as possible as they come up with their objects using manila paper.

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d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

3.4.9. Lesson 9: Maintenance of utility and learning objects

a) Learning objectives

- Identify the ways of maintaining utility and learning objects produced
- Maintain efficiently utility and learning objects

b) Teaching resources

Materials such as wrapping papers and utility and learning objects like caps, scarfs, solids such as cubes,cylinders, among others.

c) Learning activities

❖ **Guidance to the activity 3.8**

- You may introduce this lesson byasking learners whether they canrecall the learning aids and utilityobjects they made in previouslessons.
- Let them name some of them
- Allow learners to carry outa research activity on how to maintain utility objects and learning aids.
- Let them write summary notes and share with other class members
- Let learners choose group leadersto do a presentation on their behalf.
- Help them summarise mainpoints in their notebooks.
- Guide learners to come up with innovative ways of protectingtheir materials from being damaged

❖ **Answers to activity 3.8**

Ways of maintaining utility and learning objects include:

- Storing utility objects in a clean and dry place.
- They should be **covered** to avoid dust.
- The learning materials should be placed on the wall of the classroom.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

3.5. Additional information for the teacher

A toy is an item that can be used for playing. Toys are generally used for playing by children. Playing with toys isan enjoyable means of training youngchildren for life in a society. Playing with toys is important when it comesto growing up and learning about

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theworld around us. In addition, young children use toys to discover their identity, help their bodies to growstrong and practice skills they will need as adults. It also helps to improve their dexterity. Utility objects on the other hand are objects that help us during our day-to-day life activities. Examples of utility objects include scarfs, sweaters, caps, flower vessels, water pots among others.

3.6.End unit 3 assessment (Unit test)

A. Guidance to the end unit assessment

- **The end unit assessment is called "Unit Test " in the pupil's book, at Page 49.**
- Select some questions in the "**Unit Test 3**" and Ask learners those questions to know how to make toys, utility and learning objects.
- Give remedial questions to weak learners.
- Request learners to answer all questions of the Unit Test 3 during their self study and when they are at home.

B. Answers to the end unit 3 assessment

1. We use clay or plasticine and wiresto make toys.
2. We may burn the models with drygrass to make them very strong. Wemay also include a frame made ofwires.
3. Flower vessels, lamp holders, pots ,cups ,kettles ,plates and monuments.
4. When making a toy car from wires,the following steps are followed: Thematerials to use include wires, cutout car tubes, old slippers and bottletops.
    a) Make the frames andconnectors with wires.
    b) Connect the frames with theconnectors.
    c) Complete the car and connectto the steering wheel.
    d) We can make the toy look morebeautiful by covering the frame work with coloured papers.
5. a) She is making a floor mat.
    b) She is using papyrus remains.
    c) They can make the mat durableby applying a hem at the edges.
6. a) Utility objects such as scarf,socks, hat and sweater are knitted.
    b) Weaving, plaiting, coiling.

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7. Storing in a cool dry place in a cleanenvironment and keeping covered toavoid dust.
8. a) Wires.
   b) Keeping in a safe place.
9. Assess pupil work and award marks accordingly. Refer to activity 3.4 formore details.
10. He should be encouraged to continue modelling as he is likely todevelop good skills that will help him in life in future.

3.7. Additional activities

❖ **Remedial activities**

1. A toy can be made of……. And…….
2. Which utility objects do you use athome?
3. Name three types of polygons thatyou know.

❖ **Answers to the remedial activities**

1. Clay, wires
2. Baskets, mats, scarf, hat.
3. Cuboid, cylinder, cube.

❖ **Consolidation activities**

1. Describe the process of making apair of socks.
2. How can we determine the shapesof our toys?
3. How can we make our toys lookmore beautiful?

❖ **Answers to the consolidation activities**

1. Obtain a thread and fix itthrough the hole on the needle. Use two needles to knit the socks and givea desired shape. Continue knitting until you reach full socks. Wrap the end of the end of the socks using a piece of cloth to make it strong (hemming).
2. First make a sketch and then makethe frames.
3. We may try to cover the wires withpainted pieces of hard paper, this will give our toy a new look.

❖ **Extended activities**

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#	Lesson title	Learning objectives	Number of periods:17
1	Identification of elements of Gnome environment	• Manipulate the elements of Gnome window • State the different elements o f Gnome environment	1
2	Work with a document	• To create, save, open and rename a document.	2
3	Folder management	• Explain the process of creating a folder. • Recall different operations done on folders. • Create folders. • Differentiate between files and folders.	1
4	Identification of elements of Abiword window	• Identify the elements of the AbiWord environment • Classify and use AbiWord window to produce smart text that is well-formatted.	2
5	Text formatting	• Recognise different ways of editing and formatting text. • Classify and use AbiWord window to produce smart text that is well-formatted.	1
	Spread sheet environment	• Explain the role of spreadsheet applications.	2

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		• Identify the basic features of spreadsheet environment.	
7	Create, save and open a workbook Cell basics	• Create and save a document in a worksheet. • Explain the process of saving document in spreadsheet.	1
	Modifying columns, rows and cells	• Manipulate a worksheet and manage columns and rows.	1
	Formatting a cell	• Understand how to manipulate cell contents. • Organise and use various methods to move, delete and fill data from/into cells.	1
	Worksheet Basics	• Manipulate a worksheet and manage columns and rows.	2
	Mathematical operators basics	• Use basic arithmetical operations to manipulate cells data.	2
	Assessment and remediation		1

1. Distinguish between knitting andweaving.
2. Explain how the content in this unitcan affect the environment.

❖ **Answers to the extended activities**

1. Knitting: This is a method of creating fabric cloth from a singlestrand of cloth/yarn using two needles.

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Weaving: weaving is a method offabric production in which two distinct sets of threads are interlaced at right angles to form acloth.

2. When collecting clay, we may destroy the environment. This therefore must be done with care. Also, throwing pieces of paper threads and other clothing dirty the environment.

PART III: UNIT DEVELOPMENT

UNIT 4: WRITING SKILLS

4.1. Key unit competence

To perform write activity

4.2. Prerequisites

In primary four, learners were introduced to writing skills where they learnt about basic keyboard features and text formatting. They further learnt about tables, pictures and images in primary five and how to manipulate columns and rows of a table and inserting text.In this class, learners will further their skills in these areas by learning more about word processing using Abiword and Gnumeric spreadsheets. Further make learners understand that what they will learn here links with English and Mathematics. Through this, they will understand how to create a table in Write, also how to insert data and typing numbers in math and writing an article or a report using words in English,then typing in write.

4.3. Introductory activity

Guidance on the introductory activity

This topic is about Write activity. As a way of introducing the concept of typing in word processing (AbiWord in gnome interface) refer learners to the picture on page 50 of their book. Let them summarise what is going on in the picture using short notes in their exercise books. They should then type their work in Abiword using XO – Laptop and make it as attractive as possible using the various formatting tools.

4.4. List of lessons

Teaching approach for each lesson

4.4.1. Identification of elements of Gnome environment

a) Learning objectives

- State the different elements of Gnome environment
- Manipulate the elements of Gnome window

b) Teaching resources

XO laptops, laptops or desktops**,** Charts with a short text to practice.

c) Learning activities

Activity 4.2 (Refer to Pupil's book pages 52-53)

- This activity is meant to introduce the Gnome environment to learners.

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- Let the learners observe carefully this window and from the Top panel they should click on each item and write down the drop down menu list that appears. Activity 4.3 (Refer to pupil's book page 54)
- Guide learners to understand the use and the role of each item and drop down list, they should identify the parts from the top panel to bottom panel list.
- At this point, you can guide learners to open AbiWord program.

Activity 4.7 (Refer to Pupil's book page 58)

- Guide learners to follow the steps in this activity to open AbiWord window. They should then go ahead and type words of their choice or those specified in Activity 4.5 page 55 of pupil's book.
- Let learners compare their screen with that on page 53 of their book.
- Summarise the lesson by highlighting the key points on the AbiWord window. Allow learners to write summary notes as you do your presentation. You can also make this more interactive by inviting gifted learners to do lesson summary as you guide them.

Activity 4.8 (Refer to Pupil's book page 59)

- By now, learners have a grasp of what AbiWord window is. Go ahead and show them how to set time and date.
- Put learners in pairs and allow them to set time and date as directed in this activity. At the end of the exercise, they can share their work and see if the times and dates are the same. Let them repeat these until they become familiar.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment

(a) Giving learners a task on

(i) Opening a write activity and typing words of their choice.

(ii) Adjusting date and time on their XO laptops.

b) Asking learners to answer the following questions:

1. What did you learn in this lesson?

   (Ans: The elements of Gnome interface)

2. What are the steps of switching to Gnome interface?

   (Ans: Click on xo-my settings-switch desktop-switch to gnome-restart now).

3. What makes up the Gnome interface?

   (Ans: Top panel and Bottom panel)

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4. State different parts found in Top panel and their roles.
   - Places: Shows different places like documents, computers, pictures, etc.
   - Date: Indicates the calendar and current date and time on the laptop.
   - Battery status: Shows the battery status.
   - Network: Helps to connect or disconnect the Internet and shows the status of your network.
   - OLPC user: Helps to switch off or log out while in Gnome.

4.4.2. Work with a document

a) Learning objectives

- To create, save, open and rename a document.

b) Teaching resources

- Laptops and their accessories

c) Learning activities

Activity 4.8 (Refer to Pupil's bookpage 59)

- Ask learners to practice openinga new AbiWord document. Refer learners to the Activity 4.7 on page 58 that they did earlier on.
- Guide learners to follow the steps of opening a new document individually. Let Learners follow the instructions in the Learners' book and type text of their choice.
- Guide learners to discover how to save a new Abiword document.
- Guide learners while doing this activity and follow the steps of saving a new document individually.
  - Assist learners to follow the steps of choosing where to save their document and the format of saving
    I.e. 'word.doc'.

Activity 4.8 & 4.9 (Refer to Pupil's book pages 59-60)

- Ask learners to discover how to open existing Abiword document.
- Guide learners while doing this activity and follow the steps of opening an existing document individually.
- Assist learners to follow the steps on how to open an existing document make changes in the document and save again.
- They should then re-open the document where they saved and confirm the changes made.

Activity 4.11 (Refer to Pupil's book pages 61)

- At this point, bring to the attention of learners the fact that they should close a document after working on it. Ask learners how they think this can be done.
- Again, put learners in pairs and let them follow the steps given in this activity. Did they successfully close the document? Did they save the changes as prompted by the computer or not? Activity 4.13 (Refer to pupil's book page 62)
- You can then bring the attention of learners the fact that there

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may be need to rename the existing documents or file. Let them practice doing this using a document in their XO laptop.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment:

1. Open a new AbiWord document, individually practice saving the document on the desktop.

(i) Write the steps of saving a document in Abiword.

(Ans: Refer to content inActivity 4.10 page 60 of pupil's book)

2. How do you open an existing document?

(Ans: Click the File tab and select Open option. This will display Open dialog box, which lets you navigate through different file folders and also lets you select a file, which you want to open).

3. Describe the steps of renaming a document.

(Ans: Right click on the document name with the mouse and select 'Rename' from the shortcut Menu that appears. Type a new name for the File and then press Enter).

4.4.3. Folder management

a) Learning objectives

- Explain the process of creating a folder.
- Recall different operations done on folders.
- Create folders.
- Differentiate between files and folders.

b) Teaching resources

XO Laptops or computer laboratory

c) LEARNING ACTIVITIES

Activity 4.14 (Refer to Pupil's book page 62)

- Put learners in pairs considering their abilities. Let them carry out this activity.
- Guide learners to answer the questions in this activity and compare their work to other groups.

Activity 4.14 (Refer to Pupil's book page 64)

- Learners will move and delete a folder in this activity. Let them work in pairs as in earlier activity. They should then follow the instructions given in this activity.

Activity 4.16 (Refer to Pupil's book page 64)

- You may begin this activity by asking learners to tell the difference between a folder and a file. Guide them to discover the difference between these two.

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- Pair learners as done earlier, then guide them to practice the steps in this activity.
- Assist learners to type the text given in their laptops and save it on the desktop.
- They should then reopen the file and save it in the folder 'MY CLASS',access the file again and save it in the second folder 'EXERCISE1' Let them repeat this several times until they become familiar.

Activity 4.18 (Refer to Pupil's book page 66)

- Guide the learners to check the folder properties by following the steps in this activity. Let them write the properties in their exercise books.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment:

1. How can you view the folder properties?

(Ans: Right click on the folder and view the properties in the dialogue box)

2. What are the steps to create a folder?

(Ans: Right click on the empty space on the desktop. Click on the create folder, after it will be renamed 'untitled folder.

3. Identify the steps to delete a folder.

(Ans: Right click on the folder, click on move to trash)

4.4.4. Identification of elements of Abiword window

a) Learning objectives

- Identify the elements of the AbiWord environment
- Classify and use AbiWord window to produce smart text that is well-formatted.

b) Teaching resources

- XO laptops or computer laboratory with functional computers.
- The diagram on page 69 of pupil'sbook.
- Textbooks for reference or the internet.

c) Learning activities

Talking point (Refer to Pupil'sbook page 66)

- This is a discussion activity to be done in a group. Put learners into various groups depending on class size and their abilities.
- Let them look at the diagram and do research about the features of AbiWord window and their uses.
- Ask learners to label the parts shown on the AbiWord window.
- Let them compare their work to the Fig. 4.8 on page 67 of pupil's book.
- At this point, highlight the main features of AbiWord as learners write brief notes. Refer to content on pages 68.
- On the uses of AbiWord features,guide learners to carry out Activities 4.18, 4.19, 4.20, 4.21, 4.22 and 4.23.
- Summarise the lesson by highlighting the key points about using Abiword window. Better still,you can appoint a gifted learner to give summary points as you

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guide them.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment:

1. Describe three tools found on the formatting toolbars.

   (Ans: Font style, font size, bold, italics and underline)

2. What are the toolbars found in the Abi Word window?

   (Ans: Menu bar, Title bar, Formatting toolbars and Status bar)

3. Identify the uses of formatting toolbars.

   (Ans: The Formatting toolbar provides many of the most common options for formatting selected text, such as font, font size, font weight, alignment, and colour).

4.4.5. Text formatting

a) Lesson objectives

- Recognise different ways of editingand formatting text.
- Classify and use AbiWord window to produce smart text that is well-formatted.

b) Teaching resources

XO laptops and computer laboratory.

c) Learning activities

Activity 4.24 (Refer to Pupil's book page 71)

- Let learners have their laptops each and start typing the text given in the learner's book.
- Guide learners to practise selectinga word, a phrase, a sentence or a paragraph. They should also practise bolding text, moving or cutting text, copy-pasting text and how to undo and/or redo.
- Summarise the lesson by highlighting key points as learners take short notes. Refer to pupil's book pages 73.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

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Sample questions of lesson assessment:

1. Which tools are used to format and/or edit a body of text?

   (Ans: Bold, Italics, Underline, font type, font size, alignment, capital letters, colours)

2. What are the steps to selecting text?

- Double click: To select the current word, double-click it. Word will select to the left and right of the cursor, until it encounters a space character.
- Triple-click: A triple-click selects the current paragraph.
- Margin+click: To select an entire line, move the cursor into the left margin.When you see the insertion pointer turn into an arrow pointer, click. Doing so will select the current line.
- [Ctrl]+a: Pressing [Ctrl] +a selects the entire document.
- [Ctrl]+click: To select a sentence (not just a line), hold down [Ctrl] and click any place within the sentence.

3. Open Abiword document, type a text of your choice, practice copy, cut and paste options till you muster them. (Ans: Assess learner work and award marks accordingly)

4.4.6. Spread sheet environment

a) Learning objectives

- Explain the role of spreadsheet applications.
- Identify the basic features of spreadsheet environment.

b) Teaching resources

XO laptops and computer laboratory.

c) Learning activities

Activity 4.29 (Refer to Pupil's book page 74)

- Let learners study the table given,assist learners to open AbiWord and start typing the contents in the table.
- Ask the learners to first try working out the total amounts first by calculation and the using AbiWord.
- Let them brainstorm and say whether there is a better way of manipulating the data.

Activity 4.30 (Refer to Pupil'sbook page 75)

- At this point, guide learners to opena Gnumeric spreadsheet and try working out the totals. Let them compare this and the first attempt where they did it manually.
- Guide learners to harmonise their tables. Let them choose a group leader to do a presentation on their behalf.

Talking point (Refer to Pupil'sbook page 76)

- Put learners in groups depending on the size of the class and their abilities. Guide them to carry out research and discuss the features of a Gnumeric spreadsheet window.

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- They can draw a diagram in their notebooks then compare with Fig. 4.14 on page 76 of pupil's book.
- Wrap up the lesson by highlighting the main features of a Gnumeric spreadsheet with their uses. Let learners write short notes as you summarise.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment:

1. What is Gnumeric spreadsheet?

   (Ans: A computer program used to manipulate and analyze numeric data)

1. Write the steps to open the gnumeric spreadsheet.

   (Ans: Go to application-office-gnumeric spreadsheet)

2. Label the key features of the spreadsheet window.

   (Ans: Refer to Figure 4.14 page 76 of pupil's book)

3. Describe the roles of the spreadsheet?

   (Ans: Help keep track of information in lists, organize numeric values in columns and rows, perform and update calculations)

4.4.7. Create, save and open a workbook Cell basics

a) Learning objectives

- Create and save a document in aworksheet.
- Explain the process of saving document in spreadsheet.

b) Teaching resources

XO laptop or any other computeror computer laboratory, Pamphlets, handouts, and textbooks for reference in class.

c) Learning activities

Activity 4.35 (Refer to Pupil'sbook page 82)

- Let learners using their laptops go to spreadsheet and open a workbook.
  - Guide learners to practice the exercises of opening and closing a workbook.

Activity 4.36 (Refer to Pupil's book page 83)

  - Let learners understand that once they have worked on a workbook,it will need to be saved just like in Abiword. Take them through the activities of saving a workbook as described here. Let them repeat this several times until they get used.

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Activity 4.37 (Refer to Pupil's book page 84)

- Let learners understand that in this activity, they will open a spreadsheet file, which they saved earlier on. Let them carry out this activity in pairs. They should also practice several times for them toget used to.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment:

1. Create a workbook and save it on the desktop as 'My work'.

   (Ans: Assess learner work and ensure they are able to do this)

2. What is a workbook?

   (Ans: A workbook is the MS Excel file in which you enter and store related data. Each workbook can contain many worksheets).

3. State the process of opening an existing workbook.

   (Ans: Select the FILE tab in the toolbar at the top of the screen. Then click on Open in the left menu. You will see your "Recent Workbooks" listed on the right. To quickly open one of these workbooks, click on the workbook name under "Recent Workbooks").

4. State the process of opening an existing workbook. (Ans: Select the FILE tab in the toolbar at the top of the screen. Then click on Open in the left menu. You will see your "Recent Workbooks" listed on the right. To quickly open one of these workbooks,click on the workbook name under "Recent Workbooks").

4.4.8. Modifying columns, rows and cells

a) Learning objectives

- Manipulate a worksheet and manage columns and rows.

b) Teaching resources

- XO laptops or any other computers, Textbooks and other reference materials.

c) Learning activities

Activity 4.40 (Refer to Pupil'sbook page 87)

- Let learners observe the table on activity 4.40 and discuss in pairs to come up with a correct answer on the position of the active cell.
- Ask learners to practice entering and deleting text in the active cell.
- Guide learners to experiment adding columns, rows and cells, deleting columns, rows and cells and also resizing columns and rows in spreadsheet. Refer to content on pages 87-95 of the pupil's book
- Wrap up the lesson by asking learners to practice activity 4.41 in pupils' book page 88

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d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment:

1. Define rows, columns, and cells? (Ans: A column: is a vertical series of cells in a chart, table, or spreadsheet.

A row - is the range of cells that go across (horizontal) the spreadsheet/ worksheet

A cell - A cell is the intersection betweena row and a column on a spreadsheetthat starts with cell A1).

2. In your spreadsheet, practise the steps of deleting and resizing a column.

(Ans: Assess learner work during the practical and award marks accordingly.

4.4.9. Formatting a cell

a) Learning objectives

- Understand how to manipulate cell contents.
- Organise and use various methods to move, delete and fill data from/into cells.

b) Teaching resources

- XO laptops or any other computers.

c) Learning activities

You are advised to handle each of the items above one at a time.

Activity 4.44 (Refer to Pupil'sbook page 89)

- Guide learners to practice this activity in the pupil's book. Let them practice how to change font type/size, insert and remove cell borders, apply colour in text and align text.
- Highlight key points when doing this as learners take short notes. Refer to pupil's book pages 93.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment:

1. Open a workbook, apply all borders to the sheet.

2. Type the data in the cells and practise changing font size and type.

3. Practise applying background colour and text colour to your sheet.

(Ans: In all the cases above, assess learner work during the practical and award marks accordingly).

4.4.10. Worksheet Basics

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a) Learning objectives

- Manipulate a worksheet and manage columns and rows.

b) Teaching resources

- XO laptops or any other computers, Textbooks and other reference materials.

c) Learning activities

- Guide learners to practicee selecting, deleting, inserting and renaming a worksheet,
- Highlight key points learners write down short notes.
- Wrap up the lesson by explaining what a worksheet is. Refer to Pupil's book pages 93.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment:

1. What is a worksheet?

(Ans:A worksheet is a collection of cells on a single "sheet" where you actually keep and manipulate the data).

2. Open spreadsheet, rename sheet 1as P6A, sheet 2 as P6B, sheet 3 as Spreadsheet.

3. Delete the spreadsheet sheet.

(Ans: In questions 2 and 3 above, assess learner work during the practical and award marks accordingly).

4.4.11. Mathematical operators basics

a) Learning objectives

- Use basic arithmetical operations to manipulate cells data.

b) Teaching resources

XO laptops or any other computers, Textbooks

c) Learning activities

Activity 4.45 (Refer to Pupil'sbook page 93)

- Guide learners to discuss and practise the activity above.
- Help learners to understand how to perform calculations in spreadsheet.
- Provide learners with an activity to perform how to make sum by using a formula. See Activity 4.46 on page 96 of pupil's book.
- Summarise the lesson by highlighting the key points about mathematical operators as

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learners take summary notes.Better still, you can appoint a gifted learner to give summary points as you guide them. Refer to the notes in Pupil's book pages 94 – 96.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment

1. Write the examples of basic math formulas in spreadsheet:

   (Ans: =A1+A6 - this Excel formula adds the contents of cell A1 and A6

   = A1+A2+A3 - this Excel formula adds the contents of the three cells specified. (See the SUM function for adding multiple numbers).

   = A3-A1 - this Excel formula subtracts the contents of cell A1 from the contents of cell A3.

   = B2*B3 - this Excel formula multiple the numbers in cells B2 and B3.

   = G5/A5 this Excel formula divides G5 by A5).

2. What is the sum function in spreadsheet?

   (Ans:The SUM function adds together a supplied set of numbers and returns the sum of these values)

3. Why do we need to begin with equal sign in excel formula?

(Ans: This is because the cell contains or is equal to the formula and the value it calculates)

Answers to Self-Test 4.1 (Pupil'sbook Page 73)

- Assess learners' work and award marks accordingly.

Answers to Self-Test 4.2 (Pupil'sbook Page 97)

- Assess learners' work and award marks accordingly.

4.5. Additional content of student and teacher

4.5.1. Additional Information for the student

4.5.2. Additional content for the teacher

- **Workbooks and Worksheets**

When Excel is opened, a workbook appears with three worksheets. Each worksheet contains columns and rows. There are 1,048,575 rows and 16,384 columns. The combination of a column coordinate and a row coordinate make up a cell address. For example, the cell located in the upper left corner of the worksheetis cell A1, meaning column A, row 1.

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The cell address is visible in the Name Box.

Creating a New Workbook

- It is easy to create a new workbook! Simply, click on File – New or Office Button – New and click on Blank Workbook to create a new workbook.

Creating a New Worksheet

- Creating a new worksheet is just as easy. By default, each Excel workbook contains three worksheets. Three tabs displaying Sheet 1, Sheet 2, and Sheet 3 will be displayed at the bottom of the workbook to indicate the separate sheets. To add a new worksheet, simply click on the tab after the tab that says sheet

Common formula errors

- Here are some of the most common mistakes people make when entering formulas and functions:
- Not putting in all the required arguments: If a function is expecting more arguments thanyou have entered, and you get a dialog box, be sure you've placed commas between the arguments and that you haven't overlooked any.
- Circular references: If you refer to the cell's own address in a function,you create a circular error, which is like an endless loop. Suppose that you enter =A1+1 into cell A1.You'll get an error message like the one below. If you click OK at this message, a Help window appears to help you find the problem.
- Text in an argument: Most functions require numeric arguments. If you enter text as an argument, for example, = SUM (text), the word #NAME? appears in the cell. This happens because Excel allows you to name ranges of cells using text,so technically = SUM (text) isn't an invalid function. It is invalid only if there's no range that has been assigned the name "text."

- Hash marks (###) in a cell: This happens when the cell isn't wide enough to display its value. Widen the column to fix this.
- If you receive an error when copying a formula, don't panic; it happens to everyone. Use the skills you learned earlier in this chapter to display the formulas and then check them for the common errors discussed here.

Formatting Columns and Rows

- Often you will need to change your columns and rows in order for text to fit or for the text to fit on the page correctly. There are a number of different methods one can use to do this. Let's start with columns.

Column Width: The formatting thatis unique to columns is Column Width. Column Width is measured in characters. A column's width can be from 0 to 255 characters,which is a really wide column! Decimal values are allowed. In fact,the default size is 8.43 characters.

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- A width of 12, for example, means the column is wide enough for 12 average characters, using whatever you chose as the Standard font.
  The default is Calibri 11 pts. To
  change the font from the default,go to Tools-Options-General-Standard font.
- Be careful when you set a column's width with AutoFit. The column may wind up wider than you expected.Any text will be on a single line in its cell. No matter how long the text is! If you accidentally find you've widened a cell out of sight to the right, use Undo. (my favourite button!) Then resize the column with another method.

Column Width – Drag method

- Dragging is a natural method of adjusting column width. But since you can't see the change until you release the mouse button, it may take you several attempts to get a satisfactory width.

Row Height

- The only unique formatting for rows is Row Height. Row Height is measured in points, like font size,from 0 to 409 points. A row height of zero hides the row.
- The default setting for Row Height is AutoFit. The row height adjusts to the largest font size in the row.

4.6. End unit assessment

a. Guidance on End unit assessment

- The end unit assessment is called **"Unit Test"** in the student book, at Page 98-99.
- Request learners to answer all questions of the "**Unit Test"** during the time reserved to lesson of end unit assessment. If all questions cannot be completed in that time, request them to answer them during their self-study time or as homework.
- Mark their answers and keep records of every student's achievements.
- Provide the remedial, consolidation and extended activities when necessary.

b. Answers for End unit assessment

Let learners attempt the various questions practically then assess their work and award marks accordingly.

4.7. Additional activities

a. Remedial Activities

Questions

In a spreadsheet, letters are used to represent _____

a) Cells
b) Rows
c) Columns
d) Blocks

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2. Cells are identified by a combination of letters and numbers.
a) True
b) False
3. A numeric data analysis tool that allows us to create a computerized ledger.
a) Word processing package
b) Spreadsheet package
c) Graphics package
d) Mathematical Package
4. Which of the following isn't a part of a spreadsheet?
a) row number
b) column number
c) column letter
d) cell address 5. Spreadsheets cannot:
a) do calculations
b) create graphics
c) plot graphs
d) plot charts

Answers

1.C 2.A 3.B 4.B 5.B

b. Consolidation Activities

Questions

1. _____ help us to see patterns.
a) Spreadsheets
b) Calculations
c) Charts d) Graphs
2. An easier way to set up complicated calculations.
a) Decimals
b) Fractions
c) Booleans
d) Functions
3. The cell that is in use.
a) Highlighted cell
b) Main cell
c) Active cell
d) Formula cell
4. The placement of information within a cell at the left edge, right edge, or cantered is:
a) Indentation
b) Placement
c) Identification
d) Alignment
5. A change in the appearance of a value or label in a cell.
a) Alteration
b) Format
c) Indentation
d) Design

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Answers

1. C **2. D** **3. C** **4. D** **5. B**

c. Extended Activities

Questions

1. Open AbiWord blank page, Write a5 paragraph essay about 'A good friend'. Bold and underline the title, save your work in the folder called 'Essay'.
2. Open Gnumeric spreadsheet, on sheet I, type your First term report marks as written on your report. Calculate the total of your marks per subject and the percentage using spreadsheet formula. Name sheet 1 as 'Term I', save your work in the folder called 'My Report' in my Document.

Enter a formula that calculates the Average, Total marks and percentage for each subject.

Format the subject titles in bold and in blue colour.

Answer

Let learners attempt the various questions practically then assess their work and award marks accordingly.

UNIT 5: COMPUTER RESEARCH

5.1. Key unit competence

To Explore and use search engines

5.2. Prerequisites

Learners first heard about computer research in primary 5 where they carried out simple tasks line accessing the world map and the dictionary.They also learnt about emails – how to create an account, how to log in to the account and how to write and send mail. At this level, learners are expected to venture more into search engines and how to effectively search for information using the internet.Make them understand this fact andlet them know that learning the basics of using a search engine, as well as some techniques used to search on the web has some level of association with English and to some extend social studies.

5.3. Introductory activity

Guidance on the introductory activity

This topic is about Computer Research.Let learners study the picture on page 100 and say what it is about. The picture shows pupils searching for the meaning of the phrase 'search engine' and the various types of search engines in a pile of books without success. They seem to be stranded.

Let learners brainstorm and suggest a solution to this problem situation which is to

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search for the words in the internet. This the learners can only do if they have knowledge on how to do effective internet search.

5.4. List of lessons

#	Lesson title	Learning objectives	Number of periods:11
1	Introduction to search engine	▪ Explain the role of search engines ▪ Give examples of search enginesby their types ▪ Explore and use search engines	1
2	Search engine techniques	▪ To name and compare different search engines using keywords and phrases in searching techniques.	2
3	Types of search engines	▪ To name and compare different types of search engines.	2
4	Example and search engines	▪ Give examples of search Engines by their type. ▪ Categorize different Search Engines	2
5	Search information using different search engine	▪ Explore and use search Engines ▪ Desire to do more research via internet ▪ Be aware of the risks of using the internet. ▪ Evaluate information and edit and enrich the information by copying and using a Word processing program	2
	Assessment and remediation		2

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5.4.1. Introduction to search engine

a) Learning objectives

- Explain the role of search engines
- Give examples of search engines by their types
- Explore and use search engines

b) Teaching resources

- XO laptops or any other computers.

c) Learning activities

Activity 5.1 (Refer to Pupil's book page 101)

- Guide learners to carry out the activity. Let them discuss their findings in pairs and compare their answers.
- They can then have a class discussion on the various types of search engines (Talking point page101)
- Let one learner lead the class on recapping the main points and giveexamples. Explain what search engine is as learners take summary notes.

Talking point (Refer to Pupil's book page 101)

At this point, you can introduce the concept of web browser by letting learners carry out this discussion.

Help learners to distinguish between the browsers and where they can be used. You can then give a small activity on using the browsers to search for information and the learners comparing the results of the different browsers.

Activity 5.2 page 103 of pupil's book)

- Summarise the lesson by highlighting the key points about search engines as learners take summary notes. Better still, you can appoint a gifted learner to give summary points as you guide them.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment

- What did you learn in this lesson?(Ans: Search engines and their roles in research)
- What is a search engine? (Ans: A software system designed to search for information on the world wide web)
- Identify different types of search engines. (Ans: Google, Yahoo, Bing, Ask)

5.4.2. Search engine techniques

a) Learning objectives

- To name and compare different search engines using keywords and phrases in searching techniques.

b) Teaching resources

- XO laptops and any other available computers and textbooks.

c) Learning activities

Case study (Refer to Pupil's book page 102)

- Guide learners to search for a keyword of their choice using the various search engines then compare the results.
- Let them repeat this activity by this time round using a phrase instead of a keyword. Again, they should compare the results from the different search engines.
- Stress the need to be careful when choosing phrases for the searches to be successful.

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Activity 5.3 & 5.4 (Refer to Pupil's book page 104 - 105)

- Guide learners to carry out these activities in groups of four. Let them compare the search results that they obtain.
- Re-inforce the need to choose search phrases properly by letting learners carry out the case study on page 105 and activity 5.4 on pages 105 of pupil's book.
- Summarise the lesson by highlighting the key points on the phrase and keyword techniques of searching. Refer to the notes in Pupil's book page 106. Allow learners to write summary notes asyou do your presentation. You can also make this more interactive by inviting gifted learners to do lesson summary as you guide them.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment

- Identify the two search engine techniques. (Ans: Keyword search and phrase search)
- Explain the roles of search engines.(Ans: They act as a bridge between the world wide web and the computer)
- Differentiate the keyword and phrase types of search engine techniques. (Ans: Keyword uses just one word while phrase searching uses a group of words)

5.4.3. Types of search engines

a) Learning activities

- To name and compare different types of search engines.

b) Teaching resources

XO laptops or any other available computers, Textbooks.

c) Learning activities

(a) Primary search engines

Activity 5.5 (Refer to Pupil's book page 106)

- Introduce learners to the three primary search engines, which are: Google, Bing and yahoo.
- Put learners in small groups according to their abilities. Ask them to log onto their computers and input each of these search engines. Let them carry out the activity above.
- Guide learners to compare the results of their searches. Let them answer these questions: Which search engine gave more convincing outcomes? Based on this, which search engine would you prefer for carrying out your research?
- Summarise the lesson by highlighting the key points about searching a phrase 'one laptop per

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child' as learners write short notes.

b) Secondary search engines

Activity 5.6 (Refer to Pupil's book page 107)

- Put learners in groups of five and allow them to log on to their computers.
- Guide them to go to ask.com and search who the president of Rwanda is. They should then compare their search results.
- Wind up this section by clarifying what secondary search engines are giving examples.
- Let learners search the same question using the other search engines (Lycos, look smart, miva and spotting) and compare their results.

c) Targeted search engines

Activity 5.7 (Refer to Pupil's book page 107)

- Put learners in groups and allow them to log on to their computers.

Guide them to go to City search,Yahoo Travel or Music search and search for the various items listed.

- Allow the learners to discuss and share their search results.
- Clarify what targeted search engines are as learners write summary notes.

d) Meta search engines

Case study (Refer to Pupil's book page 108)

- Put learners in groups and allow them to log on to their computers.
- Guide them to go to meta crawlerand Dogpile and search for the process of digestion.
- Allow the learners to discuss and compare their search results.
- Clarify what meta search enginesare as learners write summary notes.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

5.4.4. Example and search engines

a) Learning objectives

- Give examples of search Engines by their type.
- Categorize different Search Engines

b) Teaching resources

- XO laptops or computer desktop, Internet connectivity

c) Learning activity

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a) Science-specific search engines

Case study (Refer to Pupil's book page 108)

- Put learners in groups of four and allow them to log on to theircomputers.
- Guide them to go to google scholar,science direct and Get CITED and search for climate change.
- Allow the learners to discuss and compare their search results.
- Clarify what science - specific search engines are as learners write summary notes.

b) Social Science - specific searchengines – Case study **(Refer to Pupil's book page 109)**

- Put learners in groups and allow them to log on to their computers.
- Guide them to go to behavioural brain science archive,social science research network, socio Site and The Socio Web and search for populations of sub-Saharan Africa countries.
- Allow the learners to discuss and compare their search results.
- Clarify what Social science specific search engines are as learners write summary notes.

c) Art and humanities – specific search engines – Activity 5.8 (Refer to Pupil's book page 109)

- Put learners in groups and allow them to log on to their computers.
- Guide them to go to VADS visual art images and Arts Search and search for the origin of Kinyarwanda language.
- They should also find out more about Kinyarwanda language from their parents and guardians.
- Allow the learners to discuss and compare their search results.
- Clarify what arts and humanities specific search engines are as learners write summary notes.

d) Format-specific search engines – Activity 5.9

- Finalise by informing learners that the last search engine is the format - specific one which focuses on searching for web pages in a certain subject area.
- Summarise by giving learners a task of doing research on an area of their interest then reporting their findings back to class.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

5.4.5. Search information using different search engine

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a) Learning objectives

- Explore and use search Engines
- Desire to do more research via internet
- Be aware of the risks of using the internet.
- Evaluate information and edit and enrich the information by copying and using a Word processing program

b) Teaching resources

- XO laptops or computer desktop, Internet connectivity

c) Learning activities

- Guide learners to carry out this activity. They should then compare the results of the various search engines.
- Allow learners to share their findings then help them harmonize their points as they write short notes.
- Summarise by giving learners a task of doing research on an area of their interest then reporting their findings back to class.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

1. Go to www.google.com. Search for the question 'what is a browser?Repeat this with different search engines. Compare and write down your research findings. (Ans: Assess student work and award marks accordingly)

2. Identify the different types of search engine. (Ans:Primary, secondary, targeted, meta search engine, science specific search engine, social science specific search engine, art and humanities specific search engine, format specific search engine)

3. Give examples of most popular primary search engine. (Ans: Google, bing, yahoo)

4. Give 3 examples of targeted search engines (Ans : Yahoo travel, music search, city search)

Answers to Self-Test 5.1

Refer to pupil's book page 105

1. World Wide Web
2. (a) Access to information
   (b) Ability to find resources quickly
   (c) Online communication through chat and social networking
   (d) Ability to shop online

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3. Search engines are the foundation of the Internet; it isthe quickest way of finding the information, or product that you want.

