



South Sudan

Secondary Chemistry 1

Teacher's Guide

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

The book comprehensively covers the Secondary 1 syllabus as developed by Ministry of General Education and Instruction.

Each year comprises of a Student's Book and Teacher's Guide.

The Teacher's Guide provide:

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



All the courses in this secondary series were developed by the Ministry of General Education and Instruction, Republic of South Sudan. The books have been designed to meet the secondary school syllabus, and at the same time equipping the pupils with skills to fit in the modern day global society.

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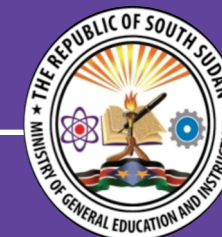
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Chemistry

Teacher's Guide 1

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FOREWORD

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

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

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

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



Deng Deng Hoc Yai, (Hon.)

Minister of General Education and Instruction, Republic of South Sudan

Table of Contents

Introduction	1
Separating mixtures and compounds	12
1.1 Definition of chemistry	14
1.2 Importance of chemistry	15
1.3 The chemistry laboratory	16
1.4 Separating mixture and compounds	21
1.5 Application of separation of mixtures and compounds	34
Particulate nature of matter, formulae and chemical equations	38
2.1 States of matter	39
2.2 Change of states of matter	40
2.3 Physical and chemical changes of matter	41
2.4 and 2.5 Kinetic theory of matter	43
2.6 Definition of elements, atoms and molecules	47
2.7 Symbols of chemical elements	47
2.8 Main components of an atom	48
2.9 Atomic characteristics	49
2.10 Electronic configuration	49
2.11 Elements and compounds	51
2.12 Ion formation	51
2.13 and 2.14 Radicals and valence of elements	53
Acids, bases and salts	57
3.1 Definition of acid, base, indicator and salt	59
3.2 Properties of acids and bases	60
3.3 Strong and weak acids and bases	61
3.4 Simple acid-base Indicators	64
3.5 The pH scale and pH meter	65

3.6 Uses of acids and bases.	67
3.7 Types of salts	68
Redox Reaction.	71
4.1 Oxidation and reduction process	73
4.2 Oxidising and reducing agents	76
4.3 Oxidation numbers	78
4.4 The reactivity series.	80

Book organisation

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

The main elements of Part 1 are:

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

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

The main elements of each unit guide are:

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

The section outlines the specific cross cutting issues that will be addresses through infusion as the learners do the activities and interacts with concepts planed for the unit This is meant to make the teacher conscious on and be on the look out for suitable opportunities through out the teaching and learning process in the entire unit to address the cited cross cutting issues. These issues will be discussed in detail later in this section.

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

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

Background Information on the new curriculum

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

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

a. Learner's competences to be attained

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

1. Critical and creative thinking

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

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

2. Communication

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

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

3. Cooperation

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

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

4. Culture and identity

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

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

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

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

(i) Environment and sustainability

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

(ii) Peace education

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

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

(iii) Life Skills

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

Basic requirements for an effective Chemistry lesson

Teacher's role and basic skills for effective Chemistry lesson

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

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

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

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

- Creativity and innovation.
- Makes connections/relations with other subjects.
- A high level of knowledge of the content.

Effective disciplining skills manage adequately the classroom

- Good communicator.
- Guidance and counselling.

Learner's role in learning Chemistry

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

For active participation in learning, the learner should:

- Raise questions about what is observed.
- Suggest solutions to the problems observed.
- Take part in planning investigations with appropriate controls to answer specific questions.
- Carry out investigations to search for answers with the help of materials in search of patterns and relationships while looking for solutions to problems.
- Working collaboratively with others, communicating their own ideas and
- Considering others' ideas.
- Expressing themselves using appropriate Chemistry terms and representations in writing and talk.
- Engaging in lively public discussions in defence of their work and explanations.
- Applying their learning in real-life contexts.
- Reflecting critically about the processes and outcomes of their inquiries.

Teaching and learning resources

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

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

(a) Classroom as a learning environment

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

Classroom organisation

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

(b) Apparatus and materials

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

When I hear I forget

When I see I remember

When I do I understand

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

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

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

These include:

(i) Chemistry Kit

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

(ii) Models

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

(iii) Resource persons

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

(iv) Improvisation

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

(vi) Scheduling learning activities and venues

Some of the activities suggested in the student's good planning and scheduling in order to get accurate results. An example is observing some effects of environmental factors on plant growth illustrated in unit 14. The teacher should therefore think ahead while making the scheme of work so that the prevailing weather pattern and the most appropriate timing are considered.