4. Key word search involves searching for one word or more words and are punctuation sensitive, while phrase search, you search for exact sentence or phrase. For

example: search for 'milk cow'.Google gives you the answer and websites to search for more information while ask directs you to another website to search for information.

Answers to Self-Test 5.2

Refer to learner's book page 114

1. Primary search engine (Example: Google, msn, yahoo, bing, ask)Secondary search engine (Example: Lycos, miva, look smart,ask.com). Targeted search engine (Example: city search, yahoo Travel, music search) Etc – refer to Pupil's book pages 106

2. Assess student work and award marks accordingly.

3. Assess student work and award marks accordingly.

5.5. Additional content of student and teacher

5.5.1. Additional Information for the student

5.5.2. Additional content for the teacher

Definition of Search Engine and browser

- A web search engine is a software system that is designed to search for information on the World Wide Web. The search results are generally presented in a line of results often referred to as search engine results pages (SERPs). The information may be a mix of webpages, images, and other types of files.

An internet browser, also known as a browser or a web browser, is a software program that you use to access the internet and view web pages on your computer. You can think of your browser as your gateway to the internet. Without browsers, the internet as we know it today cannot work. Common web browsers include Microsoft Internet Explorer, Google, Chrome, Mozilla Firefox, and Apple Safari.

Basic Internet search techniques

- Before starting your search it'sa good idea to have a basic understanding of the tools used toretrieve information. They include:
  - Internet
  - World Wide Web
  - Search engine

Defining Search Tools

- The terms Internet and World Wide Web (Web) are often used interchangeably, but they are not the same thing.
- The Internet provides the electronic communication structure.

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- The Web uses the structure to find and display information from a variety of sources.
- You can search for information on the Web using any number of different search engines. Search engines are large databases of web page files. Search engines use programs called "spiders" or "robots" to "crawl" through Web pages, index the information and add it to the search engine. Most of the information is free, though there may be links to sites that are not free
- When you use a search engine (such as Google, Yahoo, Ask, Alta vista) you are asking it to scan its index of sites and match your keyword(s) and phrase(s) with those in the texts of documents within its database. Due to the sheer number of words indexed by search engines you may get many responses to simple search requests.
- You may get lengthy documents in which your keyword appears only once. Many may not be relevant to your topic though. Web pages found by search engines do not go through a review process. Anyone can publish their ideas. You must evaluate the site and information carefully before trusting the information. No two search engines are exactly alike in terms of:
- Size
- Speed and content
- Ranking schemes
- Search options

Remember – a search engine

- Cannot think for you
- Cannot understand what you mean by your concepts or terms
- Can only match the word(s) you choose
- No single search engine can access the entire Web. The information you retrieve will depend on: The search engine(s) and the search term(s) you use. Check your search engine's home page or initial screen to find out its default or basic settings. Look for "help", "tips" ,"FAQs"
- Know the default settings as this may explain why your search results are not what you expected. Searching for information can be frustrating and the results overwhelming. Analysing your topic, and then using search techniques effectively, will help you obtain the information you needfor school or personal use. First take time to think about exactly what you are looking for – be specific. It may be useful to write out your topic in the form of a sentence or question to help clarify exactly what type of information you need (a) Example: If I want to research dyslexia. What about this topic are you interested in?
    - Do you want to know the extent of the problem (statistics), signs/ symptoms, effect on learning, how to help someone with dyslexia, what age group, etc? (b) Example:

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I want to research driving in the elderly population. What about this topic are you interested in? Do you want to know physical

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changes that affect the elderly, how many elderlies still drive (statistics),any laws that limit driving basedon age, pros and cons of driving after a certain age?

- Once you identify your topic break it into key concepts or points.Write down all the keywords and phrases that best describes your topic. Think of synonyms or related terms for each concept or point. Consider spelling variations as well as the singular and plural of words.
- Example: If writing about dyslexia in the adult population consider terms such as:
- Dyslexia: reading disorder,developmental reading disorder,learning disability.
- Adult: adults, mature individual(s)Example: If you are researching driving and the elderly consider these related terms:
- Driving: drive, automobile driving,car driving, auto driving.
- Elderly: old, aged, geriatric(s), elder,older adult, aging.
- The word(s) you use will determine the information you find. Using different words in your search may give you additional information.
- To do a basic search on most search engines type in a keyword you have identified for example: dyslexia. This will produce the greatest number of results, though often not what you want. A multiple keyword search retrieves more specific or focused results.

5.6. End unit assessment

a. Guidance on End unit assessment

- The end unit assessment is called **"Unit Test"** in the student book, at Page 115.
- Request learners to answer all questions of the "**Unit Test"** during the time reserved to lesson of end unit assessment. If all questions cannot be completed in that time, request them to answer them during their self-study time or as homework.
- Mark their answers and keep records of every student's achievements.
- Provide the remedial, consolidation and extended activities when necessary.

b. Answers for End unit assessment

1. www.amazon.in/Books/ b?ie=UTF8&node=976389031
2. www.igihe.rw/
3. (a) Check for correct prediction

   (b) the weather will be a littlebit cold, so dressing and having things like umbrella will be according to the weather.

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4. (a) http://www.answers.
com/Q/ What is the solution to climate_ change #slide=2

(b) Move immediately to renewable energy (solar,wind, water,hydro,tidal andwave, geothermal, oceanthermal, biomass, biofuel and hydrogen

(c) Stop burning fossil fuels(coal, oil and natural gas) in industry, transport and the generation of electricity, which releases carbon dioxide, reforestation.

(d) Plant billions of trees to replace our lost forests.

5. (a) Observe learner's work

(b) Observe learner's work

c. A chart showing division for the 2017 school year

School year periods	Dates	Duration
Second term	17/04/2017 29/07/2017	15 weeks
Second holidays	30/07/2017 13/08/2017	Vacancies 2
Third term	14/08/2017 18/11/2017	14 weeks
Primary leavers' examination	15/11/2017 17/11/2017	3 days

6. A new report predicts that sub-Saharan Africa will record the world's largest population growth between now and 2050. According to the Population Reference Bureau, the world's poorest region will more than double in population, from 1.1 billion to 2.4 billion.

5.7. Additional activities

a. Remedial Activities

Questions

1. What is the height of Google page rank a web page contains;

A) 500
B) 100
C) 10
D) None of the above

2. Domain authority is managed by?

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A) Moz
B) Yahoo
C) Bing
D) Google

3. which file to give instructions to search engine bots?

A) spider.txt
B) robots.txt
C) searchbots.xml
D) None of the above

4. **A web address is also known as**

A. LRU
B. LUR
C. URL
D. ULR

5. **Which is used to shares hardware, software and data between authorized user.**

A. IP
B. Network
C. CPU
D. DNS

Answers

1.C 2. A 3. B 4. C 5. B

b. consolidation activities

Questions

1. Select the examples of agents;

A) Opera
B) Internet Explorer
C) SQL Server database attached to a website
D) Search engine spiders

2. Select the purpose of Search engines;

a. search video
b. search documents
c. download software
d. all of these

3. Google provides priority to themed in-ward links?

A) False
B) True

4. Which of these defined the internet?

a) The Federal Network Committee

b) The Federal Network Council
c) The Federal Networking Committee
d) The Federal Networking council
5. Which is not the example of web browser

A. Safari
B. Avast
C. Internet Explorer
D. Google Chrome

Answers

1. A, B&D 2. D 3. B 4. D 5. B

c. Extended activities

Questions

1. What are the major differences between a browser and a search engine? How can they be useful to you?

2. Give 4 examples of search engines.

Answers

1. Difference Between Browser and Search Engine is that Web browser, or browser, is application software that allows users to access and view Web pages or access Web 2.0 programs. While **search engine is helpful in locating information for which you do not know an exact Web address or are not seeking a particular Web site**.
The search engine is used by the web browser to access and display information from web pages on online servers. Web browsers are intended to view the current URL on the host's web page.

2. Search Engine Market Share. According to statistics from net market share, statist and stat counter, the top 5 search engines worldwide in terms of market share are **Google, Bing, Yahoo, Baidu, and Yandex Ask.com**. Google is the best search engine with a worldwide market share between 81.5% and 92.96%. Bing market share is between 2.34% and 5.29%.

UNIT 6: PROGRAMMING FOR CHILDREN

6.1. Key unit competence

To design and construct geometric shapes using Turtle Art Activity and design different projects in scratch and use Etoys Activities

6.2. Prerequisites

In primary 4, learners practiced turtle art and scratch activities. They learnt about the various features of turtle art and scratch windows and practiced drawing using turtle art and creating simple animations using scratch. At this level learner are expected to further their knowledge in these areas by practicing using turtle art to display various things including images andvideos and carrying out slightly more advanced animations using scratch and e-toys programs. Further let learners understand the fact that this unit has connections with creative writing in English as learners need to think about stories to

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animate and geometric shapesin mathematics.

6.3. Introductory activity

Guidance on the introductory activity

This topic is about Programming for children. Computer programming is the art of writing computer programs, which are a sequence of instructions written using a Computer Programming Language to perform a specified task bythe computer. Computer Programmingis fun and easy to learn provided you adopt a proper approach.

This topic attempts to cover the basics of computer programming using a simple and practical approach for the benefit of new learners. You will build from turtle arts, which pupils learnt in Primary4 and 5 to introduce this unit. Refer learners to the picture on page 116 of their books and the conversations going on. It shows pupils watching a cartoon program with their father. The pupils seem to be amazed. One of them is interested in making his own cartoons when he grows up. The father intervenes and tells him that it is possible for him to make some even now at his age. Let the learners brainstorm about how the kid can make his dream come true -the answer lies in learning computer programming!

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6.4. List of Lesson

#	Lesson title	Learning objectives	Number of periods:25
1	Displaying text and numbers	-State how to compute the sum, difference, product, quotient or average - Compute and perform different calculations in scratch. Conceptualize the ICT contribution in the real life	2
2	Displaying image and audio	-Describe instructions used to display things such as text, images or video and sound. -Outline and use different turtle art instructions to display sound, video and text. Conceptualize the ICT contribution in the real life	2

3	Drawing irregular polygons in turtle art	-Identify turtle art instruction to draw cylinders and cuboids. -Construct and produce different geometric shapes using turtle art instructions.	2
4	Programming animations and computing in Scratch	- Summarize a given story using animations -Design and create cartoon animations according to the given topic - Show creativity for designing and creating more projects reflecting the real life experience	2
5	Scratch project	-State the steps followed to produce a project Support the ideas by developing a convincing project -To select a sprite that fit with the idea to develop a project, and identify any sprite and scene with each step of project -Express the desire to draw more colourful drawings using turtle art commands	2
6	Working with stage in Scratch	-To organize background and sprites for suitable projects. Organize background and sprites for a suitable project - Show creativity for designing and creating more projects reflecting the real life experience	2
7	Creating animated stories in Scratch	-Identify the steps and instructions of creating animations. -Design and create cartoon animations according to the given topic -Summarize a given story using animations.	2
8	Determining angles and shapes	-Recall examples to compute the area, perimeter of geometric shapes. -State how to compute the sum, difference, product quotient or average. -Compute and perform different calculations in scratch.	2
9	Determining areas and working out averages	-State how to compute the sum, difference, product, quotient or average - Recall examples to compute the area, perimeter of geometric shapes.	2

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		- Compute and perform different calculations in scratch.	
10	Identification of elements of Etoys environment	-Identify the components of Etoys environment -Practice and use the components of Etoys window - Show concern of keeping projects	2
11	Adding drawings to the book and painting the background	-Organize background and sprites for a suitable project -Show concern of keeping projects -Express the desire to draw more colourful drawings using turtle art commands	2
12	Etoys projects and animation	-Identify the steps and instructions of creating animations in Etoys. -Explain the steps to save, open, delete and rename a project. To create etoys book containing text, images and animations Appreciate the way of expressing the ideas through projects, animations and Etoys books Be proud to arrange commands and produce animations	2
13	Assessment and remediation		1

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6.4.1. Displaying text and numbers

a) Learning objectives

-State how to compute the sum, difference, product, quotient or average
- Compute and perform different calculations in scratch.
-Conceptualize the ICT contribution in the real life

b) Teaching resources

- XO laptops or any other computers

c) Learning activities

Activity 6.2 (Refer to Pupil's book pages 118)

- Guide learners to perform this activity individually with their computers.
- They should then run the program and see what happens.
- Next, learners should practice displaying numbers and text.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

6.4.2. Displaying Images and Audios

a) Learning objectives

-Describe instructions used to display things such as text, images or video and sound.
-Outline and use different turtle art instructions to display sound, video and text.
-Conceptualize the ICT contribution in the real life

b) Teaching resources

- XO laptops or any other computers

c) Learning activities

Activity 6.3 (Refer to Pupil's bookpages 119 -120)

- Guide learners try the commandsgiven in their XO – laptops. Allow them to run the program and see the outcome. Did they listen to the sound produced?
- At this point, introduce the other command 'print' that can as well be used to display things. Let learners know that it is possible to use both'print' and 'show' to display things together.
- Next, learners should practice displaying images and capturing images using the webcam camera.
- Let learners practice with the commands Activity 6.4 in pupil's book page 120.
- Summarize the lesson by highlighting the key points, which should include the way of arranging commands in drawing shapes and allowing learners to write short notes.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and

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answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment

1. What did you learn in this lesson? (Ans: How to use turtle artfor displaying things).
2. (a) What are the commands that can be used in displaying images or text? (Ans:'show','print')

6.4.3. Drawing irregular polygons in turtle art

a) Learning objectives

-Identify turtle art instruction to draw cylinders and cuboids.
-Construct and produce different geometric shapes using turtle art instructions.

b) Teaching resources

- XO laptops or any other computers, Pamphlets, handouts and textbooks

c) Learning activities

Activity 6.5 (Refer to Pupil's bookpage 121)

- Allow learners to study the polygonLet them say what it is and comeup with commands to draw it in pairs. Guide them accordingly. Let them write the commands down intheir notebooks.

  Further, guide learners to practice and run the commands on page 122 in their laptops. What shape did the commands give? Let them discuss.

- Ask learners how they canarrange commands and draw a parallelogram. Let them write the commands down and try it using their XO laptops.
- Summarise the lesson by highlighting the key points on how better they can draw different regular polygon in turtle art. Refer to the notes in Pupil's book pages121-123.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment

1. Draw the following shapes in turtle art/blocks.
   (a) A cube
   (b) A circle
   (c) A cylinder
   (Ans: Assess learner work as lesson progresses and award marks accordingly)
2. Give examples of irregular polygons. (Ans: cuboids and cylinders)

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6.4.4. Programming animations and computing in Scratch

a) Learning objectives

- Summarize a given story using animations
-Design and create cartoon animations according to the given topic
- Show creativity for designing and creating more projects reflecting the real life experience

b) Teaching resources

- XO laptops or any other computers Pamphlets, handouts and textbooks

c) Learning activities

Activity 6.9 (Refer to Pupil's bookpage 124)

- Ask learners to switch on their laptops, open scratch activity and practice the commands in thisactivity.
- Let them run the program and see what happens.
- Guide learners to understand that in scratch, it is possible to use existing sprites or create your own, make them move and create a scene.
- Demonstrate the above by guiding learners to create a scratch project as shown in Activity 6.10. page 125 of pupil's book.

Activity 6.10 (Refer to Pupil'sbook pages 125)

- Ask learners to open a scratch program in their XO laptop.Guide them to use the commandsprovided to create a cat animation.They should then test the program if it is working.
- Guide learners on how to create their own project by going throughthe steps highlighted in pages 128

Activity 6.12 (Refer to Pupil's book pages 126)

- Guide learners to carry out this activity in groups depending on the size of the class and learner abilities. Let learners share their work with other members. Correct their work as is appropriate.
- Summarize the lesson by highlighting the key points on the different ways of choosing a sprite and how we give movement toa sprite and create animations. Allow learners to write summary notes as you do your presentation.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment

1. (a) What are the steps to follow when you want to make a dog run?

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(b)Write a program to make a dog run.

Ans:(a) – choose a sprite from thefile (a dog) after choosing a sprite,go to script area and start find in the commands to make the dog run.

(b) Sample program is as follows:

- When clicked
- Move 9 steps
- Next costume
- Wait 0.2 secs
- If on edge bounce
- Forever

2. Write the steps to save a project in scratch? (Ans: Go to file-save as-give a name and click on save)

6.4.5. Scratch project

a) Learning objectives

-State the steps followed to produce a project Support the ideas by developing a convincing project.
-To select a sprite that fit with the idea to develop a project, and identify any sprite and scene with each step of project
-Express the desire to draw more colourful drawings using turtle art commands

b) Teaching resources

- XO laptops or any other computers Pamphlets, handouts and textbooks

c) Learning activities

X,Y Co-ordinates (Refer to Pupil's book page 128 - 129)

- You may then inform learners that this lesson is about manipulating the stage. Let learners know that for them to manipulate the stage better, they must know the x, y –co-ordinates of the stage.
- Put learners in pairs considering their abilities. Let them carry out this activity.
- Guide them to move the sprite about and place a cursor at a point as they write the x and y co-ordinates of that point.
- Explain the fact that the x and y co-ordinates are used to locate or specify the position of the sprite. Refer to the content in learner's book page 135. Re-inforce these by way of a demonstration. Give a further activity on determining the position of a sprite.

d) Lesson assessment and Conclusion

- During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some

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questions on the performed activities or content learnt to assess the learning and summarize the content.

6.4.6. Working with stage in Scratch

a) Learning objectives

To organize background and sprites for suitable projects.
Organize background and sprites for a suitable project
- Show creativity for designing and creating more projects reflecting the real life experience

b) Teaching resources

- XO laptops or any other computers Pamphlets, handouts and textbooks

c) Learning activities

Activity 6.15 (Refer to Pupil'sbook pages 130)

- Next, let learners know that thereis need to bring some life to the background of a sprite. This will make the stage beautiful and more attractive.
- Guide learners to carry out this activity. They should at the end run the program and see what happens.

Activity 6.16 (Refer to Pupil's book pages 133)

- By the end of previous activity, the cat was stationery. It is important to make the cat move in order to bring some life to the whole animation.
- Learners should make the cat jump up and down as opposed to the previous scenario where it was stationery. Let learners carry out this activity in groups depending on size and learner's ability.
- Input the commands shown in your XO - laptop then run it. What can you see?
- Save your program file with the name 'cat jumps'. The file will be saved in the scratch default folder present in the XO - laptop.
- Wrap up this lesson by giving learners additional activities, for example the further activity on page 135 of pupil's book.

d) Lesson assessment and Conclusion

- During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment

1. In scratch make a cat animation and make the cat change colour while moving.

2. By choosing a sprite from file, make an animation of boys in parade at the national stadium,put the sound of the drum in their parade.

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3. Write the commands which made animations in question 2.(Ans: Assess leaner answers and award marks accordingly).

6.4.7. Creating animated stories in Scratch

a) Learning objectives

-Identify the steps and instructions of creating animations.
-Design and create cartoon animations according to the given topic
-Summarize a given story using animations.

b) Teaching resources

- XO laptops or any other computers
- The diagrams on table 6.1 page138 of pupil's book.

c) Learning activities

- The learning here will involve going through steps 1–7 of creating an animated story and carrying out activity 6.18 pupils book pages 135-143.
- Guide learners to read and understand the story line on page 139 of their book. You can then go through the steps of creatinganimations as described in pupil's book pages 135– 143.

- In paint editor assist learners to draw Mr Meow, Donut man and Donut.
- Assist learners to create the scripts from the story line and choose a suitable background for it.You will also need to add scripts for movement.
- Do a demonstration, then let learners follow the steps to create,save and test their scratch project.
- You can then let learners carry out.Further activity page 143 in their books. Assess learner work and guide them in doing corrections as is appropriate.
- Summarize the lesson by highlighting key points about creating stories and animating them. Let learners take summary notes. Better still, you can appoint a gifted learner to give summary points as you guide them. Refer to the notes in Pupil's book pages135-143.

d) Lesson assessment and Conclusion

- During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment

1. What is a paint editor?

(Ans: The Paint Editor in Scratch allows you to design and or edit the costumes of sprites and backgrounds of theStage)

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2. Draw a girl skipping the rope and make the script to make a movement and animation.
(Ans: Assess learner work and award marks accordingly)

3. What is a script area?

(Ans: The Scripts Area is where scripts can be assembled. The Scripts Area is the area on the right side of the project editor where scripts are assembled. It can be accessed from both the Stage and from sprites, although the Stage and each sprite all have separate scripts areas and scripts)

6.4.8. Determining angles and shapes

a) Learning objectives

-Recall examples to compute the area, perimeter of geometric shapes.
-State how to compute the sum, difference, product quotient or average.
-Compute and perform different calculations in scratch.

b) Teaching resources

XO laptops or any other computers

c) Learning activities

Activity 6.19 (Refer to Pupil's book pages 144-145)

- Put learners in pairs considering their abilities. Let them carry out this activity by following the instructions given in the pupils' book. Let them identify the shape and angles. They should also find out how to draw this shape in scratch activity.
- Ask learners to switch on their computers and switch on scratch activity. Guide them to input the commands in this activity.
- Let them run the program and see the shape that comes out. At this point, you can tell learners that it is possible to come up with a simpler command using the repeat loop that can do the same thing asthe one above. Let them run this program in their computers and see the shape that comes out.
- Allow learners to try out different commands and see the shape that comes out. They should compare their work to those of other learners.
- Summarise this section by highlighting key points about as learners take summary notes. Better still, you can appoint a gifted learner to give summary points as you guide them.

d) Lesson assessment and Conclusion

- During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

6.4.9. Determining areas and working out averages

a) Learning objectives

-State how to compute the sum, difference, product, quotient or average
- Recall examples to compute the area, perimeter of geometric shapes.

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- Compute and perform different calculations in scratch.

b) Teaching resources

XO laptops or any other computer.

c) Learning activities

Activity 6.20 (Refer to Pupil's book pages 147)

- In order to calculate area of a rectangle, you need to create two variables i.e. length (L) and width(W). You can then guide learner show to make variables and set length and width. Guide learners on how to do this then guide them to input this data in scratch.
- Let them repeat this several time still they master. They should come up with the area of the rectangle by running the program.
- Give them additional activity of calculating the perimeter of the rectangle. They should use the formula: P = 2(L+W)

Using scratch to compute average

- Guide learners to calculate the average by following the guidelines in the learners' book page 148. Ask if they are aware the average can be done in scratch.
- Let them aware that just like in area,there is need to create variables before computing average. This is the first step. Refer to page 148 of pupil's book for an explanation of the variables.
- Refer to content on page 155 on how to create the variables. Let leaners create all the variables and input them in scratch.
- The next step is to create the program. The program has three parts namely:
  - the part that allows you to insert values (N).
  - the part that prompts inputting of numbers.
  - the part that computes the average.
- Guide learners to identify these parts in Fig. 6.7 on page 149. They should then open a scratch activity and input the instructions to determine the average of 14,15 and 16. Let them run the program and see the average obtained.

  Let learners compare their work with that of the rest of the class members.

- Wind up the lesson by giving learners a task to calculateaverage of a set of numbers. Refer to further activity on page 156 ofpupil's book.
- Summarise the lesson by highlighting the key points about calculating the area, perimeter, average and drawing differentshapes in scratch as learners write short notes. Refer to the notes in Pupil's book pages 154 – 156.

d) Lesson assessment and Conclusion

- During the activities, keep on observing and understanding what learners do

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and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment

1. Identify the formula for calculating the area of a rectangle.

   (Ans: area = length x width)

2. Which scripts would you use to draw a square?

(Ans: When clicked, Clear, Pen down, Repeat 4, Move 100, Turnright 90)

6.4.10. Identification of elements of Etoys environment

a) Learning objectives

- Show concern of keeping projects
-Identify the components of Etoys environment
-Practice and use the components of Etoys window.

b) Teaching resources

XO laptops or any other computers

c) Learning activities

Activity 6.21 (Refer to Pupil'sbook page 151)

- Begin this lesson by letting learners input the commands in this activity in their XO laptops. Let them run the program and say what shape is produced. Ask them whether they think the shape can be produced in a better way. The answer is: yes – using Etoys program.
- At this point, you can define what etoys is i.e. a kind of program that allows joining together of code snippets that have been written tocreate interesting motions, games, videos, etc.

(Refer to Pupil's book page 158-159)

- Begin this lesson by letting learners observe carefully the Etoys window and try to identify different tools. Let them draw the window in their notebooks and label the various parts.
  - At this point, let learners log onto their computers and open Etoys program. Ask them to study the window that pops up and compare it to what they saw in activity 6.17.
  - Guide learners to describe what they have seen. Ask probing questions such as: What toolbarscan you see, give their names? (Ans: navigator bar, automobile, three colored clouds and the script). How is etoys screen called? (Ans:The world)
  - Ask learners to describe the etoys window using their own words.

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- Summarise the lesson by highlighting the key points about Etoys window as learners write short notes. Refer to the notes in Pupil's book pages 151 - 152.

d) Lesson assessment and Conclusion

- During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment

1.Name some important elements in etoys window.

(Ans: navigator bar, clouds,automobile, script)

2.What general name do we give to etoys window? (Ans: the world)

3.How can we use etoys?

(Ans: Etoys can be used in makingyour own games, multimedia presentation, computer art, animated story books, computer simulations and many others)

6.4.11. Adding drawings to the book and painting the background

a) Learning objectives

Organize background and sprites for a suitable project
-Show concern of keeping projects
-Express the desire to draw more colourful drawings using turtle art commands

b) Teaching resources

- XO laptops or any other computers

c)Learning activities

Activity 6.22 (Refer to Pupil'sbook page 153)

- Let learners open etoys activity, and open etoys book. Assist learners to view and describe the tools available in 'Supplies option'and their uses.

  Guide learners to do activity 6.24 on page 155 of pupil's book by practicing creating etoys book and add a text.
- Through your guidance, let learners practice adding text, a drawing to the book, and paint abackground using paint toolbar.
- Test the link: https://www.youtube. com/watch?v=Zbem3iKl5NE. This link has a video on creating a book and adding some images. Let learners study it and practice what they see.
- Guide learners to carry out activities 6.23 and 6.24 pages 155-156 in the pupil's book. Did their work look like the picture After the presentations, guide learners to write short notes in their created book and write the main points in their notebooks. Refer to Pupil's book pages 155 – 159.

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- Summarise the lesson by giving learners a task of coming up with a created diary and adding an image in etoys book.

d) Lesson assessment and Conclusion

- During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment

1. What is an etoys book?

   (Ans: A book is a multi-page structure for creating texts, presentations, and the like by dropping in other objects, with controls for adding or removing pages and for navigating).

2. Identify two ways of getting image for the book.
   (Ans: By drawing in paint editor and by importing from the laptop)

3. What is 'halo' in etoys?
   (Ans: A halo is a set of controls that let you make changes to objects in etoys)

4. Identify the tools found in supplies option.
   (Ans: Sound recorder, rectangle,eclipse, star, book and holder)

5. Using paint toolbars, draw a star in e-toys.
   (Ans: Assess student work and award marks accordingly)

6.4.12. E-toys projects and animation

a) Learning objectives

-Identify the steps and instructions of creating animations in E-toys.
-Explain the steps to save, open, delete and rename a project.
-To create e-toys book containing text, images and animations
-Appreciate the way of expressing the ideas through projects, animations and E-toys books
-Be proud to arrange commands and produce animations

b) Teaching resources

- XO laptops or any other computers.
- Video link: https://www.youtube.com/watch?v=xMDYf3_uovk.

c) Learning activities

- Let the learners watch the video above carefully. They should describe what is happening in the video.
- After watching the video, learners now have a rough idea of how to go about creating an etoys animation project.
- Take learners through the steps of creating the animation project as explained in pupil's book pages157 – 166.

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Activity 6.26 (Refer to Pupil's book pages 158)

- Guide learners to practice drawing a car, let them follow the steps as highlighted in the pupils' book.

Activity 6.27 (Refer to Pupil'sbook page 159-160)

Assist the learners to view the properties of the car using the handles as explained here.

Activity 6.28 & 6.29 (Refer to Pupil's book page 160- 162)

- Assist learners to experiment on moving a car fast or slow. Follow the steps from the pupil's book page 158-163

Activity 6.30 (Refer to Pupil's book page 163-164)

- In this activity help learners to continue building their project by creating a steering wheel then fixing it onto the car and using it.

Activity 6.31 (Refer to Pupil's book page 164)

- Guide learners to try different effects on their project, they should also perform saving their projects and opening it.

Activity 6.32 (Refer to Pupil's book page 165)

- Guide learners to perform this activity and see the effect of changing the specifications on the performance of the car.
- You can then let learners know that after finishing the project,they need to publish it. this is same as saving the project.
- Summarize the lesson by highlighting the key points on how to draw the car step by step. Refer to the notes in Pupil's Book pages 151 – 166 Allow learners to write summary notes as you do your presentation. You can also make this more interactive by inviting gifted learners to do lesson summary as you guide them.

d) Lesson assessment and Conclusion

- During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarize the content.

Sample questions of lesson assessment

1. How do you add an image to the book?
   (Ans: Drug it and drop over the book).
2. Create a human head in etoys
   with eyes and mouth that moves.
   (Ans: Assess learner work and award marks accordingly)

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Answers to Self-Test 6.1

Refer to learner's book page 123

1. Text, numbers, sound, images,videos.

2. Regular polygons have equal angles and lengths of sides, irregular polygons do not.

3.Cube, cuboid, rectangle, square.

4.Practical activity – assess learner work then award marks accordingly.

5.Practical activity – assess learner work then award marks accordingly.

6.Practical activity – assess learner work then award marks accordingly.

Answers to Self-Test 6.2

Refer to learner's book page 151

1. An object in Scratch which performs functions controlled by scripts.
2. Because every program is made of sprites and the scripts (instructions) that control them.
3. Practical activity – assess learner work then awards marks accordingly.
4. (a) The "X position" value determines the horizontal location of the sprite and the"Y position" value determines the vertical location or height.

   i. moves sprite horizontally left

   (ii) moves sprite vertically up

5. (a) Create a story line,
   (b) Create sprites
   (c) Create scripts
   (d) Create a simple scene
   (e) Add movements
   (f) Save your projects
   (g) Test
6. Area, perimeter and average.

Answers to Self-Test 6.3

Refer to learner's book page 167

1. World
2. Navigator bar, three colored clouds, an automobile that travels around and the

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script
that controls the car's movement.

3. Halo is a set of tools provided for each object. Right-clicking the object brings up a halo like this one.

4. Right click your mouse over the object then click on viewer handle to see a set of script tiles.

5. Size , color, location, and direction.

6. Script is a sequence of instructions, which is interpreted by anotherprogram.

7. The heading indicates at what angle the object is rotating. It will turn right.

6.5. Additional content of student and teacher

6.5.1. Additional Information for the student

6.5.2. Additional content for the teacher

Turtle Art/Blocks is a fun activity in which you learn how to command a little turtle to draw shapes, pictures and designs. It is an off shoot of the Logo programming language and is intended for children as young as from 6 years old to learn about programming and debugging.

They can play with Turtle Art to draw colourful art patterns using the turtle that accepts instructions for movement. You program with Turtle Art by snapping together blocks. Each block is a command for the turtle, e.g., there is a block to tell the turtle to go forward, to turn right, etc. The blocks are organized on palettes: one for the turtle, one for the pen, etc. Start by clicking on the turtle to show the turtle palette. Try dragging blocks from the palette onto the turtle canvas. Click on them to see what they do.

Scratch is a programming language and an online community where children can program and share interactive media such as stories, games and animation with people from all over the world. As children create with Scratch, they learn to think creatively, work collaboratively and reason systematically. Scratch is designed to be fun, educational, and easy to learn. It has the tools for creating interactive stories, games, art, simulations, and more, using block- based programming. Scratch even has its own built-in paint editor and sound editor.

Users program in Scratch by dragging blocks from the block palette and attaching them to other blocks like a jigsaw puzzle. Structures of multiple blocks are called scripts. This method of programming (building code with blocks) is referred to as "drag-and-drop programming".

E-toys on the other hand is;

- An educational tool for teaching children powerful ideas in compelling ways.
- A media-rich authorising environment and visual programming system.

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- A free software program that works on almost all personal computers.
- E-toys makes children active participants, gives immediate feedback and rewards, and allows students to pursue their own interests in building projects. Young children learn best by experimentation and play. In etoys, kids are trained to grasp, drop, stack, and smash the world around them, often without adult encouragement. E-toys makes abstractions more palpable, allowing children to visualize and explore new ideas.

6.6 End unit assessment

a. Guidance on End unit assessment

- The end unit assessment is called **"Unit Test"** in the student book, at Page 168.
- Request learners to answer all questions of the "**Unit Test"** during the time reserved to lesson of end unit assessment. If all questions cannot be completed in that time, request them to answer them during their self-study time or as homework.
- Mark their answers and keep records of every student's achievements.
- Provide the remedial, consolidation and extended activities when necessary.

b. Answers for End unit assessment

Assess learners work and award marks as is appropriate. The learner should have shown high level ofcreativity in order to earn maximum marks.

6.7 Additional activities

a. Remedial Activities

Questions

1.Scratch is a programming language.

a. True

b. False

2.What is the name of the software that you use to create the game?

a. sprite

b. scratch

c. stage

3.What is the function of the 'forever' command block?

a. Runs the script inside over and over

b. Point sprite in specified direction

c. If condition is true, runs the blocks inside

4. Which command block enables you to control the car?

a. Point in direction

b. Wait secs

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c. When key is pressed

Answers

1. A 2. B 3. A 4. C

B. Consolidation activities

Questions

1. What would you call the track (background) in your racing car game?

a. Sprite

b. Stage

c. Script

2. What is the car in the racing car game?

a. Stage

b. Sprite

c. Script

3. What is the function of the 'when green flag clicked' command block?

a. Points sprite in the specified direction

b. If condition is true, runs the blocks inside

c. Runs the script

4. What is the function of the 'Move 10 steps' command block?

a. Runs the blocks inside over and over

b. Move spite forward

c. Runs script below when specified key is pressed

Answers

1. B 2. B 3. C

c. Extended activities

Questions

1. Self-Test 6.1 Questions 4, 5 and 6

2. Self-Test 5.2 Question 3 and 5

3. Unit Test 6 Questions 4, 5 and 7

Answers

Answers are in teacher guide.

UNIT 7: AIR POLLUTION

7.1.Key unit competence

To explain the phenomenon of air pollution, its consequences and management

7.2.Prerequisites

Learners were already introduced tothe concept of air and its components in primary four.They also learnt about the uses of the main components of air i.e nitrogen, oxygen and carbon dioxide. In this class, they aresupposed to learn about air pollution,its causes, consequences and how it can be controlled. Further, it is also important to highlight the fact that theconcepts in this unit can be

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applied inenvironmental management in social studies. Also, learners should be made aware when they continue with their education in this area,they may becomeenvironmentalists.

Due to increased human activities that include industrialisation,transportation,use of fuel for power generation,cooking,cigarette smoking and many others;suchactivities lead to air pollution. When airis polluted it becomes harmful to humanbeings, other animals and plants. Air pollution also causes global warming which has lead to changes in the climateand unpredictable seasons. Therefore, this unit is about creating awareness onair pollution and its consequences

7.3. Introductory activity and guidance

❖ **Guidance on the introductory activity:**

– In this topic, you will teach about air pollution, its causes, effects and control/ prevention measures.
– Use the pictures in pupil's book on page 169 to guidethe learners on what they are goingto discover in this topic.
– Let learners observe the picture carefully. It shows a mother and her daughterlighting a charcoal burner inside a closed room. This is very dangerous because of the possibility of carbon monoxide poisoning.
– Assist learners to discoverthis and relate it to air pollution which is the concern of this topic.

❖ **Answers for introductory**

The ways to reduce air pollution:

- Using public transports
- Turn off the lights when not in use
- Recycle and Reuse
- No to plastic bags
- Reduction of forest fires and smoking
- Use of fans instead of Air Conditioner
- Use filters for chimneys
- Avoid usage of crackers
- Avoid using of products with chemicals
- Implement Afforestation

7.4.List of lessons

#	Lesson title	Learning objectives	Number of periods: 10
1	Definition of air pollution and Common air pollutants	– Define the term air pollution – Identify airpollutants – Recognize apolluted air	2
2	Sources of common air pollutants	– Identify the sources of common air pollutants	2

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		– Apply the knowledge of recognizingair pollutants	
3	Consequences of polluted air	– Identify causes anddangers associatedwith air pollution	3
4	Protection of air against air pollutants	– Explain how to protect airagainst air pollutants – Develop positive attitude towards avoiding airpollution	2
6	**Assessment and remediation**	– Demonstrate the achievement of key unit competence and lessons objectives	1

Teaching approach for each lesson

7.4.1. Lesson 1: Definition of air pollution and Common air pollutants

a) Learning objectives

– Define the term air pollution
– Identify airpollutants
– Recognize apolluted air

b) Teaching resources

- Computers connected to the Internet.
- Textbooks, pamphlets, handoutsand charts on air pollution.
- Photographs of polluted cities ortowns.

c) Learning activities

❖ **Guidance to the activity 7.1**

- You may begin the lesson by askinglearners probing questions such as:have you ever heard of the word‘pollution?What does it mean?
- This is a research activity to bedone by individual learners. Let learners go to the library toread textbooks on the meaning of air pollution, its various causes and consequences. They can also visit sites where they can get this information. For example: http:// www.scholar.google.com or by simply searching the phrase ‘ ‘air pollution using google searchengine.
- Guide learners to discover the definition of air pollution, which is ‘contamination of air with harmful chemicals.
- Emphasise the fact that we should avoid polluting air at all times.

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- They may also hold group discussions and agree on themeaning of air pollution.
- Let them write their findings down and correctthem as is appropriate.

❖ **Answers to the activity 7.1**

Toxic substances such as carbon dioxide and carbon monoxide are emitted when fuels such as gasoline and diesel oil are burned in automobiles. These substances cause a variety of environmental problems such as **air pollution and global warming**, which is why people say that cars are bad for the environment.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

7.4.2. Lesson 2: Sources of common air pollutants

a) Learning objectives

- Identify the sources of common air pollutants
- Apply the knowledge of recognizingair pollutants

b) Teaching resources

- Computers connected to theInternet.
- Textbooks, pamphlets, handoutsand charts on air pollution.
- Charts on sources of air pollution
- Photographs of polluted cities or towns or drawings of sources of airpollution in manila papers.

c) Learning activities

❖ **Guidance to the activity 7.2**

- Introduce the lesson by reminding learners what they learntunder meaning of air pollution.
- Let volunteers define what air pollution is. Build on this and ask whether the learners know what causes air pollution. Have a brainstorming session.
- Let learners look at the pictures and say what is going on in the pictures of the activity 7.2 (page 170 in learner's book.
- Let them suggest how theactivity in the picture is going toaffect the air.
- Guide the learners to make a fieldstudy and observe physically the possible causes of air pollution andtheir sources. Ask them questions such as:
    1. Which causes of air pollutionare natural?
    2. Identify examples of artificialcauses of air pollution in theenvironment.
- Back in class, let learners writea summary of what causes air pollution and their sources. They

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can group them as shown in the table below.

Cause of air pollution	Artificial source	Natural source

- Summarise the lesson by highlighting main points as learners write summary notes. Refer to Pupil's book pages 171.

❖ **Answers to the activity 7.2**

2. Smokes are being ejected in the air. These cause air pollution
3. (a) Air pollution is caused by **solid and liquid particles and certain gases that are suspended in the air**. These particles and gases can come from car and truck exhaust, factories, dust, pollen, mold spores, volcanoes and wildfires. The solid and liquid particles suspended in our air are called aerosols.

   (b) The effects of air pollution are Long-term health effects from air pollution include **heart disease, lung cancer, and respiratory diseases such as emphysema**. Air pollution can also cause long-term damage to people's nerves, brain, kidneys, liver, and other organs. Some scientists suspect air pollutants cause birth defects

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

7.4.3. Lesson 3: Consequences of polluted air

a) Learning objectives

- Identify causes anddangers associatedwith air pollution

b) Teaching resources

- Computers connected to theInternet.
- Textbooks, pamphlets, handoutsand charts on air pollution.
- Charts on sources of consequencesof pollution.
- Photographs of polluted cities or towns or drawings of consequences of air pollution in manila papers.

c) Learning activities

❖ **Guidance to the activity 7.3**

- You may introduce the lesson using probing questions such as' what do youthink are the consequences of pollutedair? Let them have a brainstorming session.

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- Let learners perform experiment in the activity 7.3 (page 171 in learner's book) individually at their home.
- Let them hold group discussions at school and answer the questions asked in the activity 7.3.
- Let them write their findings down and correctthem as is appropriate.
- Summarise the lesson by highlighting main points as learners write summary notes.

❖ **Guidance to the activity 7.4**

- This is a research activity to bedone by individual learners. Let learners go to the library to readtextbooks on the consequencesof air pollution. They can also visit sites where they can get thisinformation. For example: http:// www.scholar.google.com or by simply searching the phrase 'air pollution' using google search engine
- You may also organise for learners to visit a local environment management office.While there, let them find out from the officers concerned some of the consequences of air pollution.
- Guide learners to discover the consequences of air pollution, during the research activity or the academic visit.
- Emphasize the fact that we shouldavoid polluting air at all times.
- Summarise the lesson byhighlighting main points as learners write summary notes.Refer to Pupil's book pages 172.

❖ **Answers to the activity 7.3**

1. Smokes will spread in the whole room.
2. The shiny lid or pan becomes black.
3. It causes respiratory symptoms such as coughing andwheezing , it causes bronchitis, it causes irritation of eyes nose mouth and throat. It brings on asthma attacks

❖ **Answers to the activity 7.4**

Some consequences that they may mention include:

- *Damage to living organisms(food crops, or natural environment).*
- *Global warming, acid rain.*
- *Destruction of atmosphere.*

Effects on human beings include:

- *It makes the lungs not to function well*
- *It causes irritation of eyes nosemouth and throat*
- *IMay cause asthma attacks*
- *It causes respiratory symptoms suchas coughing and wheezing*
- *It may cause bronchitis*

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- *It causes headaches and dizziness*
- *It may cause cardiovascular problems*
- *It may cause cancer*

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

7.4.4. Lesson 4: Protection of air against air pollutants

a) Learning objectives

- Explain how to protect airagainst air pollutants
- Develop positive attitude towards avoiding airpollution

b) Teaching resources

- Computers connected to theInternet.
- Textbooks, pamphlets, handouts and charts on air pollution.
- Charts on control measures ofpollution.
- Photographs of clean and well-kept environment with many trees or drawings of such an environment in manila papers.

c) Learning activities

❖ **Guidance to the activity 7.5**

- You may introduce the lesson using probing questions such as 'how do you think we can reduce air pollutantsin the atmosphere?
- Let them have a brainstorming session.
- This is a research activity to bedone by individual learners. Let learners go to the library to read textbooks on the control measures of air pollution.
- They can also visit sites where they can get this information on the internet. Let them search for the phrase 'air pollution' using google search engine.
- You may also organise for learnersto visit a local environment management office. While there, let them find out from the officersconcerned some of the controlmeasures of air pollution.
- Guide learners to discover how to control/prevent air pollution from the research activity or the academic visit.
- Emphasise the fact that 'PLANTING OF TREES' is the best way of ensuring clean air. Bring to their attention the factthat this is why the Rwanda government emphasizes on plating two trees every time one is cut.
- Summarise the lesson by highlighting main points as learners write summary notes. Refer to Pupil's book pages 173

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❖ **Answers to the activity 7.5**

The activities in the pictures are very important because planting plenty of trees to create forest covers in order to absorb carbon dioxide. Forests act as both water catchment areas and recycling points of gases.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

7.5. Additional information for the teacher

Some information that may be relevantin this topic include:

(a) *Examples of greenhouse gases are:*

Dangerous gases to the atmosphere are called greenhouse gases. Green house gases are both produced naturally and through human activities. Such gases include carbon dioxide, methane, nitrous oxide and fluorinated gases including chloroflourocarbons(CFCs).

(b) *Effects of global warming include:*

- Desertification
- Increased melting of ice burgswhich increases ocean levels
- Drought
- Changed weather patterns
- Violent winds and hurricanes

(c) *Ways of reducing globalwarming include:*

- Use of energy saving bulbs
- Switch off electric appliances
- Use of solar energy
- Planting many trees
- Reduce rubbish at home
- Reduce use fossil fuels

7.6. End unit 7 assessment (Unit Test 7)

A. Guidance to end unit assessment

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- **The end unit assessment is called "Unit Test " in the student book, at Page 174**
- Select some questions in the "**Unit Test 7**" and Ask learners those questions to create awareness on air pollution and its consequences. Give remedial questions to weak learners.
- Listen to learners as they make presentations on air pollution, and their prevention
- Request learners to answer all questions of the Unit Test 7 during their self study and when they are at home.

B. Answers to end unit assessment/Unit Test 7

1. Air pollution is the adding of dangerous substances intothe atmosphere.
2. Carbon monoxide, methane, nitrous oxide and chlorofluorocarbons.
3. - It causes diseases that affectanimal lives e.g. respiratory diseases.
   - It causes global warmingwhich has caused climate change in the world, those results into natural disasters.
   - Air pollution causes acid rain which damages crops and erodes buildings and vehicles.
4. Burning charcoal producescarbon monoxide in a closed room due to limited supply of air. This can cause carbon monoxide poisoning.
5. The term 'go green' means reducing pollution by all possibleways. When you reduce pollution you help to conserveour environment.
6. Smoking cigarettes in public places is disastrous because it causes respiratory diseases to the passive smokers (non- smokers) and it also contributes to air pollution.
7. (a) Wrong - causes air pollution

   (b) Wrong - Causes air pollution

   (c) Right - Planting trees improves forest cover which in the long run helps in cleaning up the surrounding air by using carbon dioxide during photosynthesis.
8. (a) Global warming refers to the increase of the average atmospherictemperature due to effects of greenhouse gases such as carbon dioxide.

   (b) Planting many trees and avoiding quarrying, mining, smoking, etc to avoid accumulation of green house gases in the atmosphere.
9. Due to smog formed by air pollution, it is always difficult for drivers to drive well due to poor visibility.

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10. People who use fossil fuels should change to clean energylike using natural gas, solar biogas and other forms of energy to avoid pollution.
11. Air pollution is severe in citiesbecause this is where most industries are located, also there are always very many vehicles in the cities.
12. B

7.7. Additional activities

❖ Remedial Activities

1. Air pollution is _____
2. ____,_____,_____gasesare examples of air pollutants.
3. State how air pollution affectsplants.
4. Name one natural and oneartificial source of air pollution.
5. One method of controlling airpollution is to plant__.

❖ Answers to the remedial activities

1. Contaminating air with air pollutants.
2. Carbon dioxide, carbon monoxide, sulphur dioxide, methane.
3. Brings about acid rain which burns plants. Also smoke or dust particlesclog leaves which interferes withtheir normal processes.
4. Natural – dust from volcanic eruptions and that created by wind. Artificial – smoke from industries,fumes from vehicles, etc.
5. Trees

❖ Consolidation activities

1. Define air pollutant?
2. Give two effects of air pollutants to the environment.
3. Suggest different ways of safeguarding air against pollutants.

❖ Answers to the Consolidation activities

1. *Airpollutants are substances that cause air pollution*
2. *Acid rains, destruction of atmosphere, global warming*
3.

- *Using sources of fuel which do not produce so much air pollutants.*
- *Cars should be fitted with catalytic converters which remove dangerous exhaust gases.*
- *We should find alternative sources of energy that are clean, like using solar energy or wind mills.*

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- *Encouraging people to use public transport other than buying their own cars, also walking, cycling, sharing carsall reduce the rate of pollution fromvehicles.*
- *Consider going green by planting moretrees and garden plants.*
- *Use natural gas instead of charcoal.*
- *Quit smoking and encourage those around you to do the same, smoking is terrible for you and for the quality of air around us*

❖ **Extended activities**

1. What differentiates a polluted and a non-polluted environment?
2. The consequences of not taking care of our environment are grave.Discuss.
3. The Rwanda government insists on planting TWO trees for every onecut down. Explain why.

❖ **Answers to the extended activities**

1. Polluted is contaminated with airpollutants, the other one is not.
2. Refer to consequences of airpollution as explained in pupil's book pages 178 - 180.
3. To conserve the environment as trees help in cleaning or refreshingthe air.They also act as catchment areas of rain.

UNIT 8: ANIMALS

8.1. Key unit competence

To explain and practice effective management of goats and cows.

8.2. Prerequisite

Under this unit, learners have already been introduced to the various classesof animals that is mammals, birds, fishes,reptiles and amphibians in primary 4. Further, in primary 5, learners were taught about chicken rearing and goodpractices that should be carried out in chicken farming. In this class, learners will further be taught and practice goatand cattle farming. They will learn about proper housing for goats and cattle, goat and cattle breeds, how to feed goats and cattle and how to prevent goat and cattle diseases. There is also need to sensitize learners about the fact that the concepts in this unit canbe applied in Agriculture under animalmanagement. Let them know that when they continue and further theireducation in this area, they may becomeAgricultural officers, veterinary doctorsor professional farmers.

8.3.Introductory activity and guidance

❖ **Guidance on the introductory activity**

- This topic is about cattle and goat rearing.
- Ask learners to look at the picture on page 176 (Fig 8.1) and let them discuss what they see.
- Let them brainstorm in five minutes to discover what is taking place in the picture of the introductory activity.
- Ask them questions under the picture and try to orient their answers to the right ones.
- What topics do they think this unit will include based on the picture?

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- Give time for some brainstorming and after share the main sub-units.
- The picture is associated with traditional cattle keepingwhereby many cattle are kept withina very small piece of land. The cattleare less productive and are generally weak and unhealthy. This practice goes against the modern way of farming which entails practices like zero grazing and intensive farming. Learners should identify this as the problem situation in the picture.

❖ **Answers to the introductory activity**

2. The picture is associated with traditional cattle keepingwhereby many cattle are kept withina very small piece of land.
3. The cattleare less productive and are generally weak and unhealthy. This practice goes against the modern way of farming which entails practices like zero grazing and intensive farming

8.4.List of lessons

#	**Lesson title**	**Learning objectives**	**Number of periods: 14**
1	Characteristics of a good cowshed/ goat shelter	– List the characteristics of a good cowshed/ goats shelter – Show interest incow/goat breeding	1
2	Types of cattle and goat breeds	– Identify the types ofcow/ goat breeds – Choose a good types ofcows / goats for breeding	2
3	Characteristics of cattle and goat breed to rear	- select proper goats and cattleto rear based on their characteristics - Apply techniquesof cows / goats breeding	2
4	Proper feeding of cows and goats	– Identify elements of agood diet of cattle	2
5	Cattle or goat health sanitation conditions	- Explain health sanitation conditions of cattle and goats.	2
6	Common diseases of cattle/goat	- Explain the most common cattle'sdiseases, their prevention and treatment.	2

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7	Importance of cattle/goat farming	– Explain the importance of cattle/goat farming	2
8	**Assessment and remediation**	- Demonstrate the achievement of key unit competence and lessons objectives	1

Teaching approach for each lesson

8.4.1. Lesson 1: Characteristics of a good cowshed/ goat shelter

a) Learning objectives

- List the characteristics of a good cowshed/ goats shelter
- Show interest incow/goat breeding

b) Teaching resources

- Animal structures at school at home or in a farm.
- Photographs/ charts showing animal structures.

c) Learning activities

This lesson will be divided into two parts:cowshed and goat shelter. Youwill teach about the characteristics of either in two separate sections.

Ask learners if they keep someanimals at home. Ask them the kind of shelter the animals live in.

❖ **Guidance to the activity 8.1**

- Let learners write down the characteristics of the type of shelter where the animals live as per the questions in this activity.
- You can then organise for learnersto visit a nearby livestock farm. While in the farm let them observe the characteristics of the animal houses.
- Let them ask questions in the activity 8.2 (page 177) regarding the type of shelter as the farmer answers.
- They should come up with summarynotes then compare with what they wrote down earlier.
- Back in class,wrap up by highlightingthe characteristics of a good cowshed and goat shelter as learners write summary notes. Refer to pupil's book page 177.

❖ **Answers to the activity 8.1**

Learners will provide different answers depending to the shelter or cowshed visited. Use their findings to conclude by providing the characteristics of a good cowshed. Refer to pupil's book page 177.

d) Lesson assessment and Conclusion

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During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

8.4.2. Lesson 2: Types of cattle and goat breeds

a) Learning objectives

- Identify the types ofcow/ goat breeds
- Choose a good types ofcows / goats for breeding

b) Teaching resources

- Animal structures at school at homeor in a farm.
- Photographs / charts showing various types of animals.
- Textbooks and the internet.

c) Learning activities

Introduce the lesson by remindinglearners about the previous lesson. Ask them whether they remember the animals they saw. Let them name some of them.

❖ **Guidance to the activity 8.2**

- Seek permission from a nearby livestock farm for an educational visit.
- Ask learners to observe livestock athome and in school in preparationfor the lesson.
- Ensure the internet is working fordoing research on livestock breeds.
- This lesson will be taught in twoseparate sessions (1) cattle breeds and (2) goat breeds.
- Ask learners if they keep someanimals at home. Ask them the kind of shelter they use.
- During the trip, let learners observethe various types of cattle (both dairy and beef). Let them write downthe characteristics of cattle that they see. They may consider things like colour, weight, presence/absenceof horns, among others.
- Back in class, give learners the charts of cattle to observe. They shouldcompare the characteristics of the cattle in the chart with what they wrote during the trip. Based on this, guide them to identify the cattle thatthey saw.
- Summarise by highlighting the maincharacteristics of the various breedsof cattle. Refer to pupil's book pages178 – 184.

❖ **Answers to the activity 8.2**

Learners will provide different answers depending to the cattle farm visited. Use their

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findings to conclude by providing the types of cattle/goat breeds. Refer to pupil's book page 178-180.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

8.4.3. Lesson 3: Characteristics of cattle and goat breed to rear

a) Learning objectives

- Select proper goats and cattle to rear based on their characteristics
- Apply techniques of cows / goats breeding

b) Teaching resources

- Photographs / charts showinggood animals for rearing
- Textbooks and the internet

c) Learning activities

- Introduce the lesson by remindinglearners about the previous lesson. Ask them whether they remember the various breeds of animals. Let themname some of them.
- During the trip done in activity 8.2, let the learners finding out what the word'characteristics of a good breed to rear are'. Let them write summary short notes on these.
- Back in class, put learners in groupsdepending on class sizes and theirabilities. Let them summarise theirfindings.
- They should then choose a group leader to do a presentation on behalf of the rest.
- At this point you can explain the various features to look for whenchoosing cattle and goats to rear.
- Emphasise the need to identify high productivity breeds, both drought and diseases resistant breeds and those with good feeding habits.

❖ **Answers to the activity**

Learners will provide different answers depending to the cattle farm visited. Use their findings to conclude by providing the characteristics of cattle/goats for rear. Refer to pupil's book page 184.

d) Lesson assessment and Conclusion

EXPERIMENTAL VERSION

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

8.4.4. Lesson 4: Proper feeding of cows and goats

a) Learning objectives

- Identify elements of a good diet of cattle

b) Teaching resources

- Sample animal feeds such as napier, lucern and a variety of concentrates
- Photographs/charts showing varioustypes of livestock feeds
- Textbooks and the internet

c) Learning activities

❖ **Guidance to the activity 8.3**

- Take learners for an academic visit to a goat/cattle farm. Let them observe the types of feeds that the animals are feeding on.
- Let them find out from the farmerwhy he/she prefers those feeds. Let them write summary notes.
- Back in class, put learners in groupsdepending on their abilities and classsize. Let them discuss their findings.
- Guide learners to categorise the feeds that they saw. Let them come up with a table on the same. They should then compare their work toother group members by way of presentations.
- Emphasize the fact that cattle arefed depending on their type and the age. Also their status, for example, whether pregnant or not matters.
- Also, emphasize the need to give balanced ration to cattle/goats.Balanced ration contains all body nutrients necessary for healthy growth of the animals.
- At this point, you can introduce theconcept of classification of animal feeds.

❖ **Answers to the activity 8.2**

Learners will provide different answers depending to the cattle/goat's farm visited. Use their findings to conclude by providing the proper feeding of cattle and goats. Refer to pupil's book page 184

d) Lesson assessment and Conclusion

EXPERIMENTAL VERSION

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

8.4.5. Lesson 5: Cattle or goat health sanitation conditions

a) Learning objectives

- Explain health sanitation conditions of cattle and goats.

b) Teaching resources

- Photographs/charts showing varioustypes of livestock
- Textbooks and the internet

c) Learning activities

❖ **Guidance to the activity 8.4**

- Take learners for an academic visit to a goat/cattle farm. Let them observe the sanitation conditions on the farm.
- Let them find out from the farmer how to maintain properly the sanitation conditions in a goat or cattle farm. Let them write summary notes.
- Back in class, put learners in groupsdepending on their abilities and classsize. Let them discuss their findings.
- Guide learners to provide the sanitation conditions in a goat or cattle farm. They should then compare their work too the group members by way of presentations.

❖ **Answers to the activity 8.4**

Learners will provide different answers depending to the cattle/goat's farm visited. Use their findings to conclude by providing the proper sanitation conditions in a goat or cattle farm. Refer to pupil's book page 186

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

8.4.6. Lesson 6: Common diseases of cattle/goat

a) Learning objectives

- Explain the most common cattle'sdiseases, their prevention and treatment.

b) Teaching resources

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- Reference materials on diseases that affect cattle and goats.
- Livestock farm
- Computers and Internet

c) Learning activities

This lesson will involve a researchactivity and an academic trip toa livestock farm. Therefore seek permission in advance from the farmmanagers/owners.

❖ **Guidance to the activity 8.5**

- Introduce the lesson by remindinglearners about common diseases that they know or might have come across. They may name some diseases that affect human beings.
- You can then ask them if they think the same diseases affect animals. Theanswer may be yes or no.
- Take advantage and build on this byasking them to do research about this
- You can then take learners for anacademic trip to a livestock farm.While at the farm, let them look outfor any sick animals. They should identify an animal, say 'animal X' and write down its characteristics.
- Back in class, put learners in groups depending on the size of the class and the abilities of class members to harmonise their findings.
- Give them a chart showing variousdiseases that affect cattle and goats.Alternatively, they can look at table 8.1 pupils' book pages 188 - 191 on the various diseases that affect livestock. Let them go through the signs and symptoms column and the animals affected.
- They should then compare the characteristics they wrote down during the academic trip with these information. Let them use it toidentify the disease the animal wassuffering from.
- Let them compare their work andsee if they all got it right.
- Wrap up by highlighting the mainpoints as learners take notes.
- You may give learners a further activity on finding out about the common diseases that affect livestock in their community. They should write a report then present it for assessment.

❖ **Answers to the activity 8.5**

Learners will provide different answers depending to the cattle/goat's farm visited. Use their findings to describe diseases, signs and symptoms that are observable through the sick animals. Refer to pupil's book page 188-191

d) Lesson assessment and Conclusion

EXPERIMENTAL VERSION

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

8.4.7. Lesson 7: Importance of cattle/goat farming

a) Learning objectives

- Explain the importance of cattle/goat farming

b) Teaching resources

- Cow or goat products such as milk,hides,belts and handbags,meat,etc.
- Charts on the products above.

c) Learning activities

❖ **Guidance to the activity 8.6**

- Introduce the lesson by asking learners whether they think cattle and goats are important or harmful to us. Allow them to give reasons for their choiceof answer.
- Guide learners to form groups depending on class size and their abilities. Let them carry out the activity 8.6 (page 192) in their groups.
- Let them fill the table in the activity 8.6.
- Emphasizethe fact that livestock farming can be asource of income in future if learnerstake it seriously.
- Wrap up by highlighting the mainpoints as learners take notes.

❖ **Answers to the activity 8.6**

Learners will provide different answers. Use their findings to provide importance of cattle or goat farming. Refer to pupil's book page 192-193.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

8.5. Additional information for the teacher

Goat farming involves the raising and breeding of domestic goats as a branch of animal husbandry. People farm goats principally for their meat, milk, fibre and skins.

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Goat farming can be very suited to production alongside other livestock (such as sheep and cattle) on low-quality grazing land. Goats efficiently convert sub-quality grazing matter that is less desirable for other livestock into quality lean meat. Furthermore, goats can be farmed with a relatively small area of pasture and with limited resources.

Physical Characteristics of Cattle

- Body: Cattle tend to be stocky with long, rectangular bodies. ...
- Weight: Weight and height vary greatly between domestic cattle breeds. ...
- Color: Color varies widely among breeds. ...
- Vision and Hearing: Cattle are prey species. ...
- Digestive: Herbivores, cattle feed primarily on grasses and stems.

8.6. End unit 8 assessment (Unit Test 8)

A. Guidance to end unit assessment

- **The end unit assessment is called "Unit Test " in the student book, at Page 194**
- Select some questions in the "**Unit Test 8**" and Ask learners those questions to create awareness on animals. Give remedial questions to weak learners.
- Request learners to answer all questions of the Unit Test 8 during their self study and when they are at home.

B. Answers to end unit assessment/Unit Test 8

1. Refer to pupil's book pages 159 -161.
2. (a) A group of organisms having common ancestors and sharing certain traits that are not shared with other members of the samespecies.Breeds are usually producedby mating selected parents.

   (b) Indigenous – local; exotic,imported or foreign breeds
3. (a) To avoid predators.

   (b) To prevent spread of diseases/parasites.
4. That she is very wrong. Tell her that farming is the backbone of ourcountry and that many families relyon farming as a source of income. As such,she should embrace it by allmeans.
5. (a) Good milk producer
   (b) Good feeder and quality meat.
6. Refer to table 8.1 pages 178 of pupil's book.

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7. It reduces chances of the animals becoming sick thereby ensuring healthy stock.

8. (a) Friesian cow (b) Hereford bull
   (c) Jersey cow

   (a) and (c) are dairy cows;
   (b) is beef cattle

9. Animal wastes can be used to produce manure which is the used toenrich soil for increased crop yields.

10. To reduce cases of malnutrition inthe country and to provide somesource of family income.

11. Unboiled milk may transmit tuberculosis to human beings.
12. (a) False (b) False

    (c) False (d) False

13. To improve nutrition of the populace.

8.7. Additional activities

❖ **Remedial Activities**

1. Examples of animal products are, and___.
2. Name three things that can be usedto make a cattle house.
3. Which local breeds of cattle do you know in Rwanda?
4. The three major classes of animalfeeds are_,_____and___.

❖ **Answers for remedial activities**

1. Hides & skins, milk, meat, eggs, etc
2. Timber, bricks, iron sheets, cement,sand, etc
3. Inyambo, zebu, boran.
4. Roughages, Succulents, concentrates

❖ **Consolidation activities**

1. What is sanitation?
2. Name two: (a) Bacterial disease, (b) Viral diseases, *(c)* Protozoon diseases that affect livestock?
3. Outline the qualities of a good cowshed/goat shelter.

❖ **Answers to the consolidation activities**

1. Keeping the environment around us clean

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2. (a) Anthrax, Pneumonia,Brucellosis, Mastitis
   (c) Foot and mouthfever, Rinderpest
   (d) Trypanosomiasis, Anaplasmosis,Heart water
3. - Should be roofed.
   - Should have proper sanitation.
   - Should be fenced.
   - Should have concrete rough floorsthat are easy to clean and not so hard.
   - Should have both clean feeding andwatering troughs.
   - There should be another part reserved for calves.
   - Should have an isolation box to accommodate the animals that are on treatment not mix and infect thenormal ones.
   - Should have a bull box as bulls shouldn't be mixed with the cows.
   - There should also be a crash.

❖ **Extended activities**

1. Comment about exotic and indigenous cattle. Which one would you prefer?
2. Which factors would you consider when choosing a heifer for breeding?
3. Why are concentrates important in animal diet?

❖ **Answers to the extended activities**

1. The preference would depend on what the farmer wants: if quantity and quality of product – exotic; if resistance to drought and diseases- indigenous.
2. Growth rate, resistance to diseases,feeding habits, productivity amongothers.
3. They are a major source of proteins.

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UNIT 9: PLANT REPRODUCTION

9.1.Key unit competence

To describe the parts of a flower and explain the process of sexual and asexual reproduction in plants

9.2.Prerequisite

This unit is about reproduction in plants.Remember, learners have come acrossplants before. For example, in primary 4, they learnt about types of plants andthe process of germination.In primary 5,they were introduced to importance of plants and trees in particular. Therefore,link what the learners already know with what they will learn here. Also, it will help if you bring to the awarenessof learners the fact that this topic is related to reproduction in plants in biology and vegetative reproduction in Agriculture. When learners pursue this and further, they can become botanists or plant specialists.

9.3. Introductory activity and guidance

❖ **Guidance on the introductory activity**

- As a way of introducing the unit, refer learners to the picture on page 196 of their book.
- Let learners commenton how they can help the family in picture B whose crops have failed.
- Let learners understand that for good crop yields, there is need to choose good planting materials and take good care of them.

❖ **Answers to the introductory activity**

1. The picture is about creating awareness about how tomaximize land usage by creating container gardens using recycled bottles and bags.
2. In picture B, they most likely used wrong planting materials and did not take good care of their crops. So, they should choose good planting materials and take good care of them.

9.4. List of lessons

#	Lesson title	Learning objectives	Number of periods: 10
1	Identification parts of a complete flower	– Draw and label a flower.	1
2	Definition of plant reproduction	– Identify the reproductive partsof a flower.	2

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3	Sexual reproduction of flowering plants	– Explain the processes of sexualreproduction of flowering plants	2
4	Asexual reproduction methods	– Explain the processof asexual reproduction of flowering plants – Recognize just by looking at plants and flowers those reproducing either sexually or asexually.	2
5	Reasons for plants reproduction	- Explain reasons ofplant reproduction	2
6	**Assessment and remediation**	- Demonstrate the achievement of key unit competence and lessons objectives	1

Teaching approach for each lesson

9.4.1. Lesson 1: Identification parts of a complete flower

a) Learning objectives

- Draw and label a flower.

b) Teaching resources

- Charts, textbooks, handouts andpamphlets on parts of a flower.
- Computers connected to the internet.
- Different flowers collected from the field.
- Razor-blade or scalpel, hand lens.
- well-painted diagram on parts of a flower on manila paper for use if you lack charts.

c) Learning activities

❖ **Guidance on the activity 9.2**

- You may begin this lesson by asking learners whether they recall the parts of a plant they learnt about in primary 3.
- Let them come up with a table onthe name of the part and its function.
- Obviously, one of the parts that learners will mention is the flower.Build on this and introduce Activity 9.2.
- Take learners for a field visit to collect flowers.Let them come backto class with them and dissect them.

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- Let the learners observe the dissected flowers using naked eyes, then hand lens. Ask them what they can see.
- Provide learners with chartsshowing parts of a flower. Let themcompare what they saw to these charts.
- Guide learners to draw the parts of a flower in their notebooks then label them.
- In their groups,they can play a gameof pointing and naming the various parts. Let one member point at a part as others name the part.
- At this point, you can highlight the main points emphasising partsof a flower and their functions. Remember to caution learnersagainst destroying plants as they collect flowers. This is not good for the environment.
- Let learners know that the parts of the flower can be put into two distinct groups that is, male and female parts.
- Put learners in groups and let them find out what these parts are made of. Let them draw the figures in their notebooks. They can refer to Fig. 9.2page 198 in their books.
- Wind up the lesson by giving learners a task of collecting flowersand identifying the male and femaleparts and drawing them in their notebooks as a further activity.
- Summarise the lesson by highlightingthe key points as learners write down short notes.

❖ **Answers to the activity 9.2**

2. Refer to pupil's book page 198
3. Refer to pupil's book page 199
4. All flowering plants do not produce 'perfect flowers' complete with male and female organs, but that there are some flowering plants with different sex flowers on the same or separate plants.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

9.4.2. Lesson 2: Definition of plant reproduction

a) Learning objectives

- Identify the reproductive partsof a flower.

b) Teaching resources

- Textbooks,handouts and pamphlets.
- Computers connected to theInternet.

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- Plant parts such as sugar cane cuttings, seeds and root tubers.

c) Learning activities

❖ **Guidance on the activity 9.1**

– Guide learners to plant some sugarcane cuttings and seeds and water them until they sprout. Let learners note their observations after two weeks. **Note:** This activity should be done two weeks in advance.

– Put the learners into groups depending on the class size and their abilities. Let them discuss their findings in the activity.

– Guide learners to discover the meaning of reproduction through their observations, which is to create new individuals for continuityof species. (You may need to stress the fact that without reproduction, species will become extinct).

– At this point, you may informlearners that reproduction can besexual or asexual.

– Ask learners how they plant sugarcane or sweet potatoes, then what happens. Emphasize the fact that this is a form of asexual reproduction where gametes are not involved.

– You can then narrow down tohuman beings and ask learners how they think babies come into being.Let them know that this is a form of sexual reproduction and that it involves reproductive systems. It is the process that leads to formation of seeds in plants.

– Wrap up the lesson by highlightingthe main points and allowing learners to write short notes. You may also appoint a gifted learner to summarise the lesson on behalfof the rest as you correct him or her as is appropriate.

❖ **Answers to the activity 9.2**

Learners will provide different answers depending their observations. Use their findings to conclude by defining plant reproduction. Refer to pupil's book page 197.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

9.4.3. Lesson 3: Sexual reproduction of flowering plants

a) Learning objectives

– Explain the processes of sexualreproduction of flowering plants

b) Teaching resources

EXPERIMENTAL VERSION

- Charts, textbooks, handouts and pamphlets on sexual reproductionin flowering plants.
- Computers connected to the internet.
- Different flowers collected from the field.
- A well-painted diagrams of processes such as fertilization and pollination and partsof a seed on manila papers for use if you lack charts.

c) Learning activities

❖ **Guidance on the activity 9.3**

- Take learners for a nature walk in the field. Let them look out for various flowers and observe whatgoes on inside them.
- Guide the learners to discuss the questions in this activity 9.3.
- Some of the observations thatlearners may record include insects and birds visiting flowers.
- Take advantage of this and explain what pollination is and the two types of pollinations: self and cross pollination.
- Guide learners to discover the difference between the two. Show them diagrams in Pupil's book pages200 -201 or the figures in charts.
- At this point you can introduce theconcept of agents of pollination. Find out (Refer to Pupil's book page201)
- Let learners go to the library to research about agents of pollinationand write a report. They can alsodo internet searches.
- Allow learners to share their findings in a discussion forum in class. Let them choose a group leader to do presentations on their behalf.
- At this point, you can introduce thethree agents of pollination, that isanimals (birds and insects), wind and water. Explain how each of these occurs.
- Wrap up by giving the main parts as learners write summary notes.

❖ **Guidance on the activity 9.4**

- Guide learners to carry out this activity in groups. The composition of the groups should be informed bysize and ability of learners. **Note:** This activity should be done 3 - 5days earlier.
- At the end of the experiment, learners should observe thatgermination has occurred. Let themsay or find out what it is and sharewith other class members.
- You can then clarify that seeds germinate into new plants after dispersal.

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- At this point, you can introduce the fact that certain conditions are necessary for germination to occur.
- Guide learners to carry out this activity in groups. Again, plan and do this activity 3-5 days in advance. The composition of the groups should be informed by size and ability of learners.
- Let them do research in the library or the internet to find out why theresults of this experiment are the way they are.
- Back in class, they should share ideas by choosing group leaders todo presentations on behalf of the rest.
- Wrap up the lesson by highlightingthe main conditions necessaryfor germination as learners take summary notes.

❖ **Answers to the activity 9.3 &9.4**

Learners will provide different answers depending on their observations. Use their findings to identify the ways in which plant reproduce. Refer to pupil's book page 202-204.

❖ **Answers to the application activity (self-test) 9.1**

1. Reproductive organ
2. Refer to Fig. 9.6 pupil's bookpage 201.
3. Anther and filament
4. Wind – cotton, Jacaranda; Water – coconut, water lily.
5. Corolla, calyx
6. Transfer of pollen grains fromanther to stigma of a flower.
7. Self, wind.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

9.4.4. Lesson 4: Asexual reproduction methods

a) Learning objectives

- Explain the processof asexual reproduction of flowering plants
- Recognize just by looking at plants and flowers thosereproducing either sexually or asexually.

b) Teaching resources

- Charts, textbooks, handouts and pamphlets on asexual reproduction in flowering plants.

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- Computers connected to theInternet.
- Different vegetative parts collectedfrom the field.
- A well-painted diagrams of processes such as grafting, cuttings, budding, layering among others on manila papers for use if youlack charts.

c) Learning activities

You may begin this lesson by lettinglearners carry out Activity 9.5 on page 205 of pupils book.

You may then inform learners thatasexual reproduction in flowering plants occur through variousprocesses. These include use of cuttings, grafting, layering, buddingand use of suckers. Therefore, this lesson will be taught in these five distinct parts.

❖ **Guidance on the activity 9.5**

The activities in this lesson should be done over a period of time with constant monitoring for learners to make and record observations.

❖ **Guidance on the activity 9.6**

- Ask learners to say what theythink happens in cuttings as a vegetative propagation method. Take advantage and introduce activity 9.6.
- Guide learners to carry out this activity in groups. The composition of the groups should be informed bysize and ability of learners.
- At the end of the experiment, learners should observe that the stem cuttings sprouted into youngplants. Let them say or find out whythis is so and share with other class members.
- You can then list examples of plants that can be planted using stem cuttings such as sweet potatoes, cassava, sugarcane, yams, etc.