Grouping learners for learning activities

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

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

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

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

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

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

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

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

- Learners can learn from one another.
- Cooperation among learners can easily be developed.
- Many learners accept correction from the teacher more readily and without feeling humiliated when they are in a small group rather than the whole class.
- Learners' creativity, responsibility and leadership skills can easily be developed.
- Learners can work at their own pace.
- The type of "grouping" that a teacher may choose may be dictated by:
- The topic or task to be tackled.

- The materials available.
- Ability of learners in the class (fast, average, slow).

Class size

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

Teaching methods

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

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

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

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

(a) Direct exposition

This is the traditional way of teaching whereby the teacher explains something while the learners listen. After the teacher has finished, the learners may ask questions.

However, in a competence-based curriculum, this technique should be used very minimally.

(b) Guided Discovery

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

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

Asking structure or guided questions that lead learners to the desired outcome. Sometimes learners are given a problem to solve and then left to work in an open-ended manner until they find out for themselves.

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

(c) Group/class discussion or pair work

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

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

(d) Project method

In this approach, the teacher organizes and guides a group of learners or the whole class to undertake a comprehensive study of something in real life over a period of time such as a week or several weeks.

Learners using the project method of studying encounter real life problems, which cannot be realistically brought into a normal classroom situation. A project captures learners' enthusiasm, stimulates their initiative and encourages independent enquiry. The teacher, using the project method, must ensure that the learners understand the problem to be solved and then provides them with the necessary materials and guidance to enable them carry out the study.

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

(e) Educational visits and trips and nature walks

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

(f) Demonstration lessons

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

doing. It is necessary to involve the learners in a demonstration, for example by:

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

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

When is a demonstration necessary?

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

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

UNIT 1

Separating mixtures and compounds

Refer to Learner's Book pages 1–42

Learn about		Key inquiry questions
<p>In this unit students will build on what they already know, learn about the meaning of chemistry as the study of materials and their properties, and begin to understand the importance of chemistry in everyday life.</p> <p>They will do these through designing and carrying out practical investigations. These will involve the use of common laboratory apparatus, including the Bunsen burner, and be aware of risk in designing and carrying out practical investigation involving the separation of mixtures and compound and their properties.</p> <p>They should have a secure understanding of techniques of separating mixtures and compounds with emphasis on concepts of filtration and crystallization or evaporation, sublimation, distillation and fractional distillation, use of a separating funnel, paper chromatography. They should obtain pure substances from mixtures, operate the Bunsen burner, and investigate the parts of non-luminous flame.</p>		<ul style="list-style-type: none"> How can you use specialized equipment to accurately measure volumes, mass, time, temperature etc.? How do you get pure substances from mixtures? How you apply techniques of separating of mixtures in daily life?
Learning outcomes		
Knowledge and understanding	Skills	Attitudes
<ul style="list-style-type: none"> Name common laboratory apparatus and understand safety rules Explain the techniques of separating mixtures and compounds and link the concepts to industry, especially crude oil 	<ul style="list-style-type: none"> Separate a range of mixtures and compounds Investigate the parts of non-luminous flame. Present reasoned explanations for phenomena, patterns and relationships Make predictions and propose hypotheses Record observations, measurements and estimates Interpret and evaluate observations and experimental results Plan investigations, select techniques, apparatus and materials Evaluate methods of investigations 	<ul style="list-style-type: none"> Appreciate knowledge of chemistry in daily life Respect for safety rules in laboratory Develop precision and accuracy in taking measurements Appreciate the different techniques of separating mixtures in daily life

Contribution to the competencies:

Critical and creative thinking through exploration of uses of common laboratory apparatus, investigation, descriptions, explanation and experimentation

Communication through presentation of group findings

Co-operation through group work

Links to other subjects:

Physics: use of apparatus, separations magnetic and non-magnetic materials

Biology: use of apparatus, classification of living and non-living things

Agriculture: use of apparatus, e.g. for analysis of soil nutrients, separation of grains from husks

Geography: use of apparatus, e.g. in collection of weather data

Mathematics: data collection and sorting out things, measurements

Introduction to the Unit

The content in this unit is about introduction to chemistry. The activities in the unit will make learners aware of the importance of chemistry in everyday life. Chemistry prepares learners for certain career courses such as medicine and dentistry. Knowledge obtained from chemistry is applied in the industrial manufacture of certain products. Employment provided by these industries and consumption of their products has an overall effect in the economic growth.