❖ **Guidance on the activity 9.7**

- Put learners into groups dependingon their abilities and class size. Let them study the diagram in this activity. They should do research and say what is happening.
- Let them find out why the activitiesin the picture are important.
- You can then inform them that the diagram is about grafting. Clarify that this is one of the methods of vegetative propagation just like useof stem cuttings.
- Summarise by explaining whathappens during grafting and givingexamples of plants that can be grafted such as oranges, lemons, mangoes and avocados.
- Wrap up this section by giving learners a project on grafting (Seepage 209 of pupil's book)

❖ **Guidance on the activity 9.8**

- Guide learners to carry out this activity in groups. The composition of the groups should be informed bysize and ability of learners.
- At the end of the experiment, learners should observe that the layered plant

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sprouted into a young plant. Let them say or find out why this is so and share with other class members.

- You can then summarise by highlighting key points as learnerstake summary notes. Refer to pupil'sbook page 207.

❖ **Guidance on the Activity 9.9 (Refer to Pupil's book page 208)**

- Guide learners to carry out this activity in groups. The composition of the groups should be informed bysize and ability of learners.
- At the end of the experiment, learners should separate theplantlets and grow them in separate field. They should take care of themuntil they become mature.
- You can then summarize by highlighting key points as learnerstake summary notes.

❖ **Answers to the activity 9.6, 9.7, 9.8 &9.9**

Learners will provide different answers depending on their observations. Use their findings to identify asexual reproduction methods. Refer to pupil's book page 205-208.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

9.4.5. Lesson 5: Reasons for plants reproduction

a) Learning objectives

- Explain reasons ofplant reproduction

b) Teaching resources

- Charts, textbooks, handouts and pamphlets on reproduction in flowering plants.
- Computers connected to theInternet.

c) Learning activities

❖ **Guidance on the activity 9.10**

- This is a research activity forindividual learners. Let them goto the library and do research orsearch the Internet.
- They should write a report then share with the rest of the class.
- Back in class, let learners do presentations as you correctthem. Guide them to discover theimportance of plant reproduction as listed in their books on page 208.

❖ **Answers to the activity 9.10**

Learners will provide different answers depending on their observations. Use their findings to write down the reason for plant reproduction. Refer to pupil's book page 208.

d) Lesson assessment and Conclusion

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During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

9.5. Additional information for the teacher

Some information that may be relevantwith regards to the reproductive systemare given below.

Crop propagation

- Crop propagation involves the formation and development of new individual plants. This can happen sexually through seeds or asexually through vegetative planting materials.
- These are parts of plants, other thanseeds, which can be used to producenew individual plants. Vegetative parts have the ability to grow intoa whole new individual plant. The use of vegetative materials for plantpropagation is known as **asexual reproduction**.
- This system of reproduction perpetuates crops as individual units. Below is a table showing various types of vegetative planting materials and a few examples of crops that are propagated by the respective planting materials.

Table 9.1:Vegetative planting materials with examples

Vegetative planting materials	**Examples ofcrops**
(a) Stems-cutting	Tea, sugarcane
(b) Leaves	Bryophyllum
(c) Suckers	Banana, pineapples
(d) Tubers	Irish potatoes
(e) Bulbs	Onions
(f) Corms	Coco yams
(g) Rhizomes	Kikuyu grass
(h) Runners	Strawberry

(a) Stems - These are cuttings that can be developed from stems of plants. Stem cuttings can be raised in nurseries as in tea or planted directly in the field, as in sugarcane. Most

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cuttings for perennial crops areobtained from the hard sections of the plant parts.

Fig. 9.1 (a) Single leaf stem cuttings of a tea plant

Fig. 9.1 (b) Sugarcane sett

(b) Leaves - Bryophyllum pinnatum(Air plant, life plant, miracle leaf or Goethe plant, is a succulent plant.

It is propagated vegetatively by growing small plantlets on the fringes of the leaves. These eventuallydrop off and begin to root.

Fig. 9.2 Leaf vegetative planting materials

(c) Suckers - These are lateral branches of a stem with terminal buds at the tips. They grow from the base of the underground stem;just beneath the soil surface. New shoots grow along the sucker withadventitious roots developing below the stem.

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Fig. 9.3: A banana sucker

(d) Tuber - This is a swollen tip on an underground stem bearinga number of reduced scale leaves.Each scale leaf surrounds the 'eye' of the tuber. The eye is actually the bud. The buds produce aerial shootsand adventitious roots grow at thebase.

Fig. 9.4: Irish potato tuber

(e) Bulb - This is a flattened stem with nodes bearing fleshy scaleleaves surrounded by some dry scale leaves. Buds arise in the axils of the fleshy scale leaves. The food isstored in the fleshy scale leaves andnot in the stem. Adventitious are found at the base of the stem.

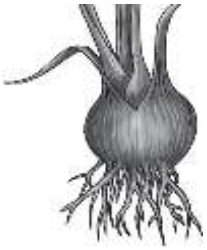

Fig. 9.5 Onion bulb

(f) Corms - These are short, thick,underground stems protected by dry scale leaves. A corm has one ormore buds located on the undersideof the leaf with adventitious rootsat the base. The corm shrivels whenthe food reserves are used up as thebuds grow into aerial shoots.

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Fig. 9.6 A corm

(g) Rhizomes - These are horizontal underground stems whichpossess scale leaves and buds. The leaves are reduced to thin scales. Insome plants, adventitious roots are present.

Fig. 9.7 A rhizome

Advantages of vegetative production

- Crops originating from vegetable materials mature faster than those from seeds
- Vegetatively propagated plantsexhibit uniformity in diseaseresistance, size, colour etc
- It is possible to produce many varieties of compatible crops on thesame root stock.
- They germinate much fastercompared to seeds because they can't go dormant.
- The resulting plant does not grow very tall hence making carrying out cultural practices like spraying practices like spraying, harvestingmuch easier
- Facilitates the propagation of seeds or plants with low viability.

Disadvantages of vegetative propagation

- It is difficult to control diseases hence an infected plant may easily transmit diseases to other plants.
- Materials are bulky hence difficultto store and transport.
- Vegetative propagation does not result in new crop varieties.
- Materials cannot be stored for long since they get spoilt.

9.6. End unit 9 assessment (Unit test)

1. Pollination – transfer of pollen grains from anther to stigma ofa flower;

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fertilization – fusion of male and female gametes to forma zygote.

2. Wind, water and animals
3. Stigma, anthers
4. Refer to Fig 9.3 and 9.4 pages 200-204 of pupil's book.
5. Root
6. Ovules, ovary
7. (a) Use of suckers
   (b) Use of cuttings
8. Wind
9. Refer to Fig. on page 206 (grafting)and page 207 (layering).
10. Water, warmth and air
11. Bees help in pollination
12. Refer to Fig 9.2 page 200 of pupil'sbook.
13. (a) - (vi) (b) – (v) (c) – (ii)
    (d) – (iii) (e) - (i) (f) – (iv)
14. (a) Fruit (b) seeds
15. To attract insects or birds forpollination to occur.

9.7. Additional activities

❖ Remedial activities

1. _____ is transferring pollenfrom the anther to the stigma of aplant.
2. Name three processes involved insexual reproduction in plants.
3. Draw and label parts of a monocotseed.
4. Which agents of pollination do you know?

❖ Answers to the remedial activities

1. Pollination
2. Pollination, fertilization, seeddispersal, germination.
3. Refer to Fig. 9.9 page 190 pupil'sbook.
4. Insects: example bees and butterflies; Birds: example: sunbird; wind, water.

❖ Consolidation activities

1. Give four methods of vegetative propagation.
2. Give three conditions necessary for germination to occur.
3. Which processes are involved issexual reproduction in flowering plants?

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❖ **Answers to Consolidation activities**

1. *Use of cuttings, grafting, budding, layering, use of suckers*
2. *Water (moisture), warmth, presence of air (oxygen)*
3. *Pollination, fertilisation, seeddispersal, germination*

❖ **Extended activities**

1. Discuss the risks of vegetative propagation.
2. Why would you prefer asexualreproduction to sexual reproduction and vice versa?
3. Describe an experiment that you would use to show the conditions necessary for germination.

❖ **Answers to the extended activities**

1. May transfer diseases and badcharacteristics to the new plant.
2. Refer to the content underadvantages of vegetative reproduction above.
3. Refer to Activity 9.3 pupil's bookpage 201.

Unit 10: Sustainable waste management

10.1. Key unit Competence

- To apply garbage collection techniques and separate hazardous, organic and recyclable waste materials.

10.2. Prerequisite

This is a relatively new topic to learners. However, it is closely related to what pupils learnt in primary 4 about the environment and in primary 5 under water and water pollution. You may take advantage of that and introduce the concept of proper waste management as a way of keeping our environment clean. You may also bring to the attention of learners the fact that the concepts in this unit can be applied in environmental management in social studies, environmental chemistry and Agriculture. Further, learners should be made aware of the fact that when they continue with their education in this area,they may become environmentalists.

This unit is about sources of wastes and how to manage wastes in our environment. If we do not manage wastes, it becomes a problem in our environment. You are therefore expected to show learners how to manage wastes diseases hence helps to reduce health related costs. Also, buying quality equipment will lead to saving money in the long run as they stay for long and costs on repairs are reduced.

10.3. Introductory activity and guidance

Guidance on the introductory activity

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-Ask learners to form groups and let them observe the picture in the learner's book.

- Let the learners to describe deeply what the picture is showing. Ask learners to explain the role of these named parts.

-Ask learners if there is a better way in which they can manage the wastes in the

picture.

10.4 List of lessons/sub-heading

#	Lesson title	Learning objectives	Number of periods
1	Classification of wastes	-To differentiate between biodegradable and non-biodegradable wastes.	2
2	Sources of waste: Municipal, medical and agricultural	-To identify different sources of wastes	1
3	Sources of waste: Automobiles and construction	To identify different sources of wastes	2
4	Sources of waste: Electronics and industrial	To identify different sources of wastes	2
5	Waste management techniques	-To cite, explain and practice waste management techniques.	2
6	**Assessment and remediation**		**1**

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10.4.1. Lesson One: Classification of wastes

a) Learning objectives

- To differentiate between biodegradable and non-biodegradable wastes

b) Teaching resources

- Computers connected to the Internet,
- Textbooks, pamphlets, handouts and charts on waste management.

c) Learning activities/ Activity 10.1

- This lesson will involve individual research work and group discussions.

- Ensure that the internet is working properly before the lesson for leaners to use to do research.
- Ask learners probing questions such as: Have you ever heard of the word ‘waste? What does it mean?
- Guide learners to discover the definition of waste, which is ‘any unwanted material in the environment.
- Emphasise the fact that we should avoid polluting the environment at all times.
- At this point, guide learners to go through the chart on picture then answer the questions associated with it.
- Let learners give the answers to the questions as you correct them. Examples of categories of wastes are: biodegradable and non-biodegradable wastes. You can also mention that wastes are further divided into hazardous, toxic, radioactive and flammable wastes.
- Explain the above kinds of wastes as learners write summary notes. Refer to learners book.
- Remind learners that it is important to always separate wastes into biodegradable/non-biodegradable, hazardous, recyclable, etc.
- Let learners take a walk around the school compound. Let them identify the types of wastes that they can see.
- Guide learners to group the wastes as shown in the table of **the activity 10.1.** Let them compare their work to those of other class members.
- Guide learners to find out the advantages and disadvantages of the various types of wastes.
- Discuss the disposal of wastes.
- Remind learners of the golden rule which is ‘the 3Rs – recycle, re-use and reduce.
- Encourage them to always practice this when they come across wastes!

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Answers to activity 10.1

3.

Hazardous wastes	**Organic wastes**	**Recyclable wastes**
Chemical wastes **(**Antifreeze, Brake fluid, Car wax, Diesel fuel, Gasoline. Fuel oil, Kerosene, gas ,…..)	Compost to grow crops, clean organic wastes to feed animals, kitchen garbage, animal dung, vegetable remains, ….	Plastics, polythene bags and glass

4. Refer to learner's book page ……

5. Waste disposal methods for different types of wastes: *Recycling*, Incineration, Chemical-physical and biological treatment, Landfills, …

10.4.2. Lesson two: Sources of wastes: Municipal, medical and agricultural

a) Teaching resources

- Computers connected to the Internet.
- Textbooks, pamphlets, handouts and charts on air pollution.

b) Learning activities / Activity 10.2

- This lesson will involve a group discussion and individual research work.
- Ensure the internet is working properly before the lesson for leaners to use to do research.
- Let learners think about the activities that take place in various places municipal, medical and agricultural as they are mentioned in **the activity10.2**. They should then say which ones create wastes based on the hints given in this activity.
- You may also guide the learners to make a field study and observe physically the sources of wastes.
- Let them come up with a report and share with the other members of the class.
- Summarise by highlighting main points as learners write summary notes.

10.4.3. Lesson three: Sources of wastes: Automobiles and construction

a) Learning objectives

- To identify different sources of wastes.

b) Teaching resources

- Computers connected to the Internet.
- Textbooks, pamphlets, handouts and charts on air pollution.

c) Learning activities / Activity 10.2

- This lesson will involve a group discussion and individual research work.
- Ensure the internet is working properly before the lesson for leaners to use to do research.
- Let learners think about the activities that take place in various places, garages (automobiles) and construction area as they are mentioned in **the activity10.2**. They should then say which ones create wastes based on the hints given in this activity.
- You may also guide the learners to make a field study and observe physically the sources of wastes.
- Let them come up with a report and share with the other members of the class.

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- Summarise by highlighting main points as learners write summary notes.

10.4.4. Lesson Four: Sources of wastes: Electronics and industrial

a) Learning objectives

- To identify different sources of wastes

b) Teaching resources

- Computers connected to the Internet.
- Textbooks, pamphlets, handouts and charts on air pollution.

c) Learning activities / Activity 10.2

- This lesson will involve a group discussion and individual research work.
- Ensure the internet is working properly before the lesson for leaners to use to do research.
- Let learners think about the activities that take place in various places, electronics and industries as they are mentioned in **the activity10.2**. They should then say which ones create wastes based on the hints given in this activity.
- You may also guide the learners to make a field study and observe physically the sources of wastes.
- Let them come up with a report and share with the other members of the class.
- Summarise by highlighting main points as learners write summary notes.

10.4.5. Lesson five: Waste management techniques

a) Learning objectives

- To cite, explain and practice waste management techniques.

b) Teaching resources

- Computers connected to the Internet.
- Textbooks, pamphlets, handouts and charts on air pollution.

c) Learning activities / Activity 10.3

- This lesson will involve an academic visit and group discussions. You will therefore organize the class as need arises during the lesson.
- Take learners for a visit to a nearby local authority. While there, let learners find out how they manage wastes.
- They should also do individual research work on how wastes can be managed. Let them come up with a report and share with other members of the class.
- At this point, you may let learners know that waste management begins with collection, processing (whereby wastes are separated into those that are biodegradable and those that

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are not, hazardous, toxic, radioactive etc), this is followed by safe transportation to disposal site or a landfill.

- Summarise the lesson by highlighting main points as learners write summary notes.
- End the lesson by giving learners a task of cleaning their school compound.

10.5. Additional content/text for teacher

10.5.1. Additional information for the teacher

This section provides additional content for the teacher to have a deeper understanding of the topic.
The most popular types of Waste Management are:
Recycling, Incineration, Landfill, Biological Reprocessing, Animal Feed.
What are the 7 principles of waste (7 R's) management?
Recycle, Refuse, Reduce, Reuse, Repair, Re-gift, Recover.
There are three steps necessary to properly manage waste: Identify Wastes. Evaluate Waste. Manage Wastes.

10.6.A. Guidance on End unit assessment

The revision activity 10 is in place of end unit assessment.

- This part provides the answers of end unit assessment with cross reference to the textbook
- The teacher's guide suggests additional questions and answers to assess the key unit competence.
- Assessment activities are designed in integrative approach to assess the key unit competence with cross reference to the textbook.
  Possible Answers for End Unit assessment / Revision Activity 13

B. Answers for end unit assessment/Revision activity 10

1. Taking care of wastes to reduce its impact on the environment.
2. Non - biodegradable – cannot be decomposed naturally for example polythene and plastics; degradable, can be decomposed for example, kitchen wastes.
3. (a) Wastes that can cause harm
(b) Biomedical wastes – can transmit diseases.
4. To recycle is to change to something else then use again; re-use is to use for a different purpose.
5. By putting in place strict legislations that hinder environmental degradation and educating the masses on the importance of environmental conservation.

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6. Recycle, Re-use, Reduce.
7.

Type of waste	Example	How to manage
Industrial	Smoke	Fitting chimneys and catalytic converters
Medical	Syringes and needles	Incineration
Electronic	Old computer parts	Recycling
Agricultural	Chemical containers	Re-using

8. Professional way of managing garbage which involves collection, processing, transportation and finally disposal.
9. This was very wrong as it will cause environmental pollution.
10. Gamka should desist from this habit as a dirty environment harbors disease-causing germs.
11. A place where wastes are dumped in the city. It helps to avoid disposal of waste everywhere in the locally. This ensures that the environment remains clean and attractive.
12. They should be incinerated.
13. We use various items in our lives which are very essential and we cannot do without.

10.7. Additional activities

Remedial activities for slow learners	**Extended activities for gifted and talented learners**
1. Cleaning the environment around home. 2. Collecting rubbish around school compound.	1. Making makeshift dust bins using banana fibres. 2. Researching more about wastes management, writing notes and sharing with other class members.
Remedial questions for slow learners	**Extended questions for gifted learners**
1. Waste is _____ 2. _____, _____, _____ are examples of non biodegradable wastes. 3. How would you manage hazardous wastes?	1. What are radioactive wastes. 2. What is the other name of biodegradable wastes? 3. Describe the process of managing wastes professionally.
Answers to remedial questions	**Answers to extended questions**
1. Unwanted materials in the environment. 2. Polythene, pipes and plastics. 3. Burning in an incinerator.	1. Wastes that emit radiations. 2. Organic wastes 3. Collecting, processing, transporting and finally disposing in a landfill.
Consolidation activities	

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1. What is waste? 2. (a) Mention the two main categories of wastes. (b) What is the difference between them? 3. (a) Which other categories of wastes do you know? 4.What sources of wastes do you know of? 5.What is the difference between biomedical wastes and electronic wastes? 6.What sources of wastes do you know of? 7.What is the difference between construction wastes and automobile wastes? 8. Give four ways of disposing of wastes safely.	
Answers to consolidation questions	
1. Any unwanted material in the environment) 2. (a) Biodegradable and non-biodegradable wastes (b) Biodegradable – can decompose naturally, non-biodegradable wastes – cannot decompose naturally 3. (a) Hazardous, toxic, radioactive and flammable wastes. 4.Municipal, industrial construction, agricultural, biomedical, electronic and automobile wastes. 5.Biomedical – from hospitals and health centres; electronic – from electronic equipment. 6. Municipal, industrial construction, agricultural, biomedical, electronic and automobile wastes. 7. Construction wastes – from construction sites; automobile wastes – garages. 8. Safe collection, processing, transportation and finally disposal.	

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Unit 11: Circulatory system 1st part

11.1. Key unit Competence

To explain the functioning of the circulatory system, its hygiene and maintenance.

11.2 Prerequisite

Learners have already been introduced to human body since lower primary. They however started learning more advanced concept at primary four. For example, they learnt about the various sence organs and human skeleton in this class. In primary 5, they learnt about the digestive and reproductive systems. In this class, they will further on their knowledge in this area by learning about the circulatory and respiratory systems. During the lessons, strive to bring to the awareness of learners the fact that this topic is related to circulatory system in biology that they will study at higher levels of learning. Let them understand that at this level, they may only need the basic information otherwise, details of functioning of the circulatory system will be learnt in high school and even better, when later in life, they specialize in the area of medicine and particularly cardiology.

11.3. Introductory activity and guidance

Guidance on the introductory activity

- Ask learners to form groups and let them observe the picture in the learner's book.
- Let the learners to describe what happening in picture A and B.
- Discuss the consequences of poor health care shown on picture A and B

11.4 List of lessons/sub-heading

#	Lesson title	Learning objectives	Number of periods
1	Organs and Main functions of the human circulatory system	• To explain the main function of human circulatory system • To name and identify the organs that make up the human circulatory system	**3**
2	Structure of the heart	• To explain the structure of the heart. • To draw and label the heart.	2

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		•To describe the functions of the various parts of the heart.	
3	Blood vessels	• To name the types of blood vessels. • To describe the functions of the various types of blood vessels.	1
4	The process of blood Circulation	To explain the process of circulation of blood in the body.	1
5	Components of blood	To explain the composition of blood	1
6	Caring for and health of circulation system.	To explain the hygiene of the human circulation system. To care for and health of circulation system.	1
7	Diseases/conditions of circulatory system	To identify main diseases of the circulatory system and state their causes, signs & symptoms and how to prevent them.	1
8	Blood pressure measurement	To interpret blood pressure measurement for different persons	1
10	**Assessment and remediation**		1

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11.4.1. Lesson one: Organs and Main functions of the human circulatory system

a) Learning objectives

- To explain the main function of human circulatory system to name and identify the organs that make up the human circulatory system.

b) Teaching resources

- Charts on parts of the human circulatory system, textbooks, pamphlets and hand outs on circulatory system
- Video link: https://www.youtube. com/watch?v=_qmNCJxpsr0

IMPROVISATION: You may come up with your own charts drawn on manila papers in case your school does not have the circulatory system charts. With the research activity, provide learners with handouts, pamphlets and textbooks and ask them to find out what circulatory system is and what its function in the body is. They can also refer to the internet.

c) Learning activities/ Activity 11.1 & Activity 11.2

- This lesson will involve individual work, video watching, research work and group activities. You will therefore organize the class as need arises during the lesson.

- Bring pamphlets, handouts, and textbooks for reference in class. Also, ensure that the Internet is working if you have a computer laboratory or any other form of internet connectivity such as WIFI or modem.
- Test the link: https://www.youtube. com/watch?v=_qmNCJxpsr0 in advance to see if it is working. This link has a video on circulation of blood, which is part of one of the activities in this lesson.
- Obtain wall charts on circulatory system and ask learners to observe them.
- Work on **activities 11.1 and 11.2** to help students in the investigations of main function of human circulatory system and in identifying organs of the human circulatory system.

Let learners have a brief discussion session on their findings then write summary notes. Refer to notes of pupil's book on main functions of the human circulatory system and organs of the human circulatory system.

• Let the learners watch the video carefully. They should note how the blood flows and the organs that are involved.

• Show learners the charts on the circulatory system. Using the charts, they should identify the organs they observed in the video.

• Let them write the names of the organs that make up the circulatory system and briefly explain their roles. The organs are:

(i) Heart – pump blood throughout the body

(ii) Blood vessels – tubes through which blood flows

(iii) Blood – circulates throughout the body

• Summarise the lesson by highlighting the key points, which should include the role of circulatory system in human body and the various organs that make up the circulatory system.

Answers to Activities 11.1 & 11.2

Refer to learners 'book for the functions of the human circulatory system and organs of circulatory system.

11.4.2. Lesson two: Structure of the heart

a) Learning objectives

To describe and explain the structure of the heart.

b) Teaching resources

- Charts on parts structure of the heart and textbooks, on circulatory system.
- Video link: https://www.youtube. com/watch?v=_qmNCJxpsr0
- Heart model
- **Improvisation**

You may come up with your own chart of structure of the heart drawn on manila papers in case your school does not have one. You can also organize for learners to model a heart using clay or plasticine.

c) Learning activities/ Activity 11.3

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• Let the learners watch the video carefully. They should describe what is happening to the heart in the video. (The pumping action)

• Ask learners where they think the heart gets the energy it uses to pump the blood. (Its muscles as they contract and expand)

• Guide learners to dismantle the model of the heart. Assist them to identify the various parts.

• At this point, you can show learners the chart on the structure of the heart. Using the charts, they should identify the parts that make up the heart.

• Let them draw the structure of the heart in their notebooks and label it.

Use the video, heart model and the charts to guide learners to accurately describe the structure of the heart and state its function.

• Summarise the lesson by highlighting the key points on the parts that make up the heart and their functions. Allow learners to write summary notes as you do your presentation. You can also make this more interactive by inviting gifted learners to do lesson summary as you guide them.

Answers to Activity 11.3

Refer to leaners's book page …. For the labelling of the various parts of the human heart.

11.4.3. Lesson five: Blood vessels

a) Learning objectives

- To name the types of blood vessels
- To describe the functions of the various types of blood vessels.

b) Teaching resources

- Charts on blood vessels,
- Video link: https://www.youtube. com/watch?v=_qmNCJxpsr0

IMPROVISATION:

- You may come up with your own chart on various blood vessels drawn on manila papers in case your school does not have one.

c) Learning activities / Activity 11.4

- This lesson will involve group work.
- Test the link: https://www.youtube. com/watch?v=_qmNCJxpsr0 in advance to see if it is working. This link has a video on circulation of blood, which is part of one of the activities in this lesson.

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- Obtain wall charts on various blood vessels in advance.
- Ask probing questions to introduce the lesson. Such questions may include:

1. What are blood vessels? (**Ans.** Pathways through which blood travels in the body).

2. How do you think they look like? Why? (**Ans:** Because they have to have space for movement of blood and this must be continuous).

- Let learners brainstorm about these questions then narrow down to the content of this lesson, which types of blood vessels and their functions.

• Put learners in pairs considering their abilities. Let them carry out **activity 11.4.** in the learner's book.

• Let the learners watch the video on the link: https://www.youtube.com/ watch?v=_qmNCJxpsr0 carefully. They should identify the blue and the red coloured vessels.

• Provide learners with the charts on the blood vessels. Help them identify the various vessels. (Its muscles as they contract and expand)

• At this point, you can introduce the three types of blood vessels i.e. arteries, veins and capillaries.

• Let learners draw the blood vessels in their notebooks and label them.

You can then guide learners to feel the pulse at the wrist as shown in procedure

3. Let them repeat this several times and count the number of heartbeats. They should come up with an average (Ans: 72 beats per minute)

• Summarise the lesson by highlighting the key points about blood vessels, pulse and heart beat.

• Finalise by giving learners a task of coming up with a table on differences between arteries and veins.

Answers to Activity 11.3

a) Veins

b) Kidneys

c) Arteries

11.4.4. Lesson four: The process of blood Circulation

a) **Learning objectives** (formulated)

To explain the process of circulation of blood in the body.

b) **Teaching resources**

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- Charts on circulation of blood in human body.
- Video link: https://www.youtube.com/watch?v=_qmNCJxpsr0

Improvisation

- You may come up with your own chart on blood circulation by drawing on manila paper in case your school does not have one.

c) **Learning activities/Activity 11.3**

- Obtain wall charts on circulation of blood in advance.
- Test the link: https://www.youtube. com/watch?v=_qmNCJxpsr0 in advance to see if it is working. This link has a video on circulation of blood, which is one of the activities in this lesson.
- Let the learners watch the video on the link: https://www.youtube.com/ watch?v=_qmNCJxpsr0 carefully. They should identify the path of blood in the vessels.

• Provide learners with the chart on circulation of blood. Using the knowledge about the video, guide them to trace the path of blood in the chart.

• Let them draw the path of blood in their notebooks and label it, See activity 11.4

• Summarise the lesson by highlighting the key points about blood circulation as learners take summary notes. Better still, you can appoint a gifted learner to give summary points as you guide them.

Answers to Activity 11.3

Refer to learners' book page …. For the circulation of blood in human body/Fig 11.6

11.4.5. Lesson five: Components of blood

a) Learning objectives

- To explain the composition of blood.

b) Teaching resources

• Charts on various components of blood.

c) **Learning activities/ Activity 11.5**

- This lesson will involve a research activity either in the library or using the Internet or group work.

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- Bring pamphlets, handouts, and textbooks for reference in class. Also, ensure that the Internet is working if you have a computer laboratory or any other form of internet connectivity such as WIFI or modem.

• Let learners go to the library and search in textbooks what blood is made of/Activity 11.5. They can also do Internet searches.

• They should also find out the functions of the various components of blood.

• Back in class, put learners in groups of five depending on the size of the class to harmonize their findings. Let them choose a group leader to do a presentation to the rest of the class.

• After the presentations, guide learners to write short notes and draw the various blood components in their note books. Refer to Pupil's book pages ……

- Summarise the lesson by giving a task of coming up with a table on the differences between white and red blood cells.

Answers to Activity 11.5

Refer to learners' book page …. For components of blood /Fig 11.7

Answers to Self-Test 11.1 Refer to learner's book pages ……

1. Heart, blood and blood vessels.

2. Refer to Fig.11.6 Page …… in student's book.

3. Prevents mixing of oxygenated and deoxygenated blood.

4. Vena cava – carries blood from the rest of the body to the heart. Pulmonary artery - carries blood from the heart to the lungs. Pulmonary vein - carries blood from the lungs to the heart. Aorta - carries blood from the heart to the the rest of the body apart from lungs.

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11.4.6. Lesson six: Caring for and health of circulation system.

a) Learning objectives

- To explain the hygiene of the human circulation system.

b) Teaching resources

- Reference materials on hygiene of circulatory system.

c) **Learning activities/ Activity 11.5**

- This lesson will involve a research activity either in the library or using the Internet.
- Bring pamphlets, handouts, and textbooks for reference in class. Also, ensure that the Internet is working if you have a computer laboratory or any other form of internet connectivity such as WIFI or modem.
- Let learners go to the library and search in textbooks what hygiene of the circulatory system is and what should be done to keep the heart and associated organs healthy / activity 11.6. They can also do Internet searches.
- They should then come up with a list of practices that enhance healthy heart, blood and blood vessels.
- Back in class, put learners in groups depending on the size of the class and the abilities of class members to harmonise their findings. Let them choose a group leader to do a presentation on their behalf.
- After the presentations, guide learners to write short notes and draw a table on how to take care of the heart, blood and blood vessels.

Answers to Activity 11.5

Refer to Table 11.1: Hygiene of the human heart, blood and blood vessels

11.4.7. Lesson seven: Diseases/conditions of circulatory system.

a) Learning objectives

- To identify main diseases of the circulatory system and state their causes, signs and symptoms and how to prevent them.

b) Teaching resources

• Reference materials on diseases of the circulatory system.

c) **Learning activities/ Activity 11.6**

- This lesson will involve a research activity either in the library or using the Internet.
  - Bring pamphlets, handouts, and textbooks for reference in class. Also, ensure that the internet is working if you have a computer laboratory or any other form of Internet connectivity such as WIFI or modem.
  - Introduce the topic by reminding learners about common diseases that they know or might have come across. Ask probing questions such as:

(i) What causes the diseases?

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(ii) How are they controlled?

- You can then ask them if they think diseases can affect circulatory system.

Find out (Refer to Pupil's book activity 131)

- Let learners go to the library and search in textbooks diseases that affect the circulatory system and their signs and symptoms. They can also do Internet searches.

- Back in class, put learners in groups depending on the size of the class and the abilities of class members to harmonize their findings. Let them choose a group leader to do a presentation on their behalf.
- After the presentations, guide learners to write short notes and draw a table on various heart diseases, their causes, signs & symptoms and control/prevention measures.

Answers to Activity 11.6

Refer to Table 11.2: Diseases of the circulatory system, their signs and symptoms and prevention and control measures

11.4.9 Lesson nine: Blood pressure measurement

a) Learning objectives (formulated)

To interpret blood pressure measurement for different persons.

b) Teaching resources

- A nearby health facility
- Sphygmomanometer

c) Learning activities/

- This lesson will involve a visit to a nearby health facility or hospital. Arrange in advance to get permission to visit the health facility.
- Ask learners to prepare questions to ask during the visit in advance.
- Take learners to visit a nearby health facility to witness blood pressure being measured on patients by the health personnel.
- Let learners observe how the blood pressure is being taken as they take notes. At the end, ask them to come up with the steps followed when taking blood pressure.
- They should ask questions during the trip such as:

(i) What is the normal blood pressure? (Ans: Between 120/80 mmHg – 140/90 mm Hg).

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(ii) How about abnormal blood pressure? (Ans: anything outside the bracket 120/80 mmHg – 140/90 mm Hg).

- Ask the nurse to take the blood pressure of a few pupils as they record. Let them work the average and compare it with the range given by the nurse as the normal blood pressure. Is it normal?
- Wrap up the lesson by explaining what blood pressure is and how it is taken.

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11.5. Additional content for the teacher

Some information that may be relevant with regards to the circulatory system are given below.

Circulatory systems in animals

There are two types of circulatory systems in animals:

• Open circulatory system

• Closed circulatory system

(a) Open circulatory system body Here, blood is pumped by the heart into a body cavity. The body cavity is a series of body spaces collectively known as haemocoel. This means that blood does not flow in closed vessels but rather flows freely into spaces. This system is found in most arthropods such as insects.

(b) Closed circulatory system Here, blood flows in closed vessels and does not come into direct contact with body tissues. Blood is pumped by the heart under high pressure to the tissue through closed blood vessels and flows back to the heart. An example is in human beings. There are two types of closed circulatory system:

• Single circulation

• Double circulation

(i) Single circulation In single circulation, blood flows through the heart once to make a complete circuit. This is found in fish, reptiles and amphibians. For example in fish, blood

flows from the heart to the gills to collect oxygen, then to all parts of the body before returning back to the heart.

(ii) (ii) Double circulation

See diagragram TG page 248

In double circulation, blood flows through the heart twice to make a complete circuit. This occurs in mammals for example, human beings and birds. The blood flows from the heart to lungs to collect oxygen and back to the heart. The blood is then pumped by the heart to all parts of the body and finally back to the heart the second time to complete the circuit.

Blood pressure is lost as blood flows through the capillaries in the lungs. The blood flows back to the heart where pressure is restored by the pumping of the blood by the heart to all part of the body. Double circulation is possible because the heart is divided into the right and left side by septum. The right side of the heart contains deoxygenated blood. The left side of the heart contains oxygenated blood.

See diagram page 249

Functioning of the heart

The heart pumps blood to the lungs and to all parts of the body. The pumping of the heart is as a result of contraction and relaxation of cardiac muscles. The contraction of heart muscles is known as systole. The relaxation of cardiac muscles is called diastole.

(a) Systole

These are two types of systole namely:

- Atrial systole
- Ventricular systole Atrial systole refers to the contraction of the atria that pushes the blood in the atria into the ventricles. The ventricular systole is the contraction of the ventricles that pushes blood out of the ventricles. During systole, semi-lunar valves opens to allow blood to flow out of the artery and out of the left ventricle through the aorta. During this time, the atrioventicular valves (cuspid valves) close to prevent backward flow of blood into the auricles.

(b) Diastole

There are two types of diastole:

- Atrial diastole
- Ventricular diastole During atrial diastole the muscles of the atria (auricles) relax and blood from the lungs and body is received in the auricles. Oxygenated bloods from the lungs enter the left auricle through pulmonary vein. De-oxygenated blood from various parts of the body enter into the right auricle through the vena cava. During ventricular diastole, the semi- lunar valves close down to prevent backward flow of blood from the pulmonary artery and aorta. The atrio-venticular valves open to allow blood to flow from the auricle to the ventricles.

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The process of blood clotting

Blood clotting occurs when blood is exposed to air such as when the tissue is injured. Blood clotting is important in reducing further loss of blood in the event of a damaged blood vessel as well as preventing entry of bacteria that cause diseases. Platelets are involved in the clotting process. Platelets contain a chemical substance called **thromboplastin,** which is released, at the injured vessel. Thromboplastin activates **prothrombin**, an inactive protein compound in plasma, to thrombin. Thrombin is a protein-digesting enzyme (protease).

It stimulates the conversion of **fibrinogen**, a protein found in plasma, to **fibrin**. Fibrinogen is a soluble protein molecule but fibrin is insoluble. Fibrin forms a meshwork of fibres that trap blood cells forming **a clot.** This prevents further blood loss.

See diagram page 250 TG

NOTE: Calcium ions play an important role in the blood clotting process. The calcium ions and vitamin K are required in the clotting process as enzyme cofactors. Enzyme co-factors activate the working of enzymes since the blood clotting process is controlled by enzymes.

Normally blood does not clot in undamaged blood vessels. There is a chemical substance found in plasma called **heparin** which prevents conversion of prothrombin to thrombin and fibrinogen to fibrin.

This chemical is used in hospitals as anticoagulant to prevent blood kept in blood bank from clotting. **Blood groups**

Human beings have different blood groups depending on the antigens found on the surfaces of red blood cells.

There are four main blood groups namely blood group A, Blood group B, Blood group AB and blood group O. The antigens contained in these blood groups are given below.

Blood group	**Antigen**
A	Have antigen A
B	Have antigen B
AB	Have both antigen A
O	Lack both antigen A and antigen B

There are antibodies found in the blood plasma as well. These antibodies interact with the antigens on the red blood cells. They are named as:

• Antibody a
• Antibody b

Note that antigens are named in capital letters (A and B) while antibody are named in

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small letters (a and b).

Blood oup	**Antigens on red ood**	**ıtibodies in plasma**
A	A	b
B	B	a
AB	A and B	None
O	None	A and b

Blood group Antigens on red blood Antibodies in plasma A A b B B a AB A and B None O None A and b A person with a specific antigen does not possess the complimentary antibody. For example, a person with antigen A (Blood group A) does not have antibody a in the plasma. The table below shows the antigens and antibodies present in the different blood groups.

Blood transfusion

Blood transfusion is the transfer of blood from one person to the blood stream of another person. The person who gives blood is called donor and the person who receives the blood is called the recipient. During blood transfusion, the blood groups of both the donor and recipient should be determined and matched.

- A person with blood group AB does not have antibodies in the blood plasma. Therefore such a person can receive blood from all other blood groups. Since there will be no antibody to agglutinate with the antigen. Blood group AB is hence said to be a **universal recipient**, that is, is able to receive blood from all donors.
- A person with blood group O lacks antigens. Such a person is referred to as **universal donor**, and is able to give blood to all other blood groups without agglutination.

The table below shows the blood transfusion options available. A tick (√) indicates that safe blood transfusion is possible while a cross (x) shows agglutination and hence safe blood transfusion is not possible.

	cipient			
Blood Group	A	B	AB	O
A	√	×	√	×
B	×	√	√	×
AB	×	×	√	×
O	√	√	√	√

Blood disorders

Examples of blood disorders include:

(a) Leukaemia

This is a disorder caused by uncontrolled production of white blood cells. Therefore, it is sometimes called blood cancer. It is characterised by abnormally high number of white blood cells per mm^3 of blood. The high numbers of cells digest the tissues

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resulting in general body weakness and body wasting. The condition can be controlled through blood transfusion from time to time; or through chemotherapy and radiotherapy to kill the abnormal number of cells.

(b) Sickle cell anaemia

This disorder arises when red blood cells lose their biconcave shape and assume sickle cell shapes that greatly reduce the surface area for transport of oxygen. Patients with sickle cell anaemia are characterised by difficulty in breathing especially after vigorous physical exercise, muscle fatigue, abdominal pain and general weakness of body. Sickle cell anaemia can be controlled by avoiding vigorous physical exercise and taking a diet rich in vitamins and mineral ions.

(c) Haemophilia

This is caused by failure of blood to clot in the event of a damaged vessel. This results in excessive bleeding. The disorder is caused by lack of clotting factors such as calcium ions and vitamin K. It can be controlled by injecting clotting factor into the blood stream of the patient.

11.6.A. Guidance on End unit assessment

The revision activity 11 is in place of end unit assessment.

- This part provides the answers of end unit assessment with cross reference to the textbook
- The teacher's guide suggests additional questions and answers to assess the key unit competence.
- Assessment activities are designed in integrative approach to assess the key unit competence with cross reference to the textbook.

B. Possible answers for end unit assessment/Revision activity 11

1. Heart and blood vessels

2. Aorta, vena cava

3. Valves

4. Aorta, vena cava

5. Refer to Fig. 11.7 page 232 of pupil's book.

6. Arteries, veins, capillaries.

7. Because they transport blood under high pressure hence blood cannot flow backwards.

8. During exercise, the heart beats faster than at rest.

9. By eating balanced diet, through regular exercises, drinking plenty of water and fluids, avoiding sex before marriage.

10. To avoid diseases like high blood pressure, heart attack and stroke.

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11. High, low

12. Fighting disease causing germs, clotting.

13. Oxyhaemoglobin

14. A

15. Pulmonary artery

16. A

17. Vena cava

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11.7 Additional activities

Remedial activities for slow learners	**Extended activities for gifted and talented learners**
1. Modelling the heart. 2. Drawing and tracing the path of blood in the circulatory system (they should use red colouring for oxygenated blood and blue colouring for deoxygenated blood). 3. Coming up with a table on differences between arteries and veins, circulatory system diseases on manila papers and hanging them on classroom walls.	1. Preparing questions to ask during educational visits such as when they visit a health facility. 2. Leading group discussions and doing presentations on behalf of group members 3. Summarizing lessons following guidance from the teacher. 4. Carrying out additional research, for example on blood disorders and the clotting process.
Remedial questions for slow learners	**Extended questions for gifted learners**
1. ____, ___ and ___ make up the circulatory system. 2. The heart has _____ chambers, two on the right and two on the left. The lower chambers are called _____ while the upper chambers are called _____. 3. Which diseases attack the heart? 4. _____ and ___ is bad for the health of the heart. 5. _____, _____ and ____ are the cells that make up blood.	1. Relate the structure of the heart to its functions. 2. Why would you rather go swimming than sleeping? 3. Assuming you cut your arm with a piece of glass which got into your bloodstream. Describe the path of the piece of glass to your leg. 4. Amongst the things that make up the circulatory system, one is NOT an organ, which one? What is it?

6. Which part forms the bulk of blood and is largely water?	
Answers to remedial questions	**Answers to extended questions**
1. Heart, blood and blood vessels. 2. Four, auricles(atria), ventricles. 3. Heart attack, thrombosis. 4. Smoking and excessive drinking of alcohol. 5. White blood cells, red blood cells and platelets. 6. Plasma.	1. - It is divided into two separate parts by septum – this ensures that oxygenated and deoxygenated blood do not mix. – Has four chambers that receive and pump blood. Lower chambers (ventricles) have thicker walls that upper ones (auricles) – this enables them generate enough force to pump blood far away. – It is made up of cardiac muscles, which contract and expand to generate pumping force. – Has valves which control the direction of flow of blood. 2. Swimming exercises the organs of the circulatory system thereby keeping them healthy. 3. Vein in the arm to vena cava to right auricle through the tricuspid valve to right ventricle to pulmonary artery to the lung to pulmonary vein to left auricle through bicuspid valve to the left ventricle to the aorta to the artery in the leg. 4. Blood. It is a tissue.
Consolidation activities	
1. What did you learn in this lesson? 2. Suppose we lacked a circulatory system, what will happen? 3. What makes up the circulatory system? 4. What are some of the processes that take place in human body? 5.What is hygiene of the heart? 6. List three practices that will enhance a healthy heart. 7. Apart from the heart, which other organs should we take care of in the circulatory system? 8.What is sphygmomanometer? 9. What blood pressure is considered normal?	
Answers to Consolidation activities	

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1. The function of the circulatory system in human body and the organs that make up the circulatory system. 2. We will not survive because our body tissues will lack oxygen, will not have digested nutrients, will not remove waste products and hormones will not be distributed throughout the body for their action. Also, antibodies and white blood cells will not go to sites where they are needed to fight diseases. This will lead to death of cells and tissues hence death of the individual. 3. The heart, blood and blood vessels 4. Respiration, excretion, digestion, circulation of blood, reproduction among others. 5. Practices that keep the heart healthy 6. Balanced diet, exercising, not smoking or taking alcohol, among others 7. Blood vessels, also blood should be taken good care of 8. Instrument used to measure blood pressure 9. Between 120/80 mmHg – 140/90 mm Hg	

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Unit 12: Respiratory system

12.1. Key unit Competence

- To explain the mechanism of respiration.

10.2. Prerequisite

In the previous unit, pupils learnt about the circulatory system. They also learnt about the

reproductive and digestive systems in primary 5.

Build on the knowledge of leaners in these areas to introduce the respiratory system, its function, its hygiene and the diseases that affect it. Also, during the lessons, strive to bring to the awareness of learners the fact that this topic is related to respiratory system in biology that they will study at higher levels of learning. Let them understand that at this level, they may only need the basic information otherwise, details of functioning of the respiratory system will be learnt in high school and even better, when later in life, they study medicine and become chest specialists.

In unit 11, learners were introduced to circulatory system. Let them understand that respiratory system is one of the many body systems just like the circulatory system.

12.3. Introductory activity and guidance

Guidance on the introductory activity

- Ask learners to form groups and let them observe the picture in the fig 12.1of the learner's book.
- Let the learners to describe deeply what the picture is showing.
- Help learners to predict what they are going to learn in this unit.

12.4. List of lessons/sub-heading

#	Lesson title	Learning objectives	Number of periods
1	Organs of the human respiratory system and their main function	• Explain the main function of human respiratory system. • Describe the human respiratory System.	2
2	Mechanism of respiration (breathing)	• To explain the process of respiration. • To describe the mechanism of respiration.	2
3	Good health practices and behaviors	To explain the care of the human respiratory system..	1
4	Diseases of respiratory system	To identify main diseases of the respiratory system and state their causes, signs & symptoms and how to prevent them.	2
5	Suffocation	To define suffocation, state its causes and do first aid to a suffocation victim	2
6	**Assessment and remediation**		**1**

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12.4.1. Lesson One: Organs of the human respiratory system and their main function

a) Learning objectives

- Explain the main function of human respiratory system.
- Describe the human respiratory System.

5. Teaching resources

- Rabbit or mouse and dissecting kit.
- Charts on parts of the human respiratory system, textbooks, pamphlets and hand outs.
- Video link: https://www.youtube.com/ watch?v=h-wATTsMBBA&t=128s

c) Learning activities/ Activities 12.1 & 12.2

- This is individual learner's activity: Let them carry out the tasks highlighted in this activity 12.1 then discuss their findings with friends.
- Guide learners to discover the role of respiratory system, which is to bring fresh air into the lungs and remove waste air out of the body. (You may need to stress that fresh air is mainly oxygen and waste air is mainly carbon dioxide and what their sources are i.e. from atmospheric air and by-product of respiration in living cells).
  - Let learners to carry out Activity 12.2 (Refer to Pupil's book) and let them to present their findings to the class.
- By now, learners have a rough idea what respiratory system and its function is hence you can now delve further into the components of the respiratory system.
- You can then do a class demonstration on dissecting either a rabbit or a mouse to show learners parts of the respiratory system. Later, depending on availability of resources, you may put learners into groups and guide them to carry out a dissection practical on a rabbit or a mouse to observe the respiratory system.
- Let them use the charts to identify the parts that they see. They can also use Fig. 12.2 on of their book. Let them make a sketch of the respiratory system in their notebooks and share with the rest of the class.
- Finally, guide learners to come up with a table on the various parts of the respiratory system and their functions.
- Wind up by giving learners a task on describing the human respiratory system in their own words.

Answers to activities 12.1 & 12.2

Refer to Fig 12.2 Parts of human respiratory system and Table 12.1: Parts of respiratory system and their functions

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12.4.2. Lesson Two: Mechanism of respiration (breathing)

a) Learning objectives

• To explain the process of respiration.
• To describe the mechanism of respiration.

b) Teaching resources

• Items like bell jar, balloons, rubber sheet, stoppers and Y- shaped glass tube.

• Charts on breathing mechanism, textbooks, pamphlets and hand outs.

• Video link: https://www.youtube.com/ watch?v=h-wATTsMBBA&t=128s
IMPROVISATION: You may come up with your own breathing model and use it during the practical activities.

c) Learning activities/Activities 12.3 & 12.4

- This lesson will involve watching a video and a practical activity. You will therefore organize the class as need arises during the lesson.
- Pre-test the video to confirm that it is working. Use video link: https:// www.youtube.com/watch?v=hwATTsMBBA&t=128s
- Obtain charts on breathing process and mechanism of breathing.
- Let learners feel the breathing process as described in the activity 12.3. They should repeat this several times and come up with a conclusion on what is happening.
- You can then play the video or let them visit the above website to watch the video in groups.
- Guide learners to describe what they have seen. Ask probing questions such as:

1. What happened to the ribs? (Ans: They were moving up and down or inwards and outwards)
2. How about the diaphragm? (Ans: Dome-shaped or flattens)
3. What is the significance of these? (Ans: They cause change in volume of chest cavity which leads to breathing in or out)

- Activity 12.4: introduce the activity on making a breathing model then demonstrating how it works.
- Ask Learners to compare this to the working of the breathing system in human beings.
- Let again them assemble the items in this activity 12.4 as shown in the figure of their book .
- Let leaners observe and state what happens.

• Ask learners what the various items in the model above correspond to and the actions.

• Guide them to summarize what the various items and actions correspond to in the respiratory system.

• At this point, you can guide learners to discover the mechanism of breathing in and out. Refer to learner's book.

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Guide learners to come up with a table on what happens to every organ in the respiratory system during breathing in and out.

• Let learners come up with summary notes on breathing mechanism. Assess their work then correct them accordingly.

Answers to activities 12.3 & 12.4

a) Chest
b) Lung
c) Diaphragm
d) Weasand

12.4.3. Lesson Three: Good health practices and behaviors

a) Learning objectives

- To explain the care of the human respiratory system.

b) Teaching resources

• Transparent plastic bottle with cap or bell jar, cigarette, two balloons, rubber stopper, Y-shaped glass tube, rubber sheet tissue paper, biro pen casing, matchbox, string.

• Reference materials or internet connectivity.

c) Learning activities

- This lesson will involve a practical activity and group work. You will therefore organize the class as need arises during the lesson.
- Bring pamphlets, handouts, and textbooks for reference in class. Also, ensure that the Internet is working if you have a computer laboratory or any other form of internet connectivity such as WIFI or modem.
- Guide learners to go through the procedures given in the activity 12.5 of the textbook.
- Ask probing questions along the way, for example:
- Why should the bottle be filled halfway with water? (Ans: to allow atmospheric pressure to push the smoke into the bottle).
- What is the use of the tissue paper? (Ans: To show the effect of smoking on the lungs)

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- Let learners discuss the results of the experiment in their groups. They should write summary notes and nominate a group leader to do presentation on their behalf.

• Summarize by highlighting the main aim of the experiment which is to find out the effect of smoking on the lungs.

• Highlight other points about safety of respiratory system as listed in Pupil's book page.

12.4.4. Lesson Four: Diseases of respiratory system

a) Learning objectives

To identify main diseases of the respiratory system and state their causes, signs & symptoms and how to prevent them.

b) Teaching resources

Reference materials on diseases of the respiratory system.

c) Learning activities / Activities 12.6

- This lesson will involve a research activity either in the library or using the Internet.
- Bring pamphlets, handouts, and textbooks for reference in class. Also, ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WIFI or modem.

• Let learners go to the library and search in textbooks, diseases that affect the respiratory system and their signs and symptoms. They can also do Internet searches and watch videos.

• Back in class, put learners in groups depending on the size of the class and the abilities of class members to harmonize their findings. Let them choose a group leader to do a presentation on their behalf.

• After the presentations, guide learners to write short notes and draw a table on various respiratory diseases, their causes, signs & symptoms and control/prevention measures. Refer to Pupil's book.

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Answers to activities 12.5

Refer to 12.6 on common diseases of the respiratory system include page 245 and Table 12.3: Signs and symptoms of the respiratory diseases and their control measures page 246.

12.4.5. Lesson Four: Suffocation

a) Learning objectives

To define suffocation, state its causes and do first aid to a suffocation victim.

b) Teaching resources

• Reference materials on diseases of the respiratory system.

• Video link: https:www.youtube.com/ watch?v=NXnXAYceSqQ

c) Learning activities

- This lesson will involve a research activity and group work involving role play.
- Pre-test the video to confirm that it is working. Use video link: https:www.youtube.com/ watch?v=NXnXAYceSqQ
- Bring pamphlets, handouts, and textbooks on first aid for suffocation for reference.
- Let learners go to the library and search in textbooks the meaning of suffocation, its causes, and how to give first aid to a suffocated person. They can also do Internet searches and watch videos using the above link.
- Let also learners to carry out activity 12.7 to investigate the causes and first aid of suffocation.
- Back in class, put learners in groups depending on the size of the class and the abilities of class members to harmonize their findings.
- Let them choose a group leader to do a presentation on their behalf.
- Let learners watch the video using the link provided above.
- Put learners in pairs and let them act first aid for suffocation as they saw in the video. One learner should act as a victim while the other gives first aid. They should then change roles.

Answers to Self-Test 12.1

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1. Eating a balanced diet, avoiding smoking and excessive consumption of alcohol, not inhaling poisonous gases, exercising regularly among other practices.
2. Asthma, tuberculosis, pneumonia, bronchitis, pleurisy, whooping cough.
3. Choking, drowning, throat infection, inhaling poisonous substances, physical damage to the airways among others.
4. Refer to learner's book page ……

12.5. Additional Information for the teacher.

Some information that may be relevant with regards to the respiratory system are given below.

Types and characteristics of respiratory surfaces

Respiratory surfaces refer to places or sites where gaseous exchange occurs in organisms. Organisms have different respiratory surfaces depending on their complexity and their habitat. Examples of specialised structures for gaseous exchange in animals include:

- Cell membrane for example in amoeba
- Tracheal system in insects
- Buccal cavity in frogs
- Skin in frogs
- Gills in fish
- Lungs in mammals, birds, reptiles and amphibians.

Gaseous exchange takes place over these respiratory surfaces. A respiratory surface must have certain characteristics that make it efficient for gaseous exchange. They include:

- Thin walls for faster diffusion of gases across it.
- It should be moist to dissolve gases as they diffuse across it.
- It must have a large surface area to volume ratio for maximum gaseous exchange.
- In animals with a transport system, the respiratory surface has to have a rich supply of blood capillaries to quickly transport gases to and from the cells.

However, not all respiratory surfaces are in direct contact with the medium through which gaseous exchange occurs, such as the water or air around the organism. This presents two difficulties to the cells namely; not getting enough oxygen, and accumulation of carbon dioxide at the respiratory surface.

Therefore, there is need for a process that can ensure a continuous supply of fresh water or air to and from the respiratory surface. This is achieved by the process of ventilation which continuously brings water or air containing more oxygen to the respiratory surface and removes from it water or air containing a lot of carbon dioxide. Ventilation, therefore, is important because it maintains a high diffusion gradient at the respiratory surface to ensure a high rate of gaseous exchange. Breathing is an example of ventilation. Learners have already been taught about ventilation (breathing) in mammals. In the next section, we present to you additional information on breathing/ventilation mechanisms in other organisms.

(a) Protozoa

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Protozoa are single celled organisms. Examples of protozoa include Amoeba, Plasmodium and Trypanosoma. These are microscopic organisms. They are mainly found in water or in the body fluids of other organisms. The respiratory surface of protozoa is the cell membrane. Gaseous exchange occurs across the cell membrane directly by diffusion. Due to respiration, the concentration of carbon dioxide inside the cell is higher than that in the surrounding water. Therefore, carbon dioxide diffuses out of the organism into the surrounding.

Diagram page 268

On the other hand, the concentration of oxygen is higher in the surrounding water than inside the organism. This gas is continuously used for respiration in the organism. Oxygen therefore diffuses from the surrounding water into the organism.

(b) Insects

The respiratory system in insects is called the tracheal system. It consists of spiracles, trachea and tracheoles.

Diagram page 269

Each spiracle has a muscular valve, which can be opened or closed to regulate the flow of air. There are also hairs in the spiracles, which prevent excessive loss of water by evaporation from the tissues.

Diagram page 269

Air sac Spiracle Blood vessel system Tracheoles The spiracles open into large tracheal tubes called tracheae (singular trachea). These tubes are strengthened with spiral bands of chitin to keep them open at all times. There are several large air sacs, which are connected to the tracheal tubes. The tracheae are subdivided into microscopic tubes (with a diameter of about 0.1mm) called tracheoles. Tracheoles penetrate the body tissues and are in direct contact with all the living cells. They lack the spiral bands of chitin and their ends are filled with a fluid. These ends act as respiratory surfaces between the cells and the tracheoles. In small insects, simple diffusion is enough to meet their gaseous exchange requirements. In large active insects, like grasshoppers, wasps, bees, and others breathing movements which ventilate the tracheal system are necessary to increase the efficiency of gaseous exchange.

(c) Bony fish

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In bony fish, the respiratory structures are the gills. The bony fish have four gills on each side of the body. The gills are located inside a cavity in the head region known as the operculum cavity. Each side of the fish has an operculum cavity which has an opening to the outside of the fish known as the opercular opening.

Diagram page 269

The gills are protected by a thick gill cover or **operculum** on both sides of the body near the head. This is a fold of skin made stiff by a bony plate. The gill of bony fish consists of a set of long, curved bony structures called **gill bars**, see Fig. 12.5. A large number of long thin-walled and moist gill filaments project from each gill bar. The curved shape of the gill bar allows for more filaments to fit on it. The filaments are richly supplied with blood due to the presence of many capillaries. The respiratory surface of the gill on the **gill filaments** is a layer of cells, exposed to the surrounding water on one side and to blood vessels on the other. The thin surface allows rapid diffusion of carbon dioxide and oxygen between water and the blood.
The gill bar has bony teeth-like structures called gill rakers on the opposite side of the gill filaments. The **gill rakers** face the mouth and prevent food and other solid materials in water from reaching the delicate filaments.

Diagram page 270

Gaseous exchange in the fish occurs between the gill filaments and water. This means that there has to be contact between water and the gill filaments. Such contact is brought about by ventilation processes of inspiration and expiration, which continuously bring in and remove water from the gills. This water gets into the mouth, passes over the gills and leaves through the opercular cavity.

(d) Amphibian

In an amphibian such as a frog, the respiratory structures are three i.e. the mouth cavity, the skin and the lungs.

(i) The mouth

The mouth or buccal cavity of a frog is the space just inside the mouth. The lining of the buccal cavity is thin and is also richly supplied with blood capillaries. It is kept moist by mucous membrane. Gaseous exchange takes place through the lining of the mouth cavity. When the frog lowers the floor of its mouth, the volume in it increases but the pressure decreases. Air is sucked

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into the mouth, through the nostrils. Since the lining of the mouth is moist, oxygen dissolves in the moisture, and diffuses into the blood capillaries beneath. Carbon dioxide diffuses from the blood capillaries into the mouth cavity. When the floor of the mouth is raised, this reduces the volume in the mouth cavity, increases the pressure and air is expelled via the nostrils.

Diagram page 271

(ii) Skin

In most land animals, the skin has a tough, waterproof epidermis for protection against injury and excessive water loss. It is not suitable for gaseous exchange. Therefore most organisms that live on land do not use the skin as a site for exchange of gases. In the frog's skin, however, the amount of protective covering in the epidermis is small. The skin is thin and richly supplied with blood vessels kept moist by secretions from glands. The frog's skin is therefore suitable, for gaseous exchange.

(iii) Lungs

The frog has two lungs, which are connected, to the buccal cavity through a small passage with a valve. The inner surface of the lungs is thin, moist and is richly supplied with blood capillaries. It also has tiny folds which increase the surface area for exchange of gases. Lungs in frogs work largely like those of human beings. Gaseous exchange across the alveoli in lungs of human beings Gaseous exchange at the alveolus takes place between the phases of inhalation and exhalation. Figure 12.7 shows that the alveolus is a suitable point for gaseous exchange because:

- It is supplied with blood, which carries the gases being exchanged.
- It has a very thin wall across which gases diffuse between it and the blood.
- It is lined with a thin film of moisture to dissolve the diffusing gases.
- A ventilation process brings in and takes away air containing the gases being exchanged.
- The lungs has a very large number of alveoli to increase their surface area for gaseous exchange.

Diagram page 272

Oxygen in air in the alveolar space is at a higher concentration than that in the blood capillaries. It therefore first dissolves in the water layer in the alveolar lining then diffuses across the alveolus and then the capillary walls into the red blood cells. This becomes oxygenated blood, which is carried to the heart by the pulmonary vein. On the other hand, carbon dioxide in the blood diffuses across the capillary and alveolus walls into the alveolar space and is eventually expelled during exhalation.

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12.6.A. Guidance on End unit assessment

The revision activity 12 is in place of end unit assessment.

- This part provides the answers of end unit assessment with cross reference to the textbook
- The teacher's guide suggests additional questions and answers to assess the key unit competence.
- Assessment activities are designed in integrative approach to assess the key unit competence with cross reference to the textbook.
  Possible Answers for End Unit assessment / Revision Activity 13

B. Answers for end unit assessment/Revision activity 12

1. Just like a car needs fuel, human beings require oxygen foe respiration that provides the body with energy to occur.
2. (a) To increase the supply of oxygen to muscle tissues to meet increased demand.
   (b) Because our body tissues are starved of oxygen when we hold our breath.
3. (a) Chest – ribs move upwards and outwards thereby increasing the volume of the chest cavity.
Lungs – expand allowing air in.
(b) Chest – Ribs move downwards and inwards thereby reducing the volume of the chest cavity.
Lungs - contract thereby expelling the air.
4. Hairs, mucus. It prevents entry of germs that can cause diseases into the body.
5. Diaphragm
6. Refer to Activity in the pupil's book.
7. Carbon dioxide, oxygen.
8. Inhalation, exhalation
9. C
10. Refer to Activity 12.5 of the learners' book.
11. Exercising, eating a balanced diet, avoiding smoking and excessive drinking of alcohol.

12.7 Additional activities

Remedial activities for slow learners	Extended activities for gifted and talented learners
1. Modelling the lungs. 2. Drawing and tracing the path of air in the respiratory system (they should use red colouring for oxygen and blue colouring for carbon dioxide.	1. Performing dissection of mouse or rabbit after demonstration by the teacher. 2. Leading group discussions and doing presentations on behalf of group members. 3. Summarizing lessons following guidance from the teacher. 4. Carrying out additional research,

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3. Coming up with a table on differences between circulatory system and respiratory system on manila papers and hanging them on classroom walls.	for example on mechanism of gaseous exchange at the alveolar level and ventilation in other animals such as fish, frog and insects.
Remedial questions for slow learners	**Extended questions for gifted learners**
1. Name two gases involved in respiration _____ and _____ 2. The trachea is also called _____ 3. Gaseous exchange in the lungs takes place inside the _____ 4. (a) What is most likely to happen if the string is pulled down in the diagram below?_____ (b) What will happen if the rubber sheet is pushed upwards_____?	1. Relate the structure of the respiratory system to its functions. 2. Account for darkened lungs in smokers? 3. Using diagrams show the difference between breathing in and out. 4. Would you rather eat apples and grapes or chew sugarcane? Why?
Answers to remedial questions	**Answers to extended questions**
1. Oxygen and carbon dioxide. 2. Wind pipe. 3. Air sacs or alveoli. 4. (a) Balloons will expand. (b) Balloons will reduce in size.	1. (a) Trachea, bronchi and bronchioles are lined with tough substance made of cartilage, which prevents them from collapsing. (b) The nose and nostril has hairs and mucous which filter dust particles and germs. (c) There are numerous alveoli, which increase surface area for gaseous exchange. (d) The walls of alveoli are very thin to reduce distance travelled by gases during gaseous exchange. (e) Alveoli are surrounded by a network of blood capillaries which supply them with blood. 2. The smoke gets into the lungs, interfere with or stain lung tissues which makes them appear dark. This reduces efficiency of gaseous exchange. 3. Eat apples and grapes. They are good for healthy lungs as opposed to sugar from sugar cane which affects the lungs.
Consolidation activities	
1. What is the difference between respiratory system and circulatory system? 2. What makes up the respiratory system 3. Suppose we lacked a respiratory system, what will happen? **4**. Which organ allows air to get into the breathing system? 5. When the diaphragm flattens during breathing in chest cavity _____. 6. What is the equivalent of these things in a breathing model? (a) Y-shaped tube	

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_____ (b) Bell jar _____ 7. What happens in the alveoli during breathing? 8. What is hygiene of the respiratory system? 9. List three practices that will enhance a healthy respiratory system. 10. How will washing hands before every meal help in keeping respiratory system healthy? 11. Give four diseases that affect the respiratory system. 12. Which signs would you look out for in order to know when someone is suffering from: (a) Tuberculosis? (b) Asthma? (c) Bronchitis?) 13. How would you prevent pneumonia in your locality? 14. To suffocate is to _____? 15. What causes suffocation?	
Answers to Consolidation activities	
1. Respiratory system helps in bringing fresh air into the lungs and removing stale air out of the body. Circulatory system on the other hand helps in transportation of substances in the body. 2. Lungs, trachea, bronchi, bronchioles, diaphragm, alveoli and ribs. 3. We will not survive because our body tissues will lack oxygen, and also, carbon dioxide will not be removed from the body leading to poisoning of body cells. 4. When the diaphragm flattens during breathing in chest cavity _____. (Ans: increases) in volume. This reduces the _____ (Ans: pressure) inside the chest cavity thereby leading to air rushing into the lungs.	

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5. (a) Y-shaped tube _____ (Ans: Trachea) (b) Bell jar _____ (Ans: chest cavity) 6. Gaseous exchange occurs i.e. oxygen is introduced into the bloodstream while carbon dioxide is released into the alveolus airspace 7. Practices that keep the respiratory system healthy 8. Balanced diet, exercising, not smoking or taking alcohol, among others 9. Prevents infection of the lungs 10. H e a r t a t t a c k , s t r o ke , antherosclerosis, high blood pressure among others) 11. Refer to Table 12.3 of Pupil's book 12.: Refer to table 12.3 of Pupil's book 13. To cause to die by to depriving air or oxygen) 14. Chocking, drowning, asthma, inhaling poisonous substances 15. Refer to pupil's book	

EXPERIMENTAL VERSION

Unit 13: Reproductive system

13.1. Key unit Competence

To explain the function of male and female genital organ, the prevention, transmission and treatment of STIs and HIV and state ways of preventing unplanned pregnancy

13.2. Prerequisite

Learners have already learnt about the reproductive system in primary 5. The teacher

takes advantage of learner's prior knowledge when teaching this unit such as functions of human reproductive system, hygiene of the male and female genital organs and Primary Sexual

characteristics in human. This content will help of course as previous knowledge which will facilitate the understanding of the new unity.

13.3. Introductory activity and guidance

Guidance on the introductory activity

- Ask leaners to observe the picture showing a family, study the picture and give some comments.
- Help learners to predict what they are going to learn in this unit.

13.4. List of lessons/sub-heading

#	Lesson title	Learning objectives	Number of periods
1	Main function of reproductive system	To explain the function of the human reproductive system.	1
2	Male reproductive organs and their functions (External and internal organs)	To identify the different parts of the male genitalia and explain their functions.	2
3	Female reproductive organs and their functions (External and internal organs)	To identify the different parts of the female genitalia and explain their functions.	2
4	Preventing unplanned Pregnancy	To be aware of the methods to use in order to prevent unplanned (unwanted) pregnancy.	2
5	Sexually transmitted infections	To explain the transmission, prevention and treatment of common STIs.	2
6	Means of transmission of common STIs/HIV	Describe common STIs/HIV • Describe and Explain how STIs/HIV.HIV are transmitted	2
7	Prevention and treatment of common STIs/HIV	. • Explain the prevention and treatment of common STIs/HIV.	2
8	Living Positively with HIV and AIDS	State how to live positively with HIV and AIDS patients	2
9	**Assessment and remediation**		**1**

EXPERIMENTAL VERSION

13.4.1. Lesson One: Main function of reproductive system

a) Learning objectives

To explain the function of the human reproductive system.

b) Teaching resources

• Textbooks, handouts and pamphlets

• Computers connected to the Internet.

c) Learning activities

- This lesson will involve individual research work and group discussions.
- You will therefore organize the class as need arises during the lesson.
- Look for textbooks, handouts, pamphlets and other materials on reproductive system.
- Ensure the internet is working properly before the lesson for leaners to use to do research.
- Let learners go to the library to read textbooks on what reproductive system is and its function and write summary notes. They can also use the textbooks and handouts or pamphlets, which you will provide. If the school has Internet connectivity, guide learners to visit sites where they can get this information. For example: http:// www.scholar.google.com or by simply searching reproduction using google search engine.
- Guide learners to discover the role of reproductive system, which is to create new individuals for continuity of species. (You may need to stress the fact that without reproduction, species will become extinct).
- At this point, you may inform learners that reproduction can be sexual or asexual.
- Ask learners how they plant sugar cane or sweet potatoes, then what happens. Emphasise the fact that this is a form of asexual reproduction where gametes are not involved.

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13.4.2. Lesson Two: Male reproductive organs and their functions (External and internal organs)

a) Learning objectives

To identify the different parts of the male genitalia and explain their functions.

b) Teaching resources

• Textbooks, handouts and pamphlets.

• Computers connected to the Internet.

IMPROVISATION: You may come up with a well-painted diagram on male genitalia on a manila paper and use it instead of charts.

c) Learning activities/ Activity 13.2

- This lesson will involve individual research work and group activity. You will therefore organize the class as need arises during the lesson.
- Look for textbooks, handouts, pamphlets and other materials on reproductive system.
- Ensure the Internet is working properly before the lesson for leaners to use to do research.
- Provide learners with charts showing both internal and external male genitalia. Let them study the charts in groups.
- In their groups, they can play a game of pointing and naming the various parts. Let one member point at a part as others name the part.
- Guide learners to draw and label the internal and external male genitalia in their notebooks. Correct them where appropriate.
- In the second period of the lesson, give learners a chance to do research on the functions of the various parts of the male genitalia. Let them write summary notes then share with other group members.
- Let the learners in each group choose a group leader to help them summarize their points on functions of the various parts of the male genitalia in a table format. He or she should then do a presentation to the rest of the class on behalf of the group.
- Summarise the lesson by describing the functions of the various parts as learners note down main points.

Answer to learning activity 13.3

EXPERIMENTAL VERSION

Refer to learners' book pages 252.

13.4.3. Lesson Three: Female reproductive organs and their functions (External and internal organs)

a) Learning objectives

To identify the different parts of the female genitalia and explain their functions

b) Teaching resources

• Textbooks, handouts and pamphlets.

• Computers connected to the Internet.

IMPROVISATION: You may come up with a well painted diagram on female genitalia on a manila paper and use it instead of charts.

c) Learning activities/ Activity 13.3

- This lesson will involve individual research work and group activity. You will therefore organize the class as need arises during the lesson.
- Look for textbooks, handouts, pamphlets and other materials on reproductive system.
- Ensure the Internet is working properly before the lesson for leaners to use to do research.
- Provide learners with charts showing both internal and external female genitalia. Let them study the charts in groups.
- In their groups, they can play a game of pointing and naming the various parts. Let one member point at a part as others name the part.
- Guide learners to draw and label the internal and external female genitalia in their notebooks. Correct them where appropriate.

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- In the second period of the lesson, give learners a chance to do research on the functions of the various parts of the female genitalia. Let them write summary notes then share with other group members.
- Let the learners in each group choose a group leader to help them summarize their points on functions of the various parts of the female genitalia in a table format. He or she should then do a presentation to the rest of the class on behalf of the group.
- Summarise the lesson by describing the functions of the various parts of the female genitalia as learners note down main points.

Answer to learning activity 13.3

Refer to learners book pages 253-254.

Answers to Self-Test 13.1

Refer to learner's book pages 256

1. Diagram of male reproductive organ labelled TG page 301

2. Labia mijora, labia minora, Bartholin's gland, clitoris and vulva

3. Diagram of female reproductive organ labelled TG page 301

4. With regards to the reproductive system are given below.

13.4.4. Lesson Four: Preventing unplanned Pregnancy

a) Learning objectives

To use in order to prevent unplanned (unwanted) pregnancy.

b) Teaching resources

• Contraceptives such as condoms, pills, diaphragms and coils, pipe, string, some water in a tin.
• Charts on vasectomy and tube ligation

EXPERIMENTAL VERSION

• Textbooks, handouts and pamphlets.

• Computers connected to the Internet.

c) Learning activities/ Activity 13.4

- This lesson will involve individual research work, group work and demonstrations. You will therefore organize the class as need arises during the lesson.
- Look for textbooks, handouts, pamphlets and contraceptives such as condoms, pills, diaphragms, coils among others.
- Ensure the Internet is working properly before the lesson for leaners to use to do research
- Let them find out more about the various methods used to prevent pregnancy individually. Let them find out how the methods work and their advantages and disadvantages.
- Back in class, put them in groups based on their abilities and class size then let them talk about what their findings were.
- Guide learners in each group to choose a group leader to do presentation to other class members on behalf of the group.
- Highlight the main points about each contraception method emphasizing their advantages and disadvantages
- For condoms, carry out a class demonstration on proper use of a condom. Refer to Pupil's book, Activity 13.5
- Using a penis model or a ripe banana, demonstrate to learners how to put on a condom properly.
- **REMEMBER:** Emphasize to learners the importance of proper putting on of condom to avoid bursting or tearing.
- Let learners individually put on a condom on the model or ripe banana. They should repeat this several times until they become familiar.
- **REMEMBER:** Emphasise the importance of using a condom during sexual intercourse as a cross cutting issue under Reproductive health and comprehensive sexuality education. This will help prevent unwanted pregnancies and STIs including HIV and AIDS.
- Narrow down to the permanent methods of family planning. i.e. vasectomy and tube ligation.
- Let learners do some research on what vasectomy and tube ligation are.

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- Show learners the charts on vasectomy and tube ligation. Put them into groups. Let them recall the structure of internal genitalia both for males and females. They should draw them in their notebooks.
- Narrow down to the cut or folded areas in the diagrams. Let them identify what has been done to these parts.
- To hammer the point home, demonstrate using a tied pipe and open pipe and water. Pour some water in an open pipe. Let learners say what happens. Next, tie the pipe using a string. Let them say what happens.
- Relate the findings above to what happens in either vasectomy or tube ligation. Let learners write summary notes and draw the diagrams in their notebooks.
- **REMEMBER:** Emphasise the advantages and disadvantages of tube ligation and the necessity to seek consent of your partner in a marriage relationship before carrying out tube ligation or vasectomy.