There are many opportunities for learners to practice and improve their critical thinking and communication skills. There are many discussions to be held about common laboratory apparatus and the need to follow laboratory safety regulations.

The activities in this unit also focus on the need to understand techniques and concepts of separating mixtures and compounds. It is possible however to find alternative and additional activities for separation of mixtures and compounds. You may choose to set this as a research project or homework activity for the learners.

Competencies to be attained

1. Cooperation

During group discussions and pair works-let learners engage one another by giving a chance for all to participate. Also, you can allow rational presentations within the group members. Further, encourage learners to be tolerant to other learners' view and to understand that people should not necessarily be right always.

2. Communication

Communication will be improved when learners freely participate in the discussions and presentations. Encourage all learners irrespective of their abilities to participate in the discussions during presentations by asking questions and during questions and answer session to either introduce or wrap up the lessons. All learners should also be encouraged to write summary notes at the end of the of the lesson as this will help improve their writing skills.

3. Critical thinking and creative thinking

This will be developed by learners as they answer the probing questions and as they discuss the results of the various practical activities. Guide learners to discover for themselves the various methods for separating mixtures and compounds.

Cross-cutting issues

1. Inclusive learning

All learners whether disabled or normal should participate actively in the lesson. Learners with seeing difficulties can be put in front of the class. Also encourage both gender to embrace the study of Chemistry because all of them can attain the best grades.

2. Peace, values

Let the learners see the need to accommodate other people's views in a discussion.

1.1 Definition of chemistry

Activities 1.1 and 1.2: Refer to page 1 of learner's book

In groups

- The pictures illustrate products made using the knowledge of chemistry.
- It is important that the learners identify the products/items in the picture. It is also important that they explain the reason for their answers for each item/product.
- As learners identify the products, encourage them to come up with other products/items other than the ones in the pictures that have been made using the knowledge of chemistry.
- Allow learners to do activity 1.2. encourage them to share their answers with rest of the class.
- You can now define the meaning of chemistry to the whole class.

Expected answers

- Detergents
- Perfumes
- Drugs
- Let learners know in activity 1.2 that cooking and brewing also involve chemistry, the plastic lunch boxes and bottles are also made using the knowledge of chemistry.

Assessment opportunity

Check whether the lesson objectives have been met by:

a. Observation and listening

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

b. Conversation

Test skill acquisition asking learners to look for the meaning of chemistry from the dictionary. They can also discuss the meaning amongst themselves.

c. Product

Appraise each learner on:

- Their understanding that some of the products that we use every day are manufactured through the application of knowledge obtained from the study of chemistry.

1.2 Importance of chemistry

Activity 1.3: Refer to page 2 of learner's book

Activity 1.4: Refer to page 3 of learner's book

In groups

- The pictures illustrate a range of activities that involve chemistry.
- It is important that the learners identify the activities being carried out in each picture and also explain the reason for their answers in each picture.
- Guide learners to answer the questions. Let them know that chemistry is important for one to pursue certain careers.
- Begin activity 1.4 by putting the materials you brought for study on the table. Ask learners to identify them and their uses
- Let learners name some products that they buy from shops or use at home. Allow them to brainstorm on their uses and whether it is important to have them.
- Emphasise the fact that industrial processes apply knowledge obtained from the study of chemistry.

Assessment opportunity

Check whether the lesson objectives have been met by:

a. Observation and listening

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

b. Conversation

Ask questions to test learner's understanding on the application of chemistry to culture and work.

c. Product

Appraise each learner on:

- Their understanding that some of the substances around are studied under chemistry.

Answers to check your progress 1.1 Refer to page 5 of learner's book

1. Chemistry is the study of the composition, structure and properties of substances under different conditions.
2. Assess the opinion of every learner and correct accordingly. Guide them on how to choose their career. Help them change their attitude where necessary.
3. Evaluate the reasons given by the learners and correct where necessary.
4.
 - (a) Evaluate every learner based on how they are able to link manufacture of chlorine and its effects on disease causing microorganisms.
 - (b) Assess answer based on how the learners are able to link chemistry knowledge in the industrial production of fertilizers.
 - (c) Let learners demonstrate that they know how to choose quality fuel for vehicles
 - (d) Application of Chemistry in the manufacture of medicines must be brought out clearly.

1.3 The chemistry laboratory

Work to do: Refer to pages 5 of learner's book

In groups

- Introduce the lesson by emphasizing that chemistry is majorly studied in the laboratory
- Guide learners to answer the questions in the work to do. This will enhance their critical thinking and problem solving skills. They should appreciate the importance of the different parts of the laboratory.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation and listening

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

b. Conversation

Ask learners probing questions to test their knowledge and understanding on the importance of learning chemistry in the laboratory.

c. Product

Appraise each learner on:

- Their understanding of the different parts of the laboratory and their uses.

Laboratory safety rules and regulations

Activity 1.5: Refer to page 7 of learner's book

Answers

1. A
2. Learners should mention some of the laboratory safety rules in case of chemical spill or one of the glassware breaks.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation and listening

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

b. Conversation

Ask learners probing questions to test their knowledge on importance of the laboratory safety precautions.

c. Product

Appraise each learner on:

- Their understanding of how to apply the laboratory rules in case of an emergency.

Laboratory safety symbols and their meaning

Activity 1.6: Refer to page 7 of learner's book

In groups

- Introduce the lesson by reminding learners the need to observe laboratory rules so as to avoid dangers and risks associated with laboratory reagents and apparatus.
- Remind learners that laboratory precautions and labels are meant to improve safety in the laboratory.
- Allow learners to draw the safety symbols on pieces of manila paper.
- Allow them to link the importance of road signs and rules with those of the laboratory.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation and listening

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

b. Conversation

Find out if learners can interpret other warning signs by asking diagnostic questions. This is to test their knowledge and understanding of the safety symbols.

c. Product

Appraise each learner on:

- Their understanding of how to interpret the laboratory safety rules.

Laboratory apparatus

Activity 1.7: Refer to page 10 of learner's book

In pairs

- Introduce the lesson by mentioning that the equipment used to carry out experiments are known as apparatus.
- The learners should appreciate the relevance of studying apparatus in their daily lives by doing activity 1.7.
- Let learners appreciate the fact that many of the apparatus used in the laboratory are also useful in daily life.
- After their research in work to do, put the apparatus you brought for study on the table, ask the learners to mention what they are and what they are used to measure.

- Put more emphasis of the apparatus to avoid expenses incurred in replacing new sets some of which are expensive. Let the learners name such apparatus.
- Use a chart to emphasize uses of some laboratory apparatus.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation and listening

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

b. Conversation

Ask learners diagnostic questions in the course of the lesson to gauge their knowledge and understanding of the laboratory apparatus and their uses. Allow them to share with rest of the class.

c. Product

Appraise each learner on:

- Their vigilant and precautionary actions while handling the laboratory apparatus.

Source of heat in the laboratory

Work to do: Refer to page 13 of learner's book

As a class

- It is important that learners appreciate the fact that cost and environmental impact are factors to consider when describing the kind of heat source they use at home and in school.
- Allow learners to suggest the most suitable source of heat to use in the laboratory. Let them share their answers with the class.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation and listening

During class discussion observe and listen to each and every learner contribution to the discussion. Check for tolerance to others views, commitment and engagement.

b. Conversation

Ask learners probing questions to test their knowledge on the sources of heat that can be used in the laboratory.

c. Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of the different heat sources to choosing the appropriate fuel to use while at home.

The Bunsen burner

Activity 1.8: Refer to page 14 of learner's book

In pairs

- Start by mentioning the importance of heat in changing the properties of substances hence it's necessary while carrying out many experiments.
- Mention a brief history of the Bunsen burner and why it is the most preferred source of heat in the laboratory.
- Allow learners to do activity 1.8. let them come up with suggestions for the use of the different parts.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners share responsibilities.

b. Conversation

Ask learners probing questions to test their knowledge of other sources of heat and how to assemble the Bunsen burner

c. Product

Appraise each learner on:

- Their acquired skills on how to assemble the Bunsen burner.