Answers to Activity 13.4

Refer to learners'book page 257

13.4.5. Lesson Five: Sexually transmitted infections

a) Learning objectives

- To describe common STIs.
- To explain the transmission, prevention and treatment of common STIs.

b) Teaching resources

• Reference materials on sexually transmitted infections diseases, their causes, signs and symptoms and prevention/control.

c) Learning activities/Activity 13.6

- This lesson will involve a research activity either in the library or using the Internet and group work.
- Bring pamphlets, handouts, and textbooks for reference in class. Also, ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WIFI or modem.
- Test whether the video link - https://www.youtube.com/ watch?v=SyJwEUIUOzk is working.

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• Let learners go to the library and search in textbooks or the internet, diseases that affect the reproductive system which are sexually transmitted and their signs and symptoms.

• Let them watch the video on sexually transmitted diseases through the link above. They should write short notes on: – Signs and symptoms of the diseases, Their cause – Mode of transmission – Control and prevention

• Back in class, put learners in groups depending on the size of the class and the abilities of class members to harmonize their findings. Let them choose a group leader to do a presentation on their behalf.

• After the presentations, guide learners to write short notes and draw a table on various STIs, their causes, signs & symptoms and control/prevention measures.

Answers to learning activity 13.6

Refer to learners'book page 260 & 261

13.4.6. Lesson Six: Means of transmission of common STIs/HIV

a) Learning objectives

•To state the meaning of HIV and AIDS.

• To explain the cause of HIV and AIDS.

• To describe how HIV and AIDS is transmitted.

• To describe the symptoms of HIV and AIDS.

b) Teaching resources

• Reference materials on HIV and AIDS – may include textbooks, magazines, hand outs and pamphlets.

• Video link on HIV and AIDS such as:https://www.youtube.com/ watch?v=17pfZUlAqow

c) Learning activities/ Activity 13. 8

EXPERIMENTAL VERSION

- This lesson will involve a research activity either in the library or using the Internet and group work.
- Bring pamphlets, handouts, and textbooks for reference in class. Also, ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WIFI or modem.
- Test whether the video link https://www.youtube.com/ watch?v=17pfZUlAqow is working or any other relevant video link.

• Let learners go to the library and search in textbooks or the Internet, what HIV and AIDS is, its cause, how it is transmitted and its signs and symptoms.

• Let them watch the video on HIV and AIDS through the link provided above. They should write short notes on: – Signs and symptoms of the disease – Its cause – Mode of transmission – Its progression – Signs and symptoms

• Back in class, put learners in groups depending on the size of the class and the abilities of class members to harmonize their findings. Let them choose a group leader to do a presentation on their behalf.

• After the presentations, highlight the main points as learners come up with summary notes.

1.Answers to learning activity 13.8

Letter	**What it stands for**
H	Human
I	Immunodeficiency
V	Virus
A	Acquired
I	Immuno
D	deficiency
S	Syndrome

2. Refer to learners'book pages 262-263

13.4.7. Lesson Six: Prevention and treatment of common STIs/HIV

a) Learning objectives

- To explain available treatment for HIV and AIDS and how to prevent it.

b) Teaching resources

Reference materials on HIV and AIDS – may include textbooks, magazines, hand outs and pamphlets.

c) Learning activities

EXPERIMENTAL VERSION

- This lesson will involve a research activity either in the library or using the Internet and group work.
- Bring pamphlets, handouts, and textbooks for reference in class. Also, ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WIFI or modem.

• Let learners go to the library and search in textbooks, magazines, pamphlets and handouts or the Internet, how HIV and AIDS can be controlled or prevented. They should also find out whether HIV and AIDS can be treated, if so, using which drugs?

- Highlight the main points as learners come up with summary notes. Refer to Pupil's book Emphasize the fact that ARVs are used to reduce SEVERITY of the disease by boosting immunity and reducing the viral load as opposed to treating the disease.
- Back in class, put learners in groups depending on the size of the class and the abilities of class members. Let them discuss how to live positively with people living with HIV and AIDS. They should also discuss the challenges that HIV positive people or their relatives go through. Let them choose a group member to harmonize their points and do a presentation to the rest of the class.
- Highlight the main points as learners come up with summary notes.
- This topic was mainly about good sexual behaviour and proper decision-making. Wrap up the topic by learners dramatizing on this as explained in this activity.
- **REMEMBER**: Emphasize the necessity to avoid HIV and AIDS infection as a cross-cutting issue under reproductive health and comprehensive sexuality education. Also, bring to the attention of learners the fact that ARVs are nowadays available to reduce the severity of the disease. Equally important is - discrimination of people living with HIV and AIDS should strongly be condemned.
- Guide learners to discover by way of research, the various methods to use to prevent the spread of HIV and AIDS. They should at the end appreciate the need to prevent/control this disease as a way of living healthy life.

Answers to learning activity 13.6

Refer to learners'book page 260 & 261

13.4.8. Lesson eight: Living Positively with HIV and AIDS

a) Learning objectives

- To state how to live positively with HIV and AIDS patients.

b) Teaching resources

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Reference materials on HIV and AIDS – may include textbooks, magazines, hand outs and pamphlets.

c) Learning activities

- This lesson will involve a research activity either in the library or using the Internet and group work.
- Bring pamphlets, handouts, and textbooks for reference in class. Also, ensure that the Internet is working if you have a computer laboratory or any other form of Internet connectivity such as WIFI or modem.
- Let learners go to the library and search in textbooks, magazines, pamphlets and handouts or the Internet, how HIV and AIDS can be controlled or prevented. • Highlight the main points as learners come up with summary notes. Refer to Pupil's book
- Back in class, put learners in groups depending on the size of the class and the abilities of class members. Let them discuss how to live positively with people living with HIV and AIDS. They should also discuss the challenges that HIV positive people or their relatives go through. Let them choose a group member to harmonize their points and do a presentation to the rest of the class.

• Highlight the main points as learners come up with summary notes. explained in this activity. REMEMBER: important is - discrimination of people living with HIV and AIDS should strongly be condemned.

Answers to learning activity 13.6

Refer to learners'book page 260 & 261

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13.5. Additional information for the teacher

This section provides additional content for the teacher to have a deeper understanding of the topic. Some information that may be relevant with regards to the reproductive system are given below.

Importance of reproduction

• Reproduction ensures continuity of individual members of a species.
• It results in the perpetuation of life on earth and increase in populations of living organisms.
• Good and desirable traits are also maintained through reproduction.

Reproduction in human beings

Human beings like all other mammals carry out internal fertilisation where the male and female gametes meet and fuse inside the body of the female to form a zygote, which then later develops into an embryo. The embryo further develops into foetus, which completes its development within the womb into a baby. The baby is then born in a process called parturition. After giving birth, the female parent nurtures the young one with milk produced from the mammary glands. Human beings have complex and elaborate reproductive system. The reproductive system involves the male and female genitals as have been taught. These organs are specialized to produce respective gametes, transfer and receive them for fertilization to occur.

The sperm This is the male reproductive cell (male gamete). The sperm has an oval head with large nucleus and a long whip-like tail for swimming. (See the figure below)

Fig. 13.1 A sperm cell

A sperm has a long whip-like tail used for propulsion (swimming). Sperms are produced in large numbers to increase their chances of survival. The large number of mitochondria located at the neck region provide enough energy needed for propulsion. The large nucleus helps the sperm cell to carry a lot of genetic information. The lytic enzymes in the acrosome digest the egg membrane to facilitate fertilisation.

Diagram page 303

The human ovum is a large cell of about 0.1mm in diameter. The outer membrane known as vitelline membrane encloses the plasma membrane, which surrounds the yolk containing cytoplasm. Right at the centre of the ovum is a nucleus encircled by a nuclear membrane.

Diagram page 303

Fig.13.2 A mature ovum

Role of hormones in reproduction in human beings

Hormones are chemicals secreted by special glands in the body called **endocrine glands**. These hormones are transported via the bloodstream to specific organs called target organs. The hormones cause specific effects in the target organs, which regulate or coordinate various body activities. Hormones that influence sexually related changes in the body are called **sex hormones**. Hormones control the entire process of reproduction from the development of the reproductive features at puberty to pregnancy and birth. Hormones also control the shedding of the (lining of the uterus) endometrium every month i.e. menstruation.

(a) Females

In girls, follicle stimulating hormone **(FSH)** stimulates the ovaries to produce **oestrogen** and **progesterone**.

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Oestrogen is responsible for the development of the female secondary sexual characteristics. The ovaries start producing ova and this leads to the first menstruation also known as **menarche**. At first, it is irregular and unpredictable. Within a year the hormone levels increase and monthly menstruation periods become more regular. In some people, pains may be experienced due to the progesterone hormone, which causes the uterine muscles to contract. These are commonly known as **muscle cramps**. Oestrogen hormone also triggers Graafian follicle to develop and mature. This brings about release of ovum under the influence of **Luteinising Hormone (LH)**, in a process called **ovulation**.

Menstruation

Menstruation is the discharge of uterine tissue lining and blood through the vagina in females. Menstruation only takes place when fertilisation does not occur. All these events are under the influence of hormones. These events are cyclic which means that the whole sequence repeats itself once every month in what is called the **menstrual cycle.** During this cycle, the uterus is prepared for implantation. If fertilisation does not occur, the new uterus lining and the ovum are discharged from the uterus

The average length of the menstrual cycle is 28 days. It can however be as short as 24 days or as long as 35 days. The first day of the menstrual period can be regarded as day 1 of the menstrual cycle. During this time, the endometrium is shed from the uterus through the cervix and vagina together with some blood.

(b) Males

At puberty, the human male pituitary gland in the brain secretes follicle stimulating hormone **(FSH)** and luteinising hormone **(LH),** FSH stimulates the production of sperms from the germinal epithelium while LH brings about secretion of testosterone hormone by interstitial cells. In boys, the interstitial cell-stimulating hormone is taken to the interstitial cells in the testes. It stimulates these cells to secrete **testosterone**, which is responsible for the development of the male secondary sexual characteristics.

Fertilisation

Fertilisation in human being takes place in the oviduct. Once the sperms are ejaculated from the penis into the vagina, they swim and are also propelled through the cervix, uterus and into the oviducts where they may meet an ovum. This normally occurs in the upper part of the oviduct. There are about 50 to 200 million sperms in a single ejaculation, although only one sperm fertilises an ovum.

When the sperms and an ovum meet, the head of a sperm sticks onto the ovum. The action of the sperm causes the follicle cells surrounding the egg to disperse. Eventually, the nucleus of one sperm passes into the cytoplasm of the ovum along with the head and middle piece leaving the tail outside. The sperm nucleus **fuses** with the nucleus of the ovum. This fusion of the sperm and ovum nuclei is known as **fertilisation**. The egg membrane changes its structure after one sperm penetrates to prevent other sperms from entering the ovum. The fertilised ovum is called a **zygote.**

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Diagram page 305

Fig. 13.3. The process of fertilisation

Implantation

Implantation is the process by which the zygote becomes embedded onto the uterus walls. After fertilisation, a zygote is formed. The zygote moves down the oviduct. Movement of the zygote is aided by the beating of cilia found on the oviduct. As it moves down the oviduct, it undergoes a series of cell divisions to form a hollow mass of cells known as the blastocyst. It develops fingerlike projections called villi which attach it to the endometrium of the uterus. It is then referred to as an **embryo**.

Development of the embryo The period within which the embryo grows and develops into a fully grown baby is known as gestation period. In humans, gestation period lasts for 38–40 weeks (9 months). The cells of the embryo continue to divide and grow, until they become organised into all the different body organs. When this is completed the embryo is known as foetus.

Diagram page 305

Fig. 13.4. Development of the embryo

The foetus further develops into a full-grown baby which is born at the end of the 9 months.

Healthy pregnancy

For a baby to be healthy and be born safely, the mother has to take care of herself well during the period of pregnancy. The care given during gestation period is called prenatal or antenatal care. A pregnant woman should ensure that;

- She eats a well balanced diet and may incorporate more iron and folic acid foods to prevent anaemia. Poor nutrition affects development of the foetus.
- She does not take any drugs unless they are prescribed by a doctor and are necessary.
- She does light exercises but avoids doing heavy work and lifting heavy loads.
- She avoids taking harmful substances that could harm the baby. She should not drink or smoke since smoking may cause miscarriage and reduce the baby's birth weight. Heavy drinking could also damage the brain of the baby.
- She wears comfortable flat-heeled shoes to avoid falling.
- She attends antenatal clinics where she is given medical advice and gets vaccinated for example, an anti-tetanus vaccine and German measles if at risk of containing the infection.

The mother should ensure that she goes to a **health facility** to give birth for safe delivery and avoid complications that might harm the baby. If any complication arises during birth, it is easier for health practitioners like a nurse or doctor to identify and deal with them.

Child Birth

In the last stages of pregnancy before a baby is born, it normally turns upside down with its head just above the cervix. Progesterone hormone levels in the mothers blood drops. This

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stimulates the pituitary gland to release another hormone called oxytocin. **Oxytocin** flows in the blood to the uterus where it simulates the muscles of the uterine wall to contract. The waves of contraction of these muscles results to pain commonly called **labour pain.** The amnion ruptures and the amniotic fluid passes out through the vagina (also known as birth canal). The uterine contractions become stronger and more frequent and the cervix dilates to let the baby's head pass through. The foetus is pushed downwards through the cervix into the birth canal. The birth canal is elastic and it widens allowing the baby to be born as the mother pushes. After birth, the umbilical cord is cut followed release of the placenta.

13.6.A. Guidance on End unit assessment

The revision activity 13 is in place of end unit assessment

- This part provides the answers of end unit assessment with cross reference to the textbook
- The teacher's guide suggests additional questions and answers to assess the key unit competence.
- Assessment activities are designed in integrative approach to assess the key unit competence with cross reference to the textbook.
  Possible Answers for End Unit assessment / Revision Activity 13

B. Answers for end unit assessment/Revision activity 13

1. For procreation there by guaranteeing continuity of species.
2. (a) Refer to Fig. 13.2 of pupil's book.

   (b) Refer to Fig. 13.4 of pupil's book.
3. Testicle, ovary.
4. Sperms, urine.
5. (a) Womb (b) Fallopian tube (c) Birth canal
6. Refer to pupil's book
7. (a) Seminal vesicle

(b) prostate gland

(c) sperm duct

(d) urethra

(e) Epididymis

(f) Penis

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(g) Testis

(h) Scrotum

8. C

9. C

10. Provide medical care when needed, show him or her love and affection, keep them clean all the time, ensure they take balanced diet, give them ARVs, comfort them.

11. Missing periods, mood swing, frequent urination, white discharge from vagina, spotting, nausea and frequent urination.

12. Refer to content of the pupil's book.

13. Because it is risky and dangerous.

14.

Disease	**Cause**	**Prevention**
Candidiasis	Fungi	Avoiding sexual intercourse or using a condom
Syphilis	Bacteria	Avoiding sexual intercourse or using a condom
Chancroid	Bacteria	Avoiding sexual intercourse or using a condom

15. (i) – (c); (ii) – (d); (iii) – (b); (iv) – (a)

16. D

17. D

18. Assess learners as they dramatise a boy seducing a girl. The girl refuses, goes on with her education and excels in exams. The girl eventually goes to university, studies medicine (or any other profession) and is proud of what she is together with her family members

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13.7

Remedial activities for slow learners	**Extended activities for gifted and talented learners**

1. Helping the teacher to collect pamphlets, newspaper cuttings, magazines and handouts on various topics on reproductive system and reproduction in general. 2. Help with labeling of parts of drawn charts. 3. Acting during role-plays. 4. Reading group reports to group/ class members. 5. To be given homework on content areas taught.	1. Reading the pamphlets, newspaper cuttings, magazines and handouts and summarizing the information. 2. Helping the teacher to come up with improvised charts with various painted drawings on parts of male and female genitalia. 3. Coming up with scripts to dramatize during role-play. 4. Compiling group reports and doing presentations. 5. To be given research work on the various content areas learnt. For example, the role of hormones in reproduction, how ova and sperms are manufactured, the process of fertilization and embryo development, etc.
Remedial questions for slow learners	**Extended questions for gifted learners**
1. Name the parts that make up external male genitalia. 2. Why do we say early pregnancy is unwanted? 3. Which of these parts act as a pathway for sperms? (sperm duct, epididymis) 4. Name the parts shown in the diagram below. JMAGE 5. Which of these is not a contraceptive? (Vasectomy, coil, pill) 6. Is abortion bad or good? Why? 7. Name any three sexually transmitted diseases that you know.	1. Relate the structure of the male reproductive system to its functions. 2. Compare and contrast vasectomy and tube ligation. 3. Using diagrams show the difference between external male and female genitalia. 4. Demonstrate how you would use a male condom. 5. Given a choice between use of a female condom and pill, which one would you go for? Why? 6. Taking care of HIV and AIDS patients is not a choice. Explain this statement.
Answers to remedial questions	**Answers to extended questions**
1. Penis, scrotum, testicles. 2. Because it happens before recommended time and causes problems to the girl who in most cases is supposed to be going to school. 3. Sperm duct 4. (A) Ovary (B) Fallopian tube (C) Uterus (D) Cervix (E) Vagina 5. Vasectomy 6. Bad – it may lead to death or cause permanent health complications. 7. Gonorhoea, syphilis, chancrod, candidiasis.	1. Refer to the adaptations to functions of the various of the male genitalia as explained in pupil's book pages 255. 2. Similarities – they all work work by blocking the union between sperms and ova. In both cases, the tube involved is either tied or cut. Differences – vasectomy is done in males, tube ligation is done in females. Vasectomy is done on the sperm duct, tube ligation is done on the oviduct. 3. Let learners follow the steps as highlighted in Activity 13.8 pages 266 of pupil's book. 5. Condoms. They are 98% effective compared to pills which are 92% effective. 6. In Rwanda it is a criminal offence to discrimate against HIV and AIDS patients. Everybody has a

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	responsibility of taking good care of the patients and giving them support where required.
Consolidation activities	
1. What is waste? 2. (a) Mention the two main categories of wastes. (b) What is the difference between them? 3. (a) Which other categories of wastes do you know? 4. What sources of wastes do you know of? 5. What is the difference between biomedical wastes and electronic wastes? 6. Give four ways of disposing of wastes safely. 7. Which parts make up the heart? (a) Externally? 8. State the role of each part of the heart. 9. Why do ventricles have thicker walls than auricles? 10. Why is separation of the heart into two distinct parts important? 11. Which organ pumps blood to all body parts? 12. From the heart, blood moves to the rest of the body through _____. 13. Oxygenated blood from the lungs comes back to the heart through _____ vessel. 14. _____ brings deoxygenated blood back to the heart. 15. ____ takes deoxygenated blood to the lungs. 16. Blood is made up of three types of cells. Name them. 17. Plasma is _____ of blood. It contains _____ , _____ and_____ among other things. 18. Platelets help in _____ of blood. This is important because it prevents excessive bleeding. 19. _____ help to carry oxygen from the lungs to body tissues. 20. Which type of cells protect the body against diseases?	

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21. Give four diseases that affect the circulatory system. 22. Which signs would you look out for in order to know when someone is suffering from: (a) Antherosclerosis? (b) Stroke? 23. What is sphygmanometer? 24. What blood pressure is considered normal? 25. What did you learn in this lesson? 26. What is the difference between respiratory system and circulatory system? 27. What makes up the respiratory system? 28. Suppose we lacked a respiratory system, what will happen? 29. Which organ allows air to get into the breathing system? 30. When the diaphragm flattens during breathing in chest cavity _____. 31. What is the equivalent of these things in a breathing model? 32. What happens in the alveoli during breathing? 33. What is hygiene of the respiratory system? 34. List three practices that will enhance a healthy respiratory system. 35. How will washing hands before every meal help in keeping respiratory system healthy? 36. Give four diseases that affect the respiratory system. 37. Which signs would you look out for in order to know when someone is suffering from: (a) Tuberculosis? (b) Asthma? (c) Bronchitis? 38. How would you prevent pneumonia in your locality? 39. To suffocate is to _____? 40. What causes suffocation? 41. Of what significance is reproductive system? 42. What makes up external male genitalia? 43. What is the function of: (a) Urethra?	

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(b) Sperm duct? (c) Seminal vesicles? 44. Do you think male genitalia are same or different from female genitalia? 45. What makes up internal female genitalia? 46. What is the other name of: (a) Uterus? (b) Fallopian tube? (c) Vagina? 47. Where does fertilization take place in female genitalia? 48. Differentiate between Batholin gland and clitoris? 49. Differentiate between early pregnancy and unplanned pregnancy. 50. Name two contraceptives that you know. 51. ———————— (Vasectomy) is to men whereas ————— is to women. 52. Write IUD in full. 53. Name common STIs that you know. 54. What causes (a) Syphilis? (b) AIDS? (c) Vaginal candidiasis? 55. Give two symptoms each of (a) Gonorrhea? (b) Chancroid? 55. What is the most effective way of preventing STIs? 56. What do HIV and AIDS stand for? 57. What causes AIDS? 58. What are opportunistic infections? 59. Write ARV in full? 60. How can you avoid HIV and AIDS? 61. Explain why drug abuse increases the chance of getting HIV and AIDS. 62. How would you handle a person living with HIV and AIDS? 63. Write ARV in full? 64. How can you avoid HIV and AIDS? 65. Explain why drug abuse increases the chance of getting HIV and AIDS. 66. How would you handle a person living with HIV and AIDS?	
Answers to Consolidation activities	
1. Any unwanted material in the environment) 2. a Biodegradable and non biodegradable wastes	

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(b) Biodegradable – can decompose naturally, non biodegradable wastes – cannot decompose naturally 3. (a) Hazardous, toxic, radioactive and flammable wastes 4. Municipal, industrial construction, agricultural,biomedical, electronic and automobile wastes 5. Biomedical – from hospitals and health centres; electronic – from electronic equipment). 6. Safe collection, processing, transportation and finally disposal 7. (a) Auricles, ventricles, aorta, vena cava, pulmonary artery, pulmonary vein, coronary artery. (b) Septum, bicuspid valve, tricuspid valve, semi-lunar valves. 8. Refer to pupil's book 9. Because they pump blood over a longer distance (to the rest of the body) compared to auricles which only push the blood to ventricles within the heart.) 10. This helps to avoid mixing of oxygenated and deoxygenated blood 11. Heart 12. Aorta 13. Pulmonary vein 14. Vena cava 15. Pulmonary artery 16. White blood cells, red blood cells and platelets 17. liquid, digested food materials, mineral salts, hormones, antibodies among others 18. Clotting 19. Red blood cells 20.White blood cells 21. Heart attack, stroke, antherosclerosis, high blood pressure among others 22. Refer to table 11.2 in Pupil's book	

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23.Instrument used to measure blood pressure 24. Between 120/80 mmHg – 140/90 mm Hg 25. The function of the respiratory system in human body and the organs that make up the respiratory system. 26. Respiratory system helps in bringing fresh air into the lungs and removing stale air out of the body. Circulatory system on the other hand helps in transportation of substances in the body. 27. Lungs, trachea, bronchi, bronchioles, diaphragm, alveoli and ribs. 28. We will not survive because our body tissues will lack oxygen, and also, carbon dioxide will not be removed from the body leading to poisoning of body cells. 29. Nose/nostril 30. **increases** in volume. This reduces the **pressure** inside the chest cavity thereby leading to air rushing into the lungs. 31. (a) Trachea (b) chest cavity 32. Gaseous exchange occurs i.e. oxygen is introduced into the bloodstream while carbon dioxide is released into the alveolus airspace 33. Practices that keep the respiratory system healthy 34. Balanced diet, exercising, not smoking or taking alcohol, among others 35. Prevents infection of the lungs 36. H e a r t a t t a c k , s t r o ke , antherosclerosis, high blood pressure among others 37. Refer to Table 12.3 of Pupil's book 38. Refer to table 12. of Pupil's book 39. Cause to die by to depriving air or oxygen 40. Chocking, drowning, asthma, inhaling poisonous substances 41. Ensures continuity of a given species. 42. Penis, testicles and scrotum.	

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43. (a) Lets out semen during copulation) (b) Passage for sperms from epididymis to urethra. (c) Produce semen together with prostate and Cowper's glands. Semen helps in transporting sperms. 44. Different 45. Ovary, fallopian tube, uterus, vagina and cervix 46. (a) Womb (b) Oviduct (c) Birth canal 47. Fallopian tube 48. Bartholin gland – produces chemical substances like hormones, Clitoris – flap of flesh in external female genitalia that is very sensitive to touch 49. Early pregnancy - Getting pregnant before marriage; unplanned pregnancy – getting pregnant accidentally). 50. Diaphragm, condoms, coils, norplant, spermicides, depo-provera 51. Tube ligation. 52. Intra-uterine device 53. Heart attack, stroke, antherosclerosis, high blood pressure among others 54. (a) Bacteria) (b) HIV (Virus) (c) Fungi 55. (a) Refer to table 13.2 Pupil's book) (b) Refer to table 13.2 Pupil's book 55. Abstinence 56. H - human, I - Immunodeficiency, V - Virus; A - Acquired, I – Immune, D - Deficiency, S – Syndrome. 57. HIV 58. Diseases that take advantage of weakened immune system to attack the body 59. Anti-RetroVirus 60. Refer to pupil's book 61. It compromises the persons' ability to think straight hence the person may engage in irresponsible sexual behavior	

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62. Taking good care of them, helping them get medical attention if need be, showing them love, assisting them to take ARVs, etc 63. Anti-RetroVirus 64. Ans: Refer to pupil's book page 263 65. It compromises the persons' ability to think straight hence the person may engage in irresponsible sexual behavior 66. Taking good care of them, helping them get medical attention if need be, showing them love, assisting them to take ARVs, etc	

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UNIT 14: ENERGY MANAGEMENT

14.1. Key unit competence

To understand the use of energy and its transformations from one form to another

14.2. Prerequisite

Under energy management learners will be taught about what energy is, the various forms of energy, its importance and the various energy transformations in our daily lives. Remember learners have already tackled some aspects of energy in primary 5. For example, they learnt about light, its properties and electricity as a form of energy. Borrowon the pupils' experiences in theseareas to introduce the concepts in thistopic. Also during the lessons, strive to bring to the awareness of learnersthe fact that this topic is related to forms of energy in Physics. Let learners understand that at this level, they may only need the basic information otherwise; details of energy generation and usage are taught in Physics in more.

14.3. Introductory activity and guidance

- **Guidance on the introductory activity**

– In this unit, you will teach about the various forms of energy, their sources,energy transformations and renewableand non–renewable energy sources.

- Ask learners to look at the picture on page 267 and let them discuss what they see.
- Let them brainstorm in five minutes to discover what is taking place in the picture of the introductory activity.
- Ask them questions under the picture and try to orient their answers to the right ones.
- What topics do they think this unit will include based on the picture?
- Give time for some brainstorming and after share the main sub-units.
- Let them brainstorm and give alternative energy as a solution to the problem situation in the picture.

❖ **Answers to the introductory activity**

2. It shows children using a tin lamp to study. The light is not sufficient, and it is producing a lot of smoke.
3. The parent should aware that there are other sources of light like solar and biogas that give clean light and can easily be installed anywhere in the country and can replace tin lamp.

14.4. List of lessons

#	Lesson title	Learning objectives	Number of periods:12
1	Definition and forms of energy	– Define the concept of energy – List the forms of energy – Make relevant choice of the best form of energy to use	1
2	Energy transformation/energy conversion	– Explain way of energy transformation/conversion – Perform basic experiments related to energy transformation – To represent in a diagram the transformation of energy in different forms	2
3	Importance of energy	– Explain the importance of energy	2
4	Sources of energy	– Identify the main sources of energy	2
5	Renewable and non-renewable energy	– Identify and explain renewable energies and state some examples – To do advocacy of the use of	2

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		renewable energy – Describe the componentsof a biogas and solar power installation.	
6	Advantage of using renewable energy	- Explain advantages of using renewable energy.	2
7	**Assessment and remediation**	- Demonstrate the achievement of key unit competence and lessons objectives	1

Teaching approach for each lesson

14.4.1. Lesson 1: Definition and forms of energy

a) Learning objectives

– Define the concept ofenergy
– List the forms of energy
– Make relevant choice of the best form of energy to use

b) Teaching resources

– Electric heater, matches and match boxes, kerosene/charcoal stove,sources of fuels such as firewood,charcoal,kerosene,etc;pen or comb,pieces of paper, file, iron bar, rubberbands, etc.

– Textbooks,handouts and pamphletson forms of energy.

– Computers connected to theInternet.

c) Learning activities

❖ **Guidance on the activity 14.1**

– You may begin the lesson by askinglearners probing questions such as: have you ever heard of the word‘energy? What does it mean?

– Guide learners to conduct the activity 14.1 at page 267.

– Let learners answer the probing questions in this activity.
– Guide learners to discover the definition of energy, which is ‘theability to do work.

– Emphasise the fact that for work tobe done, effort must be applied. Thiseffort is the energy that is required to do work.

– Wrap up the section by asking learners to provide different forms of energy.

❖ **Guidance on the activity 14.2**

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- Guide learners to conduct the activity above. At the end of the activity, they should compare the cooked and uncooked potatoes.
- Let learners answer the probing questions in this activity.
- Guide the learners to understand the relationship between energy in fuels (kerosene, charcoal and firewood) and the cooking action
- i.e. the chemical energy stored in the fuels provides the energy used during cooking.
- Emphasise the fact that similar thinghappens in our bodies where storedenergy in foods is used to help us dovarious activities. The same appliesto store energies in batteries and dry cells.
- Wrap up the section by asking learners to name other things thatcontain chemical energy.

❖ **Guidance on the activity 14.3**

- Ask learners to name some sourcesof heat that they know. They can also say what the heat is used for.
- Guide learners to conduct theactivity above. At the end of the activity, they should fill the source of warm in their hands and rubbed surfaces.
- Let learners understand that whenever two surfaces are rubbed, heat energy is produced. The heat energy causes the feeling of warmth.
- You may wrap up the section by explaining the difference between conduction, convection and radiation. Refer to pupil's book page302.

❖ **Guidance on the activity 14.4**

- Let learners observe the items in the pictures.
- You may also bring some of thesethings to class. Ask learners to name the things and say what they are used for. Ask them to say the common denominator about the things – which is 'they all use electricity'.
- You can then challenge learners to say what electricity is. Let them do simple research on this.
- Tell them that electricity is actuallyelectrical energy, which is as a resultof movement of current.
- At this point, you can mention static and current electricity and explain the difference between the two.
- Guide learners to conduct theactivity 14.4. At the end of the activity, they should conclude thatthe comb or the biro pen case areable to pick the pieces of paper dueto static electricity that is inducedduring rubbing.
- You may wrap up the section byasking learners to come up with a list of uses of electricity in our homes.

❖ **Guidance on the activity 14.5**

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- Let learners observe the items in the picture.
- You may also bring some of the magnets to class. Ask learners Whether they have seen those things. Some may say 'yes' while others 'no'. Take advantage of the yes group and ask what learners think they are used for.
- At this point, you can introduce the concept of magnetic force andmagnetism as a form of energy. **REMEMBER** – This topic will exhaustively be covered in Unit 15so do NOT delve into many detailsat this point.

❖ **Guidance on the activity 14.6**

- Begin this section by asking learnerswhether they think energy can be in motion. Ask them to say what happens when water is poured froma container.
- Take advantage of their discussionsand introduce the concept of kinetic or mechanical energy in motion.
- Guide learners to conduct theactivity14.6. At the end of the activity, they should conclude thatthe heat is produced during rubbing because of mechanical energy(movement back and forth). Thesame thing happens when rubbinga matchstick on matchbox and thiscauses fire.

❖ **Guidance on the activity 14.7**

- Ask learners whether they knowthe thing in the diagram. Ask them to say what it is or it can be used for and why.
- You can then let them make theirown catapult and play with it (useit to throw stones).Ask them to alsothrow stones using their hands.
- Learners should then compare which is more effecting at throwinga stone (catapult or bare hands?)
- Take advantage of their discussionsand introduce the concept of elastic energy which is the energy stored in things that stretch such as rubber bands.
- You could also give learners other examples of elastic materials such as springs.
- Summarise the lesson by highlightingthe various forms of energy. Letlearners come up with a list.

❖ **Answers to the activity 14.1**

2. They are cultivating.

3. They use energy to do work

❖ **Answers to the activity 14.2**

1. Cooked potato is softer.
4. The heat from the fire made the potato softer.

❖ **Answers to the activity 14.3**

When we rub our hands against each other, heat is produced. We feel **warm** as a result.

❖ **Answers to the activity 14.4**

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2. Electronic devices
3. They need electric energy to work

❖ **Answers to the activity 14.5 &14.6**

Refer to page 271-272.

❖ **Answers to the activity 14.7**

2. Catapult
5. Catapult help to throw the stone at very long distance

❖ **Answers to the application activity (Self-Test)14.1**

Refer to learner's book page 273

1. Ability to do work.
2. Chemical, thermal (heat), electrical,mechanical,elastic,electromagnetic.
3. TV, DVD, refrigerator, electriccooker, electric iron, radio, etc.
4. By rubbing a biro pen case,comb orany object made of plastic on hair.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

14.4.2. Lesson 2: Energy transformation/energy conversion

a) Learning objectives

- Explain way of energy transformation/conversion.
- Perform basic experimentsrelated to energy transformation.
- To representin a diagramthe transformation of energy in different forms.

b) Teaching resources

- Torch, dry cells, matches and matchboxes,pen or comb,pieces of paper,file, metal bar, rubber bands, bulb,switch, kettle, turbines, etc.
- Computers connected to theInternet.

c) Learning activities

❖ **Guidance on the activity 14.8**

- You may remind learners about what they learnt in the previous lesson on forms of energy. Ask Questions such as: (i)What forms ofenergy do you know?
- Ask learners whether they think the various forms of energy are inter-convertible and give examples.
- At this point,you can introduce theconcept of energy transformation as the conversion from one form of energy to another.

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- Provide learners with the materialsin the activity 14.8, page 273 in pupil's book . Let them try the various activities out.
- Guide learners to give an explanationof what happened in every activity above. Emphasize the fact that energy can NEVER be created but can only be transformed from one form to another.

❖ **Guidance on the activity 14.9**

- Let learners carry out the variousactivities. In either case, they will feelsome warmth.
- Guide learners to understand that the warmth is because of conversionof mechanical energy (rubbing) to heat (thermal) energy which causes the warmth feeling.
- Allow learners to brainstorm of other cases where this kind of transformation occurs. They shouldcome up with a list and share withother class members.

❖ **Guidance on the activity 14.10**

- Let learners carry out this activityindividually.
- Guide learners to understand that the attraction is because of conversion of mechanical energy (rubbing) to static electricity whichis a form of electrical energy.
- You can then take this opportunity to clarify the difference between static and current electricity. Give learners a chance to explain the difference based on previous lesson.
- Allow learners to brainstorm of other cases involving transformation from mechanical to currentelectricity.
- At this point, ask them whether theyknow how electricity that they use at home is generated.
- Inform them that in Rwanda, electricity mainly comes from hydro-power generation plants such as WASAC. Plan for a visit to this facility or any nearby power generation facility
- Let learners understand that in such plants, there is conversion of mechanical energy (in the rotatingturbines by water) to electricalenergy.
- Allow learners to brainstorm of other cases where this kind of transformation occurs. They shouldcome up with a list and share withother class members. The list shouldinclude windmills and geothermal power.

❖ **Guidance on the activity 14.11**

- Let learners do the activity 14.11 on page 275 to cook potatoes using burningcharcoal or kerosene.
- Let learners answer the questions in the activity 14.11.
- Guide learners to understand that the energy transformation that takes place here is chemical to heat.
- Allow learners to brainstorm of other cases where this kind of transformation occurs. They shouldcome up with a list and share withother class members. The list shouldinclude the food that

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we eat whichis burnt down to release heat which maintains our body temperatures constant.

❖ **Guidance on the activity 14.12**

- Let learners assemble the things asshown in this activity. They should then put on and off the switch then observe what happens.
- Guide learners to understand that the energy transformation thattakes place here is chemical to electrical which causes the bulb to light. If switched off, the circuit breaks and the bulb goes off.
- Allow learners to brainstorm of other cases where this kind of transformation occurs. They shouldcome up with a list and share with other class members. The list should include in a torch bulb, car headlights among others.

❖ **Guidance on the activity 14.13**

- Let learners observe the picture in activity 14.13 page 277of pupils book. It shows a houseinstalled with solar electricity.
- Let learners study the figure. You can also take them to a nearby solar electricity installation.
- Let learners discuss the questions inthis activity. It is a case where solar energy is used to provide electricity in a house.
- Guide learners to understand that the energy transformation that takes place here is solar to electrical.

❖ **Guidance on the activity 14.14**

- Let learners assemble the things asshown in this activity. They should then put on and off the switch then observe what happens.
- Guide learners to understand that the energy transformation thattakes place here is electrical to thermal energy which causes the water to boil.
- Allow learners to brainstorm of other cases where this kind of transformation occurs. They shouldcome up with a list and share with other class members.

❖ **Guidance on the activity 14.15**

- Let learners assemble the things asshown in this activity. They should then switch on the electric kettlethen observe what happens.
- Let them direct the steam from theboiling water to the turbines. They should notice the turbines moving.Ask them to give an explanation on this.
- Guide learners to understand that the energy transformationthat takes place here is electricalto mechanical which causes the turbines to turn.
- Allow learners to brainstorm of other cases where this kind of transformation occurs.

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They shouldcome up with a list and share with other class members. An example is ironing a piece of cloth using an electric iron.

❖ **Answers to the activity 14.8**

2. When the dry cell is put in the torch, the torch gives light if it is switched on.

3. when you strike a matchbox using a matchstick, the matchstick gives fire or light.

4. When you blow a whistle or flute, a sound will be produced.

5. Energy can be changed from one form to another.

❖ **Answers to the activity 14.9**

1. When the top of a table is rubbed with sandpaper, there is production of heat on the surface of the table.
2. When you rub a file with an iron bar, you feel heat.
3. The matchstick bursts into flames because of heat produced during rubbing.

❖ **Answers to the activity 14.10**

When a comb is rubbed on hair, electrical energy is produced. The electrified comb attracts small pieces of paper.

❖ **Answers to the activity 14.11**

3. The answer should be 'from chemical energy stored in the fuel'

4. During burning, this chemical energy is transformed into heat (thermal) energy that is used to cook the food.

❖ **Answers to the activity 14.12**

Refer to page 276

❖ **Answers to the activity 14.13**

1. This installation is found at many houses in community.
2. It is very important because it convert solar energy into electrical energy that we can use at our homes.

❖ **Answers to the activity 14.14**

Refer to page 278

❖ **Answers to the activity 14.15**

When an electric fan is turned on, electrical energy is transformed into mechanical energy.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

14.4.3. Lesson 3: Importance of energy

a) Learning objectives

– Explain the importanceof energy

b) Teaching resources

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- Charts of importance of energy
- Computers connected to the internet.

c) Learning activities

❖ **Guidance on the activity 14.16**

– Put the learners into groups depending on the class size and their abilities. Let them observe the pictures in the activity 14.16, page 280 in pupil's book.

– Guide learners to discuss the importance of energy in everyday life.

– Wrap up the lesson by highlightingthe main points and allowing learners to write short notes. You may also appoint a gifted learner to summarise the lesson on behalfof the rest as you correct him or her as is appropriate.

❖ **Answers to the activity 14.16**

Refer to pupil's book page 280.

❖ **Answers to the application activity (Self-Test) 14.2**

Refer to learner's book page 281

1. Chemical, thermal (heat), electrical,mechanical,elastic,electromagnetic
2. (a) Heat

(b) Electric

(c) Mechanical

3. (a) chemical to electrical to sound.

(b) Mechanical to electrical to heat or light.

(c) Elastic to mechanical.

4. Elastic – found in materials that stretch like rubber; thermal – heat energy (causes increase in temperature of a body).
5. Chemical (in lemon) to electrical (in bulb).

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

14.4.4. Lesson 4: Sources of energy

a) Learning objectives

– Identify the main sources of energy.

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b) Teaching resources

- Biogas installations, solar panels, generators, LPG, windmills, etc.
- Charts on sources of energy and textbooks.
- Computers connected to the internet.

c) Learning activities

❖ **Guidance on the activity 14.17**

- Put the learners into groups depending on the class size and their abilities. Let them observe the pictures in the activity 14.17, page 282 in pupil's book.
- Guide learners to discuss the main sources of energy.
- Wrap up the lesson by highlightingthe main points and allowing learners to write short notes. You may also appoint a gifted learner to summarise the lesson on behalfof the rest as you correct him or her as is appropriate.

❖ **Answers to the activity 14.17**

Refer to pupil's book page 283.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

14.4.5. Lesson 5: Renewable and non-renewable energy.

a) Learning objectives

- Identify and explain renewable and non-renewable energies andstate some examples.
- To do advocacy ofthe use of renewable energy.
- Describe the componentsof a biogas and solar power installation.

b) Teaching resources

- Solar panels, solar battery, inverters,bulbs etc.
- Chart on an installed solar powerplant.
- Computers connected to theInternet.

c) Learning activities

❖ **Guidance on the case study**

- Let learners study the two pictures.Initiate a discussion on what happens in the second picture (B) when the charcoal gets finishedYETTHE FOOD IS NOT YET COOKED.The answer will be: 'more charcoalis added'. As for the second picture,the cooking process goes on un-interrupted.

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- Guide learners to engage in more discussions about the advantagesand disadvantages of each. For example, A is clean energy, B - can cause death if used in a roomwithout enough ventilation due to carbon monoxide poisoning, etc.Based on these learners should feel free to choose which cooking method they prefer.
- Narrow down to solar energy as an example of renewable source of energy.

❖ **Guidance on the activity 14.18**

- Arrange for learners to visit ahouse or a place with a solar power installation facility.

  During the above visit, guide learners to engage the officer in charge or the owner in a question and answer session using the questions in this activity. Guide themto come up with summary notes and a sketch diagram of a solar power installation plant.

- Ask them to list down the variouscomponents of a power solar powerinstallation facility.
- Wind up this lesson by highlightingthe various uses of solar energy.
- Let learners write summary notes as you do the explanation.

❖ **Guidance on the activity 14.19**

- Arrange for learners to visit a placewith a biogas facility. During the visit, guide learners to engage theofficer in charge or the owner in aquestion and answer session using the questions in this activity. Guide them to come up with summary notes and a sketch diagram of abiogas digester.
- Ask them to list down the various components of a biogas facility. You may also refer learners to Fig.14.19 on page 287of pupil's book for reference.
- At this point, you may engage learners in a project of assemblinga biogas digester in school. This should be done as a class project.

❖ **Guidance on the activity 14.20**

- Begin this exercise by showing learners a demonstration video of how biogas digester is made. Use the link: https://www.youtube.com/watch?v=mWefbc1spd0 or anyother appropriate video of your choice.
- After watching the video, let learners assemble a biogas digester as highlighted in this activity. The learners should then monitor biogasproduction from this installation.**NOTE**: You may recommend use of this facility for cooking purposes in school as learners oversee the maintenance as per what they learnt during the field visit.
- Encourage learners to come up witha similar project at home under guidance of their guardians.
- Wind up this lesson by highlightingthe various uses of biogas energyand the advantages of using biogasand renewable energy in general aslisted on pages 288 of Pupil's book.

❖ **Answers to the activity 14.18**

Refer to pupil's book page 285.

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❖ **Answers to the activity 14.19**

Refer to pupil's book page 287.

❖ **Answers to the application activity (Self-Test)14.3**

Refer to learner's book page 290

1. Water, wind, biofuels such as trees,coal, crude oil, nuclear, etc.
2. Renewable – cannot be exhausted,non-renewable – can be exhausted
3. Black colour absorbs maximumamount of heat.
4. Solar panel – Absorbs light energyfrom the Sun and converts it to electrical energy

   Inverter – converts alternating current (AC) to direct current (DC)for storage.

   Battery – stores electric current.

   Wires – channels or transports current.

   found in materials that stretch likerubber; thermal – heat energy (causes increase in temperature ofa body).
5. Biogas, making charcoal balls,drying and burning directly
6. Methane
7. Cheap, safe, readily available,conserves the environment, are convenient to use.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

14.4.6. Lesson 5: Advantage of using renewable energy

a) Learning objectives

– Explain advantages of using renewable energy.

b) Teaching resources

– Solar panels, solar battery, inverters,bulbs etc.

– Chart on an installed solar powerplant.

– Computers connected to theInternet.

c) Learning activities

Use the activities done in this unit and provide the advantages of using renewable energy.

b) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

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14.5.Additional content/Information for the teacher

A. Additional content for the learner

Non- Renewable Energy

Energy exists freely in nature, some of them are infinitely available, called renewable, and some are called non-renewable. It is our responsibility to ensure the proper use of renewable and non-renewable energy. Non-renewable energy is limited resources that will eventually run out over the time frame. Non-renewable energy is one that does not renew itself at a sufficient rate for sustainable economic extraction in meaningful human time-frames.

Non-renewable energy is energy from fossil fuels such as coal, crude oil, natural gas, and uranium. Unlike renewable energy, non-renewable energy needs human intervention to make it suitable for consumption. Fossil fuels are mainly made up of Carbon. It is believed that fossil fuels were formed over 300 million years ago when the earth was a lot different in its landscape.

Non-renewable Energy Resources

The resources for non-renewable energy are mainly fuels from fossil deposits. The most commonly non-renewable resources are:-

(a) Coal

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(b) Petroleum products

(c) Compressed natural gas

Types of Non-renewable energy

Non-renewable energy is mainly fossil fuels. Apart from fossil fuels, nuclear fuels are also non-renewable.

Fossil Fuels

Fossil Fuels are formed from the remains of animals and plants. Fossil fuel is divided into three categories and is stated below:

Natural Gas	Coal	Oil
The process of decomposition is longer as it is conducted with high amounts of pressure and heat.	It is formed by the decomposition of trees, plants, and ferns which are hardened due to pressure and heat.	Due to excessive pressure, smaller organisms like zooplankton and algae are decomposed into an oil.

Nuclear Fuels

Nuclear technology relying on fission requires naturally occurring radioactive material as fuel. Uranium is the most common fission fuel and is present in the ground at relatively low concentrations and mined in 19 countries. Nuclear power provides about 6% of the world's energy and 13–14% of the world's electricity.

Non-Renewable Resources Examples

Following are examples of non-renewable resources:

- Coal
- Rare earth elements
- Petroleum products
- Gold
- Uranium

Advantages of Non-renewable energy

- The non-renewable source of energy is affordable. For instance diesel and oil.
- It is easily accessible and more compatible.
- The non-renewable source of energy is easy to store.

Disadvantages of Non-renewable energy

- Non-renewable energy cannot be replaced once its energy source is used up.
- The by-products of non-renewable energy cause environmental damage. It also increases greenhouse gases.
- Transporting fossil fuels, Mining and extraction activities can cause accidents and result in oil spills, nuclear meltdowns, pipeline leaks, and even explosions which cause harmful effects on the environment.

B. Additional information for the teacher

Some information that you may find relevant in this topic are given below.

Forms of energy

Energy exists in many different forms. Some of these forms include light, heat, chemical, sound,

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electrical, mechanical among others.

Light energy

This is a form of energy that enablesthe eye to see. It is usually produced by very hot objects such as the sun, electric bulbs, fire, e.t.c. The Sun is the main source of energy on Earth.

Heat energy

This is the form of energy which causes changes in temperature when absorbedor lost by a body. It is usually released by burning fuels, the sun, electric heaters(when a current flows through it) amongothers. Heat is given off when thermalenergy is transferred.

Chemical energy

This is a form of stored energy that exists in matter. It is released when matter is involved in a chemical reaction.Such a reaction may involve burning ofthe matter for example, burning of fuel such as kerosene in oxygen. Food is ourmain source of chemical energy. Fossil fuel like coal, petrol,oil and natural gas are other sources of chemical energy. The burning process releases the storedchemical energy in a substance.

Sound energy

Sound refers to vibrations composed of frequencies, capable of being detected.

This is a form of energy that is producedby vibrating objects.The vibrating object causes disturbances in air which transmitthe sound energy. Solids and liquids alsotransmit sound. In human beings, we hear sound using our ears.

Mechanical energy

This type of energy exists in two differentforms; the kinetic energy and potential energy.

(i) Kinetic energy (K.E)

This is a form of energy possessed bya body due to its motion. Any body in motion possesses kinetic energy, which reduces to zero when the object stops.To make a body move requires a force to act on the body, giving it kinetic energy.

***(ii)* Potential energy (P.E)**

This is the type of energy that is storedin a body and has the potential or abilityto do work. There are three forms of Potential Energy:

- Gravitational and elastic potential energy - Is a form of energy that is possessed by a body due its position relative to another point ata lower level. A body raised above the ground to a height

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possesses potential energy whose magnitudedepends on the height.

- Elastic potential energy - is a formof energy possessed by stretched orcompressed objects e.g. rubber and springs.
- Chemical potential energy is the energy a body has because of what it's made off. This energy is present in an electrical cell, explosives, food and fossil fuels.

Nuclear energy

This is a form of energy stored in thenuclei of atoms. The particles of the nucleus are held together by forces which when broken release enormousamounts of energy in form of radiations (***nuclear fission***). This energy can be converted to heat and light.The nuclear energy may also be released when smaller nuclei combine to form larger ones (***nuclear fusion***).

Electrical energy

This form of energy is obtained by conversion of energy from other forms.For example, the potential energy ofwater is converted to electrical energyin hydroelectric power stations; the chemical energy in batteries is convertedinto electrical energy in a closed circuit.This energy due to the flow of charges is electrical energy.They are of two types:static and current.

(i) **Current electricity**

Electricity is the flow of electrons. **Electrons** are negatively chargedparticles found in matter, specifically in the nucleus of atoms. Electrons are verylight and move through a conductor tomake an electric current.

Electricity (or simply moving electrons)is "pushed" by a power source suchas a cell, a battery or any other source of electrical energy. And for electrons to travel or to flow they needa pathway;they travel in a **circuit** alonga **conductor** (which is usually a metal bar – a wire) which allows electricityto flow through it.That is why **electric current** can be defined as a flow of electrons through a wire. In other words, electrons through a conductor make an electric current. Electric current (commonly just referred to as **current**)is measured using an instrument called an **ammeter**. The ammeter is always connected in **series -** in the same line with the source of electricity, such as a battery. See figure below. The units of current are **amperes** (can be shortenedto **amps** – or by using symbol **A**). It is the current that makes a bulb to lightor a radio to play. Thus, for a current to light a bulb there must be a sourceof electricity, such as a battery. For an electric current to flow, there must be acomplete **circuit**, - no gaps.

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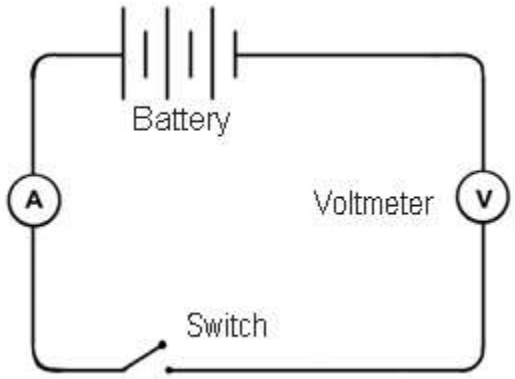


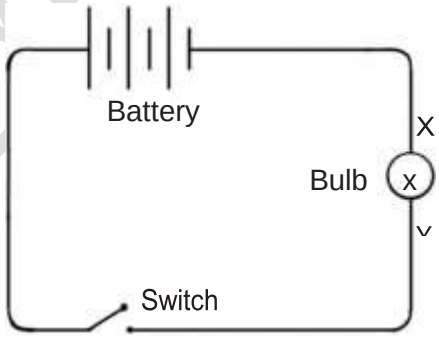
Fig. 14.1 Complete circuit

Voltage (also called Potential difference)

In order to understand what voltage is, we first need to remind ourselves of what we discussed earlier about the push that electrons get in a circuit forthem to flow. It was stated that a cell or a battery pushes electrons round a circuit. It means that for an electriccurrent to flow, there must be a force to drive or to push electricity around the circuit. Different cells can exert different electrical forces or pressures.This electrical force or pressure is called electromotive force **(**e.m.f.**)** and is provided by dry cells, batteries or generators. When a bulb is connectedto a cell, the electron power or the e.m.f. of the cell is being resisted fromflowing smoothly by the bulb (which wecan call a **resistor**).The bulb or resistoropposes the smooth flow of an electriccurrent in a circuit. This means that as current is flowing in a circuit, the e.m.f. across the bulb gradually decreases. Forexample, in figure 14.2 below, the e.m.f. at point **X** will be higher than at point

Y. A difference in the e.m.f. will thus be observed between the two ends **X** and **Y**. This difference in e.m.f. between the two ends of a resistor (bulb) in a circuit is what is referred to as **potential difference** (**p.d.**), or **voltage**; thus,

Fig. 14.2 Circuit showing voltage



there is a potential difference betweenpoints **X** and **Y**. Voltage or potentialdifference is therefore the total energysupplied by a source such as a batteryto drive electricity

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across a resistor.

Voltage or potential difference is measured in a unit called the **volt** (symbol **V**). The instrument used to measure potential difference in the **voltmeter**.Since the voltmeter measures voltage across a resistor, it is therefore always connected in **parallel** to or **across** the resistor.

(ii) Static electricity

All physical objects are made up of atoms. Inside an atom are protons, elec-trons and neutrons. The protons are positively charged, the electrons arenegatively charged, and the neutrons are neutral.

Therefore, all things are made up ofcharges. Opposite charges attract each other (negative to positive). Like chargesrepel each other (positive to positiveor negative to negative). Most of thetime positive and negative charges arebalanced in an object, which makes thatobject neutral.

Static electricity is the **result of an imbalance between negative and positive charges in an object.** These charges can build up on the surface ofan object until they find a way to be released or discharged. One way to discharge them is through a circuit.

The rubbing of certain materials against one another can transfer negativecharges, or electrons. this is what hap- pens when you rub a case of biro pen orcomb against your hair.And what aboutthat "hair raising" experience? You may have realized that when you removeyour hat from the head, you experience hair rising. As you remove your hat, electrons are transferred from hat tohair, creating that interesting hairdo! Re-member, objects with the same charge repel each other. Because they have thesame charge, your hair will stand onend. Your hairs are simply trying to getas far away from each other as possible!

When you rub a balloon against yourclothes and it sticks to the wall, you are adding a surplus of electrons (negativecharges) to the surface of the balloon.The wall is now more positively charged than the balloon. As the two come in contact, the balloon will stick because ofthe rule that opposites attract (positiveto negative).

Law of conservation of energy : When energy in one form is convertedto another form(s), the energy obtained through this conversion is always equal to that in the original form. For example when electric current flows through a light bulb, the heat and light energy obtained is equal to the electrical energydrawn by the bulb i.e.

Electrical energy drawn by the bulb = heat energy + light energyproduced by bulb

In all cases of conversion,the total energybefore conversion is equal to the total energy obtained after conversion. This issummarized in the law of conservationof energy which states:

''Energy can never be created nor destroyed but can be changed from oneform to another''

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Heat transfers

The word heat refers to the state of having **thermal energy**. It is the thermal energy that is transferred from hot places to cold places. Whenwe sit around a fire, we feel warm. This is because heat moves from the source (fire) to us. When we put a poton fire, the water inside gets hot and boils because heat moves from the fire, through the pot, to the water. Thismakes the water hot. Heat transfer is the movement of heat from a hotter place to a colder place. Heat travels through all the three states of matter i.e. solids, liquids and gases. It can also move through a vacuum.

Types of heat transfer

There are various ways through whichheat travels. They are:

- Conduction
- Convection
- Radiation

(a) Conduction

When you hold the end of an object such as a metal rod over a fire, at first you do not feel the heat. After a while, you begin to get burnt and you have to let go off the rod.

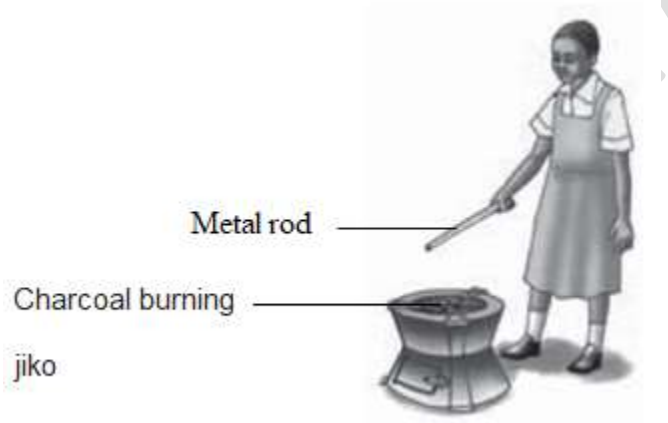

Fig. 14.3 Conduction

Look at the figure below. What will happen after a while? How did the heat reach the hand of the learner?

The heat must have travelled along the metal rod. The heat travelled from the hot end to the cooler end. Heat travelsthrough solids by a method called **conduction.**

When a substance is heated, the molecules which are nearer to the source of heat gain kinetic energy and somove faster. Each molecule passes some of its extra energy to its neighbors as it 'bumps' into them, making them move as well. The process is repeated and energy is transferred throughoutthe substance, from the hot region to colder regions. Hence in conduction, energy transfer takes place by vibration of the

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particles. **Note** that there is no actual movement of heated particles. Metals are particularly good conductors of heat because energy is transferred from the hotter regions to the colder ones by the 'free' electrons present in their structures. Materials which are poor conductors of heat are known as **insulators**. They lack free electrons that conduct heat. Examples includewood and plastic.

(b) Convection

Convection is the method of heattransfer in fluids (liquids) or air.

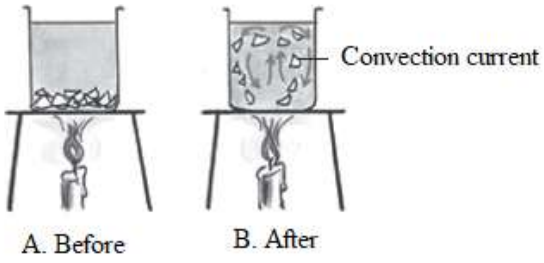

Fig. 14.4 Convection

It occurs due to the actual physical movement of molecules of the fluid due to temperature differences within thefluid. Convection cannot take place in solids because molecules in solids donot move. They only vibrate within their fixed positions. Look at the figure below that demonstrates convection in liquids.

Fig. 14.5 Convection in air

The crystals dissolve and the hot water of less density starts rising, displacing thecold dense water down.As they do this, they move together with the crystals.The streams of physically moving warm liquid (as depicted by the path takenby the crystals) are called **convectioncurrents**.

Now, hold your hand high above a fire, as shown in Fig. 14.5 below. Do you feelthe heat?

Hot air rises carrying the heat along with it.This way, the heat reaches your hand.

This method of heat transfer is called convection. Because it involves air currents, it is **convection in air**. Similarly, smoke which is made up of hotair rises up because it is lighter. It has a lower density than cold air.The cold aircomes down because it is heavier. This explains why smoke always moves up ina burning flame.

(a)Radiation

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If you stand in front of a fireplace, *Fig.*

14.6 Radiation

you feel warmth. Heat energy cannot reach you by conduction as air is a poor conductor of heat. How about convection? The hot air molecules in and around the fireplace can only rise and cannot reach you by the movement of the air currents. How does the energy from the fireplace then reach you? Heat energy must be transferred by a different mode other than conduction and convection.

Look at the picture 14.6. The people are warming themselves besides a charcoal stove.

They are separated from the charcoal stove by air. How do you think the heat or warmth reaches them? Heat reaches the girl by another method of heat transfer called **radiation**. Radiation takes place in form of waves. The waves do not require materials such as solids, liquids or air in order to travel.

Energy conservation

Energy conservation means using the available energy resources carefully so that they do not get exhausted or depleted. There are many methods of conserving energy. Examples include:

- Using energy sparingly.
- Using energy-efficient devices or equipment.
- Using renewable energy resources such as wind, sun, biogas, planting trees.
- Geothermal energy, tidal and wave energy and nuclear energy.
- Use of 3Rs of conservation

Using energy sparingly

The following examples show ways in which we can use energy sparingly.

- If we are cooking, we should use just enough fuel to complete the cooking. No fuel should be left burning wastefully after the cooking is completed.
- If we are using electricity to light our houses we should switch off lights in the rooms that are not being used. We should also use bulbs that do not consume much electricity; For example, use low energy saving bulbs.

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- If we use firewood or charcoal aftercooking the fire on the remainingpieces should be put out.

Conserving energy by using energy- ***efficient devices***

Most of the energy available is wastedbecause our machines, equipment or devices are not efficient. To be efficient means to be able to work well without wasting much energy. If the deviceswe use are efficient, then we minimizewastage of energy.

Some of these energy efficient devices/ ways that people can use include:

Fig. 14.7 Improved jiko

1. Cooking using improved fireplaces and charcoal stove

A three-stone wood fire used for cooking is very wasteful. Firewood burnsvery fast. Heat energy is spread out in all directions and as a result, a lot ofenergy is wasted.

Similarly, the ordinary charcoalstove loses most of the heat to the surroundings. It has no insulation and therefore a lot of heat is lost sidewaysthrough conduction of heat by the metal walls or casing. Heat is also lostin all directions through radiation. An improved charcoal stove like the oneshown below is preferred.

In the improved charcoal stove, the claylining keeps most of the heat inside Clayis a poor conductor of heat. It is an insulator. A few pieces of charcoal can effectively be used to cook food.

2. Other varieties of improved cookers are the clay cooker andpressure cooker.

Vacuum flask

Other methods of conserving heat energy include the use of a vacuum flask to keep liquids and foods hot for a long time. The flask is designed to prevent heat loss by either conduction,radiation or convection. By preserving drinks or foods hot in a vacuum flask, it saves on fuel that would otherwise havebeen used to re-warm them later whenwe want to take them.

Conserving energy by using renewableenergy

Fuels formed from remains of plantsand animals are called **fossil fuels**. They include coal, natural gases, oil andits products. These sources of energyare non-renewable. This means thatonce they have been used they cannotbe replaced or restored. There are alternative sources of energy which are not exhaustible. We refer to these sources of energy as **renewable sources**.They include:

- Wind energy

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- Sun or solar energy
- Biogas
- Planting trees.

The three R's of conservation

The three **R**'s mean **R**educe, **R**euse and **R**ecycle. Which by extension means. Practice what you preach, don't buythings you don't need or items that come in wasteful packaging or that cannot be recycled. **R**euse and **R**ecycle whatever you can.

Fig. 14.8 3 Rs of conservation

a). Reduce

Reducing the amount of waste you produce is the best way to help the environment. For example:

- Buying products that don't have a lot of packaging.
- Save energy by turning lights offwhen leaving a room.
- Save water by turning off taps.

b). Reuse

Instead of throwing things away, try tofind ways of using them again. For

Example:

- Plastic containers can be reused forother activities.
- Cans can be used to store otherthings.
- Use all writing papers on both sides
- Use silverware and dishes instead ofdisposables plastics.

c). Recycle

Recycled items are put through aprocess that makes it possible to create new products out of the materials fromthe old ones.

Buy materials made from recycled materials e.g. paper, towels, garbage bags, greeting cards and toilet paper among others.

14.6. End unit 14 assessment (*UnitTest)*

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A. Guidance to the end unit assessment

- **The end unit assessment is called "Unit Test " in the pupil's book, at Page 291-292**
- Select some questions in the "**Unit Test 14**" and Ask learners those questions to create awareness on energy management.
- Give remedial questions to weak learners.
- Request learners to answer all questions of the Unit Test 14 during their self study and when they are at home.

B. Answers to the end unit assessment

1. Energy is ability to work.
2. Chemical
3. Chemical energy stored in fuel is released during burning and converted to mechanical energy which is used to propel the vehicle.
4. Chemical → Electrical → Light/thermal (heat)
5. Trees are sources of renewable energy, they are sources of rain as well (through transpiration), sources of timber used to make furniture, prevent soil erosion, aremedicines, animals use some as sources of food (fruits, seeds, stems, leaves and roots), etc.
6. D
7. D
8. Chemical
9. When you rub your hands againstone another, you feel warm. This shows existence of thermal energy.
10. Static is caused by charged particlesand is immobile, current is electricityin motion.
11. A
12.

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

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

13. B

14. B

15. (a) True

(b) True

(c) False

(d) False

16. Let learners plan and execute the project under the guidance of their parents/ guardians at home. Ensure that the parent/guardian gives a report on the project progress. Evaluate and award marks to individual learners.

17. – Using energy sparingly.

- Using energy efficient devices
- Prioritizing using renewable sources of energy.
- Emphasizing on the 3Rs of conservation that is, Reduce, Recycle and Re-use.

14.7. Additional activities

❖ Remedial Activities

1. Name the common sources of fuelin your community.
2. Identify some domestic uses of heatenergy.
3. Draw a simple chart to illustratethe energy transformation of fuelsduring burning.
4. What is potential energy?
5. Solar water heater uses energy from the……

❖ Answers to the remedial activities

1. Firewood, paraffin, charcoal, LPG.
2. Cooking, warming, heating.
3. Chemical $\longrightarrow$ heat + light
4. It is a stored energy
5. Sun

❖ Consolidation activities

1. What causes heat when two objectsare rubbed together?

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2. What is energy transformation?
3. Give two examples of:
    a. Renewable sources of energy
    b. Non-renewable sources ofenergy
4. Where does energy come from?

❖ **Answers to the consolidation activities**

1. *Mechanical energy*
2. *Conversion of energy from oneform to another*
3. *(a)Solar, water, wind, biofuelssuch as trees (can be replanted)*
   (b) *Coal, crude oil, nuclear,natural gas*
4. *From various sources such as Sun,wind, water, biomass, etc*

❖ **Extended activities**

1. Food is often referred to as fuel ofthe body. Explain the statement.
2. Name two things that are producedwhen fuels burn.
3. Compare and contrast solar energyand biogas.

❖ **Answers to the extended activities**

1. It is because food has stored energywhich is produced when food is digested to make the body move and feel warmth.
2. Heat and light
3. Solar energy is from the Sun,biogasis from cow dung or kitchen wastes;solar energy is safe, biogas may bedangerous in case of leakages;bothare clean sources of energy, bothare cheap, both are convenient touse.

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UNIT 15: MAGNETISM

15.1.Key unit competence

To explain and demonstrate the existence of magnetic forces and magnetic field

15.2. Prerequisite

This is a completely new concept to the learners except for having been mentioned in the previous unit as a formof energy. Take cognisance of this is youintroduce the topic.Here,you will guidethe learning process on the definition ofmagnetism, types of magnets, definition of magnetic field and its effects, the magnetic compass and finally the usesof magnets. During the lessons, striveto bring to the awareness of learners the fact that this topic is related to magnetism in Physics. Let learners understand that at this level, they may only need the basic information otherwise; details of magnetism, its applications

and usage will be taught in Physics at higher levels of education.Bring to the attention as well the fact that magnetism is heavily applied in engineering therefore taking this topic seriously is of essence.

15.3.Introductory activity

❖ **Guidance on the introductory activity:**

- In this topic, you will teach about what magnetism is, the various types of magnets, their uses and magnetic field.
- As a way of introducing these concepts,refer learners to the diagram on page293 of pupil's book.
- Let them brainstorm in five minutes to discover what is taking place in the picture of the introductory activity.
- Ask them questions under the picture and try to orient their answers to the right ones.
- What topics do they think this unit will include based on the picture?
- Give time for some brainstorming and after share the main sub-units.
- Ask learners to give a quick solution to the mother of the child.

❖ **Answers to the introductory activity**

2. The picture is about a child having accidentally spilled metallic pins into the flour (Picture A). The motheris trying to remove the pins from the flour and it is proving to be difficult (Picture B). She is stressed.
3. The mother should be advised to use a magnet to attract the pins.

15.4. List of lessons

#	**Lesson title**	**Learning objectives**	**Number of periods: 11**
1	Definition and Types of magnets	- Define a magnet - Differentiate types of magnets	1
2	Making a temporary magnet	– Make a temporary magnet	2
3	Characteristics of magnets	- Identify the characteristics of magnets	2
4	Magnetic forces and magnetic materials	– Classify material according tomagnetic force –Compare andclassify the types of magnets, non-magnets and magneticmaterials.	2
5	Magnetic field	- Explain magnetic field - Draw the magnetic fields of various types of magnets.	2
6	Magnetic compass, its uses, and uses of magnets	- List some uses of magnets in everyday objects.	1

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7	**Assessment and remediation**	- Demonstrate the achievement of key unit competence and lessons objectives.	1

Teaching approach for each lesson

15.4.1. Lesson 1: Definition and Types of magnets

a) Learning objectives

- Define a magnet
- Differentiate types of magnets

b) Teaching resources

- Bar magnets, pins, paper clips rubber, pencils or pieces of wood, coin, string, etc.
- Charts, textbooks, handouts and other materials on magnetism.
- Computers connected to the internet

c) Learning activities

❖ **Guidance to the activity 15.1**

- Put the learners in pairs and let them carry out the activity 15.1 at page 293 in Pupil's book.
- Let them make a research and discussion about the definition and types of magnets and note down their findings.
- Let learners present their findings.
- Emphasize the fact that a magnetis a special metal with the ability topull or push other objects. Let them know that this is what magnetism isabout.
- Wrap up this lesson by highlighting thevarious types of magnets as learners write summary notes.

❖ **Answers to the activity 15.1**

Learners will provide different answers depending to the research done. Use their findings to conclude by providing the definition and types of magnets. Refer to pupil's book page 294.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

15.4.2. Lesson 2: Making a temporary magnet

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a) Learning objectives

– Make a temporary magnet.

b) Teaching resources

– Nail, piece of copper wire, a dry cell, pins or paper clips, masking tape, switch, Permanent magnet, and needle.

– Charts, textbooks, handouts and other materials on magnetism.

– Computers connected to the internet

c) Learning activities

❖ **Guidance to the activity 15.2&15.3**

– Put the learners in groups of five or any other number depending onclass size and let them connect the items as shown in the figure in the activity 15.2 and 15.3 at page 295 in Pupil's book.

– Let them try to pick up pins or paper clips when the switch is on and when off. Let them share their observations.

– Guide the learners to giveexplanations to their observationsabove.

– Wrap up this topic by highlighting the various types of magnets i.e. natural verses artificial and permanent verses temporary as learners write summary notes.

❖ **Answers to the activity 15.2&15.3**

When the circuit is switched on, the nail become a magnet and attracts paper clips on pins, but when it is switched off, the nail lost the magnetism and does not attract paper clips or pins. i.e the nail becomes a temporary magnet.

Rubbing a magnet a few times over an unmagnetized piece such as an iron nail as in the activity above, you can convert the nail into a temporary magnet. This is because the nail becomes magnetised.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

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15.4.3. Lesson 3: Characteristics of magnets

a) Learning objectives

– Identify the characteristics of magnets

b) Teaching resources

- Bar magnets, pins, paper clips rubber, pencils or pieces of wood, coin, string, etc.
- Charts, textbooks, handouts and other materials on magnetism.
- Computers connected to the internet.

c) Learning activities

❖ **Guidance to the activity 15.4**

- Put learners in groups and let them carry out the activities listed in this practical activity.
- Let them make their observations and record them in their notebooks.
- Guide the learners to discover the properties of magnets. Let them write short notes and share with their group members.
- Call upon one learner to give a summary on the characteristics of magnets as other learners take notes. Correct him/her where appropriate. Refer to pupil's book page 298 for a summary of characteristics of magnets.

❖ **Answers to the activity 15.4**

1. The magnet attracts some materials.
3. The magnets attract each other.
4. The magnets repel each other.
5. Refer to pupil's book page 298

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

15.4.4. Lesson 4: Magnetic forces and magnetic materials

a) Learning objectives

- Classify material according to magnetic force
- Compare and classify the types of magnets, non-magnets and magnetic materials.

b) Teaching resources

- Bar magnets, safety pins, paper clips rubber, pencils or pieces of wood, coin, string, white sheet of paper, iron fillings, biro pen casing, pieces of glass, cork, sewing needle, etc.
- Charts, textbooks, handouts and other materials on magnetism.

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– Computers connected to the internet for research.

c) Learning activities

❖ **Guidance to the activity 15.5**

– You may begin the lesson by asking learners probing questions such as: 'do you think all materials found on Earth can be attracted by a magnet?' 'Why is this the case?'

– Based on their answers to the above questions, introduce the concept of magnetic and non-magnetic materials.

– Put the learners in groups of four or any other number depending on the class size.

– Let them brainstorm about magnetic or non-magnetic materials that they know. They should then come up with a table like the one in procedure 1 of this activity.

– Provide each group with the materials in listed. Let them carry out the activities described.

– Let them make their observations and record them in a table like the one above. They should then compare the results in this table with the one they came up with before the practical activity.

– Guide the learners to discover the materials that are magnetic and the ones that are not. They should then come up with updated table with accurate information.

– Let them compare their table with table 15.1 on page 300 of their book. Did they get it right? If not, they should correct accordingly.

– Wrap up this topic by highlighting the various magnetic and non- magnetic materials as learners write summary notes.

❖ **Answers to the activity 15.5**

Refer to the table 15.1 in pupil's book on page 300.

❖ **Answers to the application activity (Self-Test) 15.1**

Refer to learner's book page 300

1. Nail, pin, needle, spoon, metallic plates, hoe among others.
2. Using a magnet – to attract iron fillings leaving behind salt or sugar.
3. TV, DVD, refrigerator, electric cooker, electric iron, radio, etc.
4. By rubbing a biro pen case or combon hair, it creates charges which attract pieces of paper.

d) Lesson assessment and Conclusion

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During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

15.4.5. Lesson 5: Magnetic field

a) Learning objectives

- Explain magnetic field.
- Draw the magnetic fields of various types of magnets.

b) Teaching resources

- Bar and horseshoe magnets, ironfillings, a piece of white paper.
- Charts, showing magnetic fields ofdifferent magnets.
- Computers connected to the internetfor research.

c) Learning activities

❖ **Guidance to the activity 15.6**

- Put the learners in pairs or groupsdepending on the size of the class.
- Provide each group with the materials listed. Let them carry out the activities described underprocedure 1 and 2.
- Let them make their observationsand record them in their notebooks.They should draw the pattern obtained when the various magnetsare used.
- Guide the learners to discover themagnetic field lines of bar and horseshoe magnets.
- Let them compare their drawings with those in Fig.15.4 on page 301oftheir book. Did they get it right? If not,they should correct accordingly.
- They should then proceed withprocedures 3 and 4 by bringing like poles of same magnet and unlike poles together. They should observethe pattern formed by the iron fillings and come up with a drawing.
- Let them compare their drawings to those in Fig.15.6 and 15.7 for barmagnet.Guide them to correct theirdrawings accordingly.
- Wrap up this lesson by highlighting the meaning of magnetic field andclarifying the differences between the various magnetic fields formed by different types of magnets andwhen like and unlike poles arebrought close together.

❖ **Answers to the activity 15.6**

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Refer to the pupil's book on page 301-302.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

15.4.6. Lesson 6: Magnetic compass and uses of magnets

a) Learning objectives

- Explain magnetic compass and its uses.
- List some uses of magnets in everyday objects.

b) Teaching resources

- Bar or horseshoe magnet, clear plastic jar with water, three needles, thread, pencil, piece of manila paper, clay or plasticine, tape.
- Magnetic compass.
- A piece of needle or pin, sand, grass.
- Textbooks on uses of magnets.
- Computers connected to the internet for research.

c) Learning activities

❖ **Guidance to the activity 15.7**

- Put the learners in groups depending on the size of the class. Provide each group with the materials listed.
- Guide the learners to carry out the activities described under this activity. At the end of the activity, they would have made a home- made magnetic compass and tested how it works. Let them make their observations and record them in their notebooks.
- At this point, you should show learners the magnetic compass again. Let them say what it is based on earlier discussions.
- Throw the magnetic compass next to the equipment that they made. Let them note the direction where the north pole points compared to their equipment.
- Guide the learners to discover the use of a magnetic compass in showing direction.
- Let learners write summary notes as you explain the concepts above.

❖ **Guidance to the activity 15.8**

- Put the learners in groups depending on the size of the class.
- Ask learners to observe the pictures in the activity 15.8 on page 306 in pupil's book and discuss how magnets are used in them.

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- Let the groups present their findings.
- Facilitate the learners to summarize the lesson by providing the main points from their findings based on the uses of the magnets in everyday life.

❖ **Answers to the activity 15.7**

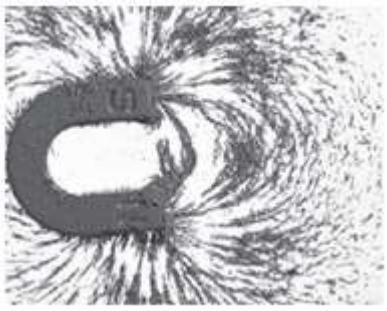
The Earth is a big magnethence being a magnet, it has poles. Therefore, based on the rules of magnetism whereby like charges attract and unlike repel, when a magnet like the magnetic compass isplaced on Earth's surface,it tends toobey this law. Therefore the North Pole will always point away from the Earth's magnetic North. This concept is what causes the pointer of the magnetic compass to settlein a direction that is always southof the Earth's magnetic North pole.As such, the magnetic compass can be used to tell the direction where one is going or coming from.

Refer to the content in pupil's book on page 305.

❖ **Answers to the activity 15.8**

Refer to the content in pupil's book on page 306.

❖ **Answers to the application activity (self-test) 15.2.**

1. Area around a magnet where magnetic force is experienced.
2. To tell direction
3. 
4. Fridge,TV,radio,hand bags,wallets,DVD, Microphone, etc

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

15.5.Additional content for the student and information for the teacher.

A. Additional content for the students

Magnetic force

As children, I am sure all of us have played with magnets. Magnets have always been a mystery to us. They are a fun manipulative. At some orientation, they would pull each other towards

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themselves and at some, they would move away from each other. Over the years we learnt that the force that works behind this behaviour of magnets is its Magnetic Force which is attractive or repulsive in nature depending on its orientation with other magnets.

Magnetic Force can be defined as the attractive or repulsive force that is exerted between the poles of a magnet and electrically charged moving particles. Hence, it is a consequence of the electromagnetic forces.

B. Additional information for the teacher.

Some information that you may findrelevant in this topic are given below.

Origin of magnetism

The people of Magnesia in Asia Minor observed that certain kinds of naturallyoccurring ores possessed an iron-attracting property. The ore was discovered near the city of Magnesia andhence it was named Magnetite. Huge lumps of magnetite were often calledlodestone meaning " leading" stone or natural magnet. Chemically lodestoneconsists of iron oxide.Dr.William Gilbert (1540-1603) did a lot of work with thenatural magnets. He published a book called De magnete in 1600 in which hegave an account of his research into themagnets and their properties.

Identification of the poles of a magnet

In order to identify the poles of a magnet,the ends are usually painted in differentcolours. For example, the N-pole is painted red while the S-pole is painted blue. In other cases the whole bar is painted red with a white dot or spot on one end to identify the north pole.Also,letters 'N' and 'S' are used to identify North and South poles respectively.

Testing polarity of magnets

To do this, freely suspend a bar magnet.

Bring the two poles of the magnet in turn close to a nail placed on a table.Record your observations. Repeat theprocedure, using a second bar magnet instead of the nail.

Fig. 15.1 Magnet attracting nails

We observe that there is attraction when the south and north pole of thesuspended magnet is brought near thenail. When the second bar magnet is used, both attraction

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and repulsion are observed. We can conclude that there isalways an attraction between a magnetand a magnetic material or between the unlike poles of different magnets. But there is always **repulsion** between two like poles of a magnet. Repulsion istherefore, the only sure way of testing for polarity of a magnet. However, the poles of the suspended magnet must beknown first.

Making magnets (Magnetisation)

In the second century A.D, Chinese found a method of making magnets by rubbing pieces of common iron against lodestone. Nowadays, magnets are made using various methods. Some ofthese methods include:

- Stroking or touching method
- Electric method
- Hammering and
- Induction method

(a) Stroking method

This can be single or double stroking.

(i) Single stroking

Here, a piece of steel e.g. steel needle isplaced near a magnet and it becomesmagnetised. However, the magnetism acquired usually disappears quickly whenthe magnet is removed (temporary magnet).

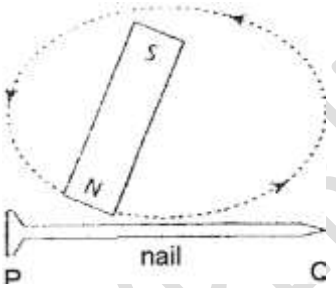

Fig. 15.2 Single stroking

Place the steel needle on the bench. Stroke the steel needle with the southpole of a bar magnet along the wholelength of the steel needle. Once at the end, lift the magnet well away from thesteel needle i.e. make a wide sweep as shown in Fig. above. Repeat the process several times (50 times).Test the polarityof the steel needle by the repulsion method. It is observed that the steel needle becomes magnetised with end Bbecoming a S-pole and end A becoming a N-pole. Note that the end of the magnetic material last touched by the magnet acquires a polarity opposite to the one touching it.

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(ii) Double stroking

Stroke a steel needle using two magnets as shown in Fig.15.3 below. The stroking should begin at the middle of the steel needle each time making sure that the two bar magnets are lifted far awayfrom the steel needle once you reachthe ends.

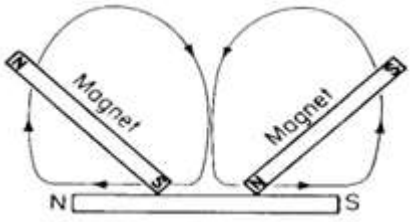

Fig. 15.3 Double stroking

Test for the polarity at the end of the needle. It is observed that end C becomes a N-pole while end D becomes a S-pole. The double stroke method is also called the divided stroke method.

(b) **Electrical method**

Using a wire wind a number of turnsround a hollow rod. This is called a **solenoid**. Place a steel knitting needle and pass a direct current (DC) throughthe turns of the solenoid as shown in Fig. 15.4. Switch off the current and removethe needle.Test for polarity of the needle.Repeat the experiment but with the electric current direction reversed. Testfor polarity of the needle.

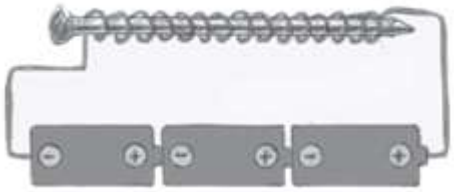

Fig. 15.4 Making a magnet by electrical method.

It is observed that the polarity of themagnet produced depends on the direction of the electric current.

(d) Magnetisation by induction

Place a magnet near an unmagnetisedsteel pin and note what happens. The pinis attracted by the bar magnet. Bringanother pin next to the first pin and note what happens. The second pin is attracted to the first pin (Fig. 15.5 (a)

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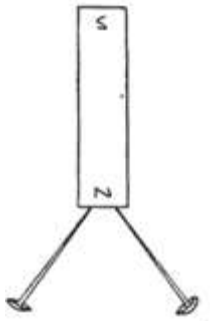

Fig. 15.5 To make a magnet by induction

The first pin becomes magnetised by the magnet through a process called induction and then gets attracted to themagnet.The second pin gets magnetisedby the first pin through the same process.Separate the first pin from the magnet and note what happens to the secondpin. It is observed that the second pin falls off.This shows that it is the presenceof the bar magnet that sustains the magnetism between the first and secondpin. Repeat the experiment using two pins placed side by side. Introduce a north pole between the two pins and observe what happens. The two pins separate further when a north pole isplaced in between them (Fig. 15.5). This shows that the induced pole nearestto the magnet is of opposite polarity tothat of the inducing magnet.

Demagnetisation

Demagnetisation is the process throughwhich magnets lose their magnetism.

The process may be achieved through a number of methods. Some of themethods are discussed below.

Hammering

Hammering a magnetised material placed in the East-West direction or dropping it violently on the hard floorseveral times makes it lose most of itsmagnetism.

Heating

Heating a magnetised material until redhot and cooling it suddenly when restingin East-West direction makes it lose its magnetism.

Electrical method

Placing a magnetised needle in a coilplaced in East-West direction and passing an alternating current (A.C) demagnetises the needle.

Domain theory of magnetism

The domain theory of magnetismdeveloped by a scientist calledWilhelm Weber helps to explain the phenomenon of magnetism.

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Magnetise a steel bar using any of themethods described earlier. Cut the magnetised bar into two halves.Test thepolarities of the ends of each half.

Cut one of the halves into two halvesand again test the polarities.

Fig. 15.6 Effects of cutting bar magnet into small pieces

Continue cutting one piece until you are not able to cut it any more. Each time test the polarity of the halves (Fig.15.6).The polarity test for the first halves shows that each piece is a magnet in itsown right. Further cutting of the piecesstill yields a smaller magnet. The smallestportion of any matter is a molecule. Thus,if we were able to cut the magnet furtherwe would see that the smallest magnetwould be a molecule.

In ferromagnetic materials, these molecular magnets also called dipoles(because of the two poles) occupytiny regions called **domains** within a magnet. The magnetism of each domainis aligned. However, different domains point in different and random directionsas shown below.

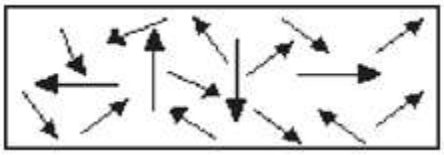

Fig. 15.7 Unmagnetised material

The domain theory may be used to explain the processes of magnetization and demagnetisation.

Magnetisation

Since the domains are aligned in all possible directions in an unmagnetised material (Fig. 15.8), the net magnetismin the material is zero. In a partially magnetised material the domains align themselves as shown in Fig. 15.8 (a). Notice that the domains in Fig. 15.7 and 15.8 (a) are not all aligned in the same direction. When the material is fullymagnetised the domain walls move and the molecular magnets align themselves in one particular direction as shown inFig. 15.8 (b).

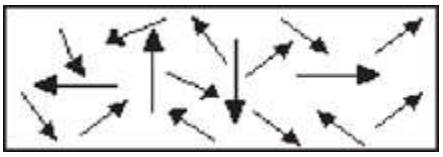

Fig. 15.8 (a) Unmagnetised material

EXPERIMENTAL VERSION

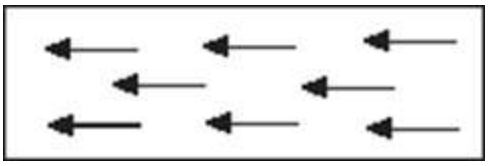

Fig. 15.8 (b) Magnetised material

A ferromagnetic material is said tobe magnetically saturated when the walls are swept out and the molecularmagnets point in the same direction.

A resultant north pole is produced at one end and a south pole at the otherend as shown in Fig. 15.8 (b).

Demagnetisation

The walls of the domain slowly returnto their original state with time as this is a more stable state; hence thematerial becomes **demagnetised**. This kind of demagnetisation is calledself-demagnetisation. This is due to the poles at the end, which tend to reverse the direction of the molecular magnets. The demagnetisation process can alsobe influenced externally by giving themolecular magnets enough energy to overcome the forces holding them ina particular direction. The energy may be provided by heating, hammering or dropping on a hard surface or by usingan alternating current.

Storage and uses of magnets

A bar magnet loses its magnetism with time due to self-demagnetisation. The process of self-demagnetisation starts atthe ends of a magnet in which the free like poles repel each other and slowlyupsetting the alignment of the molecularmagnet inside it. To minimise this, soft iron bars called keepers are placed across their ends as shown in Fig. 15.9

Fig. 15.9 Keepers for storing magnets

This way, the dipoles find themselvesin a closed chain or loops round themagnet and the keepers, with no free poles, available to upset the domains.

The soft iron keepers are used since they are easily magnetised by induction.

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The earth's magnetic field

When a bar magnet is suspended freely,it comes to rest in N-S direction. Thisis as if it is trying to align itself with acertain magnetic field. It is believed that this alignment of the bar magnet is dueto the magnetic field due to the earth. The earth is considered to behave as if it contains a bar magnet positioned atits centre.

15.6.End unit 15 assessment (Unit test)

A. Guidance to the end unit assessment

- **The end unit assessment is called "Unit Test " in the pupil's book, at Page 307**
- Select some questions in the "**Unit Test 15**" and Ask learners those questions to explain and demonstrate the existence of magnetic forces and magnetic field.
- Give remedial questions to weak learners.
- Request learners to answer all questions of the Unit Test 15 during their self study and when they are at home.

B. Answers to the end unit assessment

1. A term used to refer to a property associated with magnets, which causes attraction or repulsion of substances that are magnetic.
2.

Magnetic materials	**Non magneticmaterials**
Iron	Paper
Steel	Cork
Nails	Wood
Pins	Plastic
Needle	Ceramic
Paper clips	Pieces of cloth

3.

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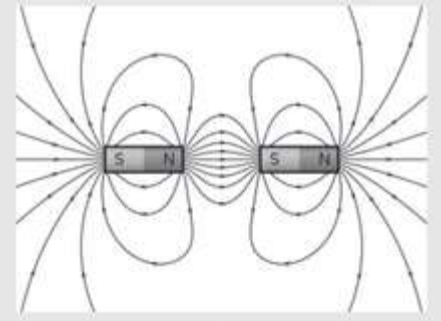

4. Temporary magnets lose magnetism when taken away from magnetic field or when power is disconnectedin an electromagnet, permanent magnets do not lose their magneticproperties whatsoever unless themagnet is physically destroyed.

5. Magnetic materials or metals thatthat can be attracted by a magnet.Examples include iron, nickel, cobalt or naturally occurring magnetic materials such as magnetite or lodestone.

6. B

7. B

8. Ask learners to first write downhow they will do it then go ahead and make a magnet. The magnet ismade by stroking a magnetic metalon a bar magnet several times (50 times) only in one direction. The speed should be that of striking amatchstick. The parent or guardianshould be advised to follow up andensure the learner has made the magnet.

9. Have two poles (North and Southpole), like poles attract while unlike poles repel, attract magneticmaterials but not non magnetic materials, when suspended, they rest with their south pole settlingin the Earth's magnetic north pole direction,

10. Magnetite or lodestone

11. When separating mixtures of magnetic and non magnetic substances, in finding lost magnetic items, in telling direction (magnetic compass), etc.

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15.7.Additional activities

❖ Remedial Activities

1. How would you differentiate magnetic from non-magneticsubstances?
2. Look around you. List some magnetic materials that you can see.
3. Like charges attract while unlikecharges repel. True or false?
4. What is a magnet?

❖ **Answers to the remedial activities**

1. By bringing a magnet close to theitem. If it attracts, it is magnetic; if it doesn't, it is not.
2. Magnetic: Nail, pin, paper clip, doorhandle. Non magnetic – wooden chair/table, biro pen case, book, etc)
3. False
4. An object/item that produces a special type of force, which either attracts or repels certain materials.

❖ **Consolidation activities**

1. Why is it more appropriate to usea magnet to separate iron fillingsfrom flour?
2. What is magnetic compass?
3. How can you make a temporarymagnet using a permanent magnet?

❖ **Answers to the consolidation activities**

1. Because it will attract all the iron fillings living behind pure flour.
2. An instrument or a device that uses magnetized steel bar to indicate direction relative to the Earth's magnetic poles.
3. Moving the metal to be magnetizedin the same direction, rather than backand forth. Using the same quick motion you would use to light a match and continue rubbing the material with themagnet about 50 times as quickly as you can.

❖ **Extended activities**

1. Explain why it is possible to telldirection using a magnetic compass.
2. How are magnets used in a
    a. Speaker?
    b. Refrigerator?
3. Explain why electromagnets are used in lifting of heavy machinery at the port.

❖ **Answers to the extended activities**

1. The Earth has magnetic materialsat its core. As such, it is kind of a huge magnet. Being a magnet, ithas North and South poles. Whena magnetic compass is placed on the Earth's surface. Its North pole is repelled by the Earth's magnetic North pole. Therefore, the north pole of the magnetic compass always settles southwards. Usingthis knowledge, we can drop a magnetic compass and look atthe pointer. Where it points is the south of the earth hence we can use that information to tell the direction where we are going orcoming from.

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2. (a) A speaker converts electrical signals into sound energy. By moving the cone back and forth,thespeaker increases and decreases the air pressure in front of it thuscreating sound waves. When a fluctuating electric current(from the sound system such as radio or TV) flows through the coil, it becomes a temporary electromagnet, attracted andrepelled by the permanent magnet.As the coil moves, it moves the cone back and forth, pumping soundwaves into the air.That is howwe get to hear the sound.

   (b). In the doors to keep the doorslocked.

3. Huge magnets are very powerful hence can be used to lift heavy loads. Additionally, electromagnetsare made from magnetic cores andcoilings, which use electricity. It istherefore possible to determine what amount of force is generatedor even manipulate the amount of force generated, plus it can be switched on to lift the load and switched off to drop it once the point of offloading is reached.

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UNIT 16: STATES OF MATTER

16.1.Key unit competence

To demonstrate and explain changes of state of matter

16.2.Prerequisite

This is a new area although learners have already interacted with solids,liquids and gases in their lives. Let them understand that in this unit, they will be introduced to the definition of matter, the various forms of matter and theprocess that take place when matter is transformed from one state to another. During the lessons, strive to bring to the awareness of learners the fact that this topic is related to states of matter in Chemistry and Physics. Let learners understand that at this level, they may only need the basic information otherwise; details of states of matter, its applications and usage will be taught inChemistry and Physics at higher levelsof education.

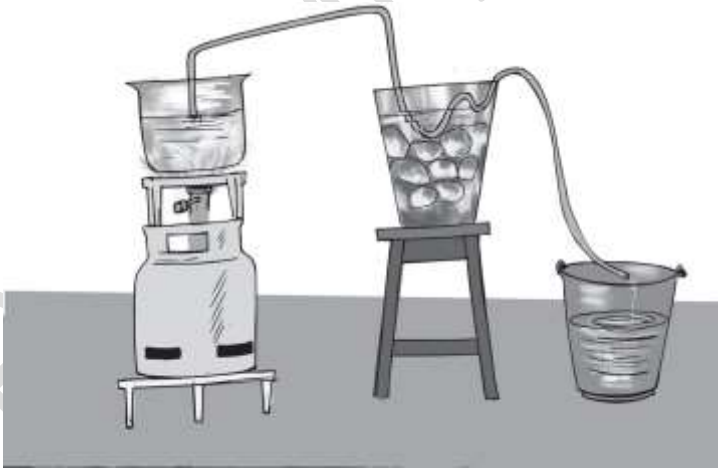
16.3.Introductory activity

- **Guidance on the introductory activity**

  - In this topic, you will teach about states of matter andthe various processes involved during change of state.As a way of introducing these concepts,refer learners to the diagram on page 308 of pupil's book.
  - Let them brainstorm in five minutes to discover what is taking place in the picture of the introductory activity.
  - Ask them questions under the picture and try to orient their answers to the right ones.
  - What topics do they think this unit will include based on the picture?
  - Ask learners to give a quick solution to how pure water can locally bemade at home.

- **Answers to the introductory activity**

  2. We take medicines with pure water to dissolve them without any impurities.
  3. Liquid state
  4. An easy way of making pure water is shown below.



In the diagram, pure water is being obtained by heating water using gas then directing the vapour through a pipe to a bucket of ice. The ice helps to cool the vapour which is then collected in another clean bucket. This water is pureenough and can be used to dilute the medicine.

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16.4. List of lessons

#	Lesson title	Learning objectives	Number of periods:10
1	Definition of matter and its states	– Define the matter. – List the three states of matter	2
2	Properties of the three states of matter (in terms of shape and volume)	– Identify the threestates of matter in terms of shape and volume. – Observing and compare differentobjects/matter in different states	2
3	Change of state in water	– Identify three interchangeablestates of water. – State how water changes from onestate to another. – State the melting point of ice (freezing point of water) and the boiling point of water.	1
4	Changes in states of water in the water cycle	- Explain the roles of evaporation and condensation in the water cycle. - Recognize the changes in states ofwater in the water cycle.	2
5	Transformation of states of matter	- Describe the transformation of the various states of matter.	2
6	**Assessment and remediation**	- Demonstrate the achievement of key unit competence and lessons objectives.	1

Teaching approach for each lesson

16.4.1. Lesson 1: Definition of matter and its states

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a) Learning objectives

- Define the matter.
- List the three states of matter

b) Teaching resources

- Items for use during practicals such as balloons, stick, eureka can,measuring cylinder, stone, bottle ofwater, among others
- Computers connected to the internet

c) Learning activities

❖ **Guidance to the activity 16.1**

- You may begin the lesson by asking learners probing questions such as: Have you ever heard of the word'matter'? What does it mean?
- Put learners in groups of four orany other number depending on the class size. Let them carry outthe activities listed in this practicalactivity.
- Let them make their observations and record them in their note books.
- Guide the learners to discover the meaning of the word matter by discussing the results of above experiments.
- Emphasise the fact that matter isanything that occupies space and has volume. Prove the fact that this is the case by citing the results of the experiments in this activity.

❖ **Answers to the activity 16.1**

Refer to the content in pupil's book on page 310.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

16.4.2. Lesson 2: Properties of the three states of matter

a) Learning objectives

- Identify the three states of matter in terms of shape and volume.
- Observing and compare different objects/matter in different states.

b) Teaching resources

- Water in a container, juice, stone, pieces of wood, cooking oil, book,milk, methylated spirit, inflated balloon, among others.
- Textbooks in the library and charts on states of matter.
- Computers connected to the internet.

c) Learning activities

❖ **Guidance to the activity 16.2**

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- Put learners in pairs then let themcarry out the activities listed in thispractical activity. You can also use groups of varied numbers dependingon the size of the class. Let thempour, compress and feel the variousitems as they make observations.
- Let them record their findings in their notebooks.They can do it in a table format as shown in their bookspage 311.
- Guide the learners to discover thedifferences between the various states of matter. They should try to group them based on the characteristics that they have observed.
- Let them do research on the characteristics of the various statesof matter. They should then comparetheir findings to the characteristics that they earlier wrote down.
- Guide them to make conclusions about the three states of matter i.e. solids, liquids and gases.
- Emphasise the fact that the particlesin the three states of mater are organised differently hence the observed characteristics. Show learners the pictures in Fig. 16.2 page 311-312 of their books to helpthem differentiate between the threestates.
- Wind up the lesson by highlightingthe characteristics of the threestates of matter as they write summary notes.

❖ **Answers to the activity 16.2**

Refer to the content in pupil's book on page 311.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

16.4.3. Lesson 3: Change of state in water

a) Learning objectives

- Identify three interchangeablestates of water.
- State how water changes from onestate to another.
- State the melting point of ice (freezing point of water) and the boiling point of water.

b) Teaching resources

- Water in a container, freezer, bucket of ice, clock, source of heat, tin with lid, transparent beaker, thermometer,test tubes, among others
- Textbooks in the library and charts on states of matter
- Computers connected to the internet

c) Learning activities

❖ **Guidance to the activity 16.3**

- This can be a class demonstrationor alternatively, if you have enough equipment, put leaners in groups of manageable sizes to carry out the activity. Let them carry

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out theactivities listed in this experiment.

- They should heat some water andallow it to cool then observe the underside of the container on topwith cold water in it or lid. Help learners to draw a conclusion about this.
- In the same manner, allow learnersto heat some ice then observe andrecord what happens. Guide themto interpret the observations.
- Next, guide learners in finding out the melting point of ice and boilingpoint of water. Heat ice and water respectively with thermometerimmersed in it. Let them record the temperature at which the ice meltsand the water boils.
- Guide learners to answer the study questions in this activity.
- Summarise the lesson by guiding learners to discover the meaning of melting, evaporation, condensationand freezing. Stress the fact that melting point of ice is the same asfreezing point of water. Help them come up with a chart like the one shown in Fig. 16.3 page 314 of pupilsbook.
- Emphasise the fact that pure water boils at 100^0C and ice melts at 0^0C

❖ **Answers to the activity 16.2**

Refer to the content in pupil's book on page 314.

❖ **Answers to the application activity (Self-test)16.1**

1. Anything that occupies space andhas weight.
2. Solid, liquid, gas.
3. Transformation of a substance fromone form to another.
4. Cooling happens when temperatureis reduced while heating occurs when temperature is increased.
5. B
6. Ice, steam
7. 100°C, 0°C

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

16.4.4. Lesson 4: Changes in states of water in the water cycle

a) Learning objectives

- Explain the roles ofevaporation and condensation in the water cycle.

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- Recognize the changes in states ofwater in the water cycle.

b) Teaching resources

- Chart on water cycle or the Fig. onpage 315 of pupil's book.
- Textbooks in the library.
- Computers connected to the internet.

c) Learning activities

❖ **Guidance to the activity 16.4**

- Put learners into groups depending on the class size and theirabilities.
- Provide learners with a chart on thewater cycle. Alternatively, let themstudy the picture on page 315 with their friends in the group.
- Guide learners to discover what ishappening in the various processes in the diagram. You may remind themof the outcomes in Activity 16.3.Youmay also repeat this activity as well.
- Letlearners understand that after condensation of water vapour in thesky, clouds are formed which later precipitate into drops of rain.
- Let learners understand that when it rains, some water goes to water bodies, others are absorbed into thesoil while others form surface run-offs.
- You may then wind up the topicby highlighting the main points about water cycle as learners writesummary notes.

❖ **Answers to the activity 16.4**

2. A- evaporation, B - transpiration and C-condensation respectively. Refer to the content in pupil's book on page 316.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

16.4.5. Lesson 5: Transformation of states of matter

a) Learning objectives

- Describe the transformation of the various states of matter.

b) Teaching resources

- Naphthalene solid, iodine ,transparent tin with lid, bottle top and a source of heat.
- Textbooks in the library
- Computers connected to the internet

c) Learning activities

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❖ **Guidance to the activity 16.5**

- Put learners in various groupsdepending on class size then demonstrate what happens when naphthalene and iodine solids areheated and cooled.
- Let learners observe and record what happens.
- You can then clarify the fact thatsome solids change directly to gaseous state when heated while when cooled, they also change directly to solid state. Give iodine and naphthalene in this experimentas examples.
- At this point, you can explain thedifference between sublimation anddeposition. Refer to pupil's book page 316.
- Remind learners about activity 16.3where they heated water and ice.Let them say what they observed.You can also carry out this activity here again. Ask them the processes involved.
- From the activity above, learners should list evaporation and melting and condensation and freezing assome of the processes involved.
- Combine the content above and what has been learnt in this activityand summarize the various changes of state that occur in substances. Refer to Fig.16.4 in pupil's book page 318.
- Wrap up the topic by highlightingthe main points as learners write summary notes.

❖ **Answers to the activity 16.4**

3. Iodine solid when heated, changes directly to vapour.
4. Iodine vapour when cooled forms iodine solid without going through the liquid state.
5. When naphthalene is heated, it changes to liquid at 80ºC. Further heating leads to formation of a gas at 140ºC.

❖ **Answers to the application activity (Self-test)16.2**

1. The process by which water is madeavailable on the surface of the earth.
2. (a) Bring about transpiration

   (b) leads to accumulation of waterin water bodies

   (c) It is where evaporation occurs
2. Evaporation, transpiration, condensation, precipitation, surface runoff.
4. Permanent change in state of a substance.
5. Refer to Pupil's book page 317.

d) Lesson assessment and Conclusion

During the activities, keep on observing and understanding what learners do and answer, and note their progress. At the end the lesson, ask again some questions on the performed activities or content learnt to assess the learning and summarise the content.

16.5. Additional Information for the teacher

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Some information that you may find relevant in this topic are given below.

Temperatures at which water changes state

Changes in temperature can cause asubstance to change its physical state.We have seen that water can be a solid(ice), a liquid (water) or a gas (vapour or steam). Its state can be changedby heating or cooling. This is because heating or cooling affects the kinetic energy of the molecules.

When ice is heated, its temperaturerises steadily until it all melts. This change is called **melting** and the temperature at which it occurs is the **melting point**. The melting point ofpure water is O˚C.

On further heating,the temperatureof the water rises steadily, some ofthe water change to vapour (steam).This change is called evaporation.The hotter the water gets, the quicker it evaporates and soon bubbles appear. The water is now boiling and this is the boiling point ofwater. At sea level the boiling pointof pure water is 100˚C.

A plot of temperature against time givesa graph similar to the one shown below

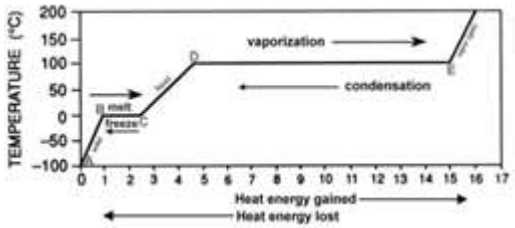

Fig. 16.1 Heating curve for water

The change of state from solid (ice) toliquid (water) and then from liquid tosteam (water vapour) can be reversedby cooling.On cooling,the water vapourchanges into water. This process is called*condensation*.

On further cooling (to below 0°C), the liquid water changes into solid ice.The process is called *freezing.* The freezing

point of water is the same as the melting point of ice (i.e. 0°C). All these changes can be represented as shown in the Fig.16.2 below.

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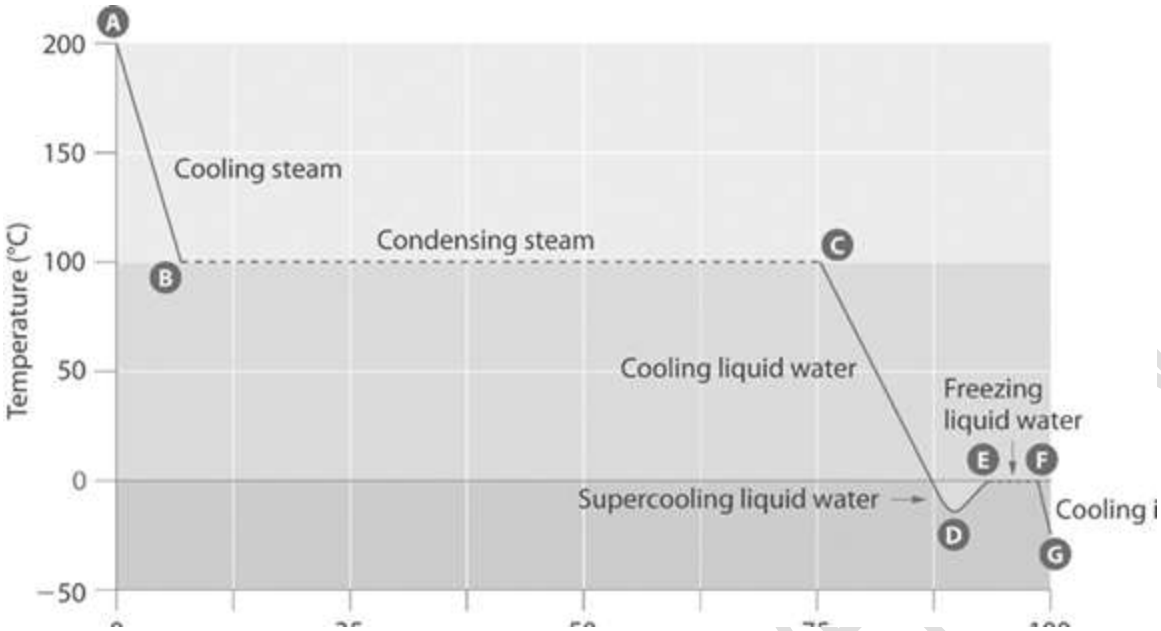

Fig. 16.2 Cooling curve for water

16.6.End unit 16 assessment (Unit test)

A. Guidance to the end unit assessment

- **The end unit assessment is called "Unit Test " in the pupil's book, at Page 319**
- Select some questions in the "**Unit Test 16**" and Ask learners those questions to describe the transformation of the various states of matter.
- Give remedial questions to weak learners.
- Request learners to answer all questions of the Unit Test 16 during their self study and when they are at home.

B. Answers to the end unit 16 assessment

1. Occupies space.
2. Liquids flow, solids do not flow
   liquids can be compressed, solids
   cannot.
3. Refer to Activity 16.3 pages 326 – 327 pupil's book
4. D
5. Total amount of matter in a substance.

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6. (a) A – Transpiration, B – Evaporation

   (b) Water vapour

   (c) Precipitation

7. (a) Rain forms through water cycle. It is the main source of water which has a wide variety of uses in our lives ranging from domestic to agricultural and industrial uses.

   (b) Because trees are important catchment areas of rains. Trees undergo transpiration process which leads to availability of water vapour in the atmosphere. The water vapour is condensed to give us rain.

8. Use thermometer while heating then

   note the temperature at which (a)

   melting occurs and (b) boiling occurs.

9. C

10. (a) Melting

    (b) Evaporation

    (c) Condensation

    (d) Freezing

11. B

12. Melts

16.7.Additional activities

❖ **Remedial Activities**

1. Matter is anything that occupies…….and has……...
2. The three states of matter are------, ……and …….
3. Give the name of (a) water in solid state…… (b) Water in gaseous state. _____
4. The boiling point of water is……..ºC while the melting point of ice is…….. ºC

❖ **Answers to the remedial activities**

1. Space, mass
2. Solid, liquid and gas
3. (a) Ice (b) Steam
4. 100, 0

❖ **Consolidation activities**

1. Where does water come from?
2. Name two process that lead to formation of water vapour in the atmosphere.

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3. What is precipitation?
4. Distinguish between sublimation anddeposition.

❖ **Answers to the consolidation activities**

1. condensation of water vapour in the atmosphere
2. Evaporation from water bodies, transpiration.
3. the process by which rain drops are formed from clouds.
4. Sublimation – direct change from solid to gas on heating; deposition – direct change from gas to solid on cooling.

❖ **Extended activities**

1. The fact that water is found bothas ice and steam shows it exits in……..states.
2. Why would you be unable tocompress a stone?
3. Distinguish between deposition andsublimation.
4. Describe water cycle.

❖ **Answers to the extended activities**

1. Three
2. Because its particles are arranged/ packed very closely together.
3. Sublimation – change from solid togaseous state directly. Deposition – change from gaseous to lsolid state directly.
4. The process by which water is madeavailable on Earth's surface.It involvesfour processes namely evaporation,transpiration, condensation and precipitation. Evaporation andtranspiration add water vapour intothe atmosphere. The water vapour is then converted to clouds through condensation. Precipitation leads to rainfall.After it has rained, watergets into the water bodies throughsurface runoff, plants absorb water from soil and the processes are repeated over and over.

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