How to light a Bunsen burner

Activity 1.9: Refer to page 15 of learner's book

In pairs

- Let learners know that the Bunsen burner is lit following a particular set of instructions just as other sources of heat we use at home.
- Guide learners as they carry out activity 1.9. You can start by demonstrating how to light the Bunsen burner. Let them appreciate that extra care is important when lighting a Bunsen burner to prevent any injuries.
- Allow learners to also appreciate the fact that the different sources of heat used at home must be lit in a particular way to avoid occurrence of accidents.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners share responsibilities.

b. Conversation

Ask learners oral questions during the course of the lesson to gauge their knowledge and understanding of how different sources of heat are lit.

c. Product

Appraise each learner on:

- Their acquired skill on how to light a Bunsen burner.

Answers to check your progress 1.2: Refer to page 16 of learner's book

1. The answer here should show that the learner is now vigilant and is ready to act in case of an emergency
2. The learners should bring out the importance of First Aid and reporting to the technician any incident that occurs in the laboratory.
3. Learners should remember the need to inform the laboratory technician before attempting any experiment in the laboratory.
4. Mark and award accordingly.
5. Let the learners give the precise functions of the parts mentioned.

Flames of the Bunsen burner

Activity 1.10: Refer to page 16 of learner's book

In groups

- Introduce the lesson by asking learners to describe the kind of flames produced by the sources of heat used at home.
- Let learners know that there are two kinds of flame produced by the Bunsen burner.
- Let them appreciate the fact that the kind of flame produced depends on whether the air hole is open or closed.
- Allow each group to share their drawings with the class. Let them then compare their drawings with the drawings in the chart you have provided.
- Lead learners in discussing the different parts of the Bunsen burner flames. It is important that learners understand why luminous flame produces soot.
- Allow them to discuss why and share their thoughts with the class. Let them then compare their thoughts and to theoretical reasons that you will tell them as illustrated in their books.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

During class presentation, check for support from group members towards their representative.

b. Conversation

Ask learners probing questions to test their knowledge on how to apply the knowledge of different flames of the Bunsen burner while at home.

c. Product

Appraise each learner on:

- Their understanding of how to interpret the different flames of the Bunsen burner

Determining the type of flame that produces most heat

Activity 1.11: Refer to page 17 of learner's book

In groups

- Introduce the activity by emphasizing on the need to use the suitable flame when heating substances to be able to get the desired results.
- Allow learners to appreciate the fact that the two kinds of flames produced by the Bunsen burner have different heating effect.
- Allow them to predict which flame will heat the water faster and reasons why they think so.
- Lead the learners in discovering the fact that the non-luminous flame is the most preferred flame used for heating in the laboratory
- Guide the learners after the activity in discussing the different parts of the flames and lead them to discovering the hottest part of the non-luminous flame

Difference between luminous and non-luminous flames

Table 1.2: Refer to page 18 of learner's book

Luminous flame	Non-luminous flame
Large and steady	Short and steady
Produces soot	Does not produce soot
Burns quietly	Burns with a roaring noise
Fairly hot	Very hot
Has 4 regions	Has 3 regions

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner contribution to the discussion as you go to each group. Check whether learners share responsibilities.

b. Conversation

Ask learners oral questions to test their knowledge and understanding on the type of flame that can be used to heat substances in the laboratory.

c. Product

Appraise each learner on:

- Their understanding of how to use the Bunsen burner and adjust the different flames.

Answers to Check your progress 1.3: Refer to page 20 of Learner's Book

1. Let learners state at least two apparatus that can be used for heating in the laboratory.
2. Non-luminous flame.
3. Incomplete combustion of carbon particles due to insufficient air.
4.
 - i. Pipette
 - ii. Preparing accurate volumes of liquids
 - iii. Holding small quantities of substances while heating.
 - iv. Separating funnel

1.4 Separating mixtures and compounds

Activity 1.12: Refer to page 21 of learner's book

In pairs

- Let learners know that many things that we use in daily life are mixtures.
- Allow them to carry out activity 1.12
- It is important at this point that learners understand that there are some mixtures that can be easily separated while others require specific methods to separate.
- You can ask them to share with the class what they think mixtures are. Let them compare their answers to the definition you will give them.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with their partners.

b. Conversation

Ask learners probing questions to test their knowledge on how to apply the knowledge of separation in their daily life.

c. Product

Appraise each learner on:

- Their understanding of how to apply the separation methods in their daily life.

Methods of separating mixtures

Work to do: Refer to page 21 of learner's book

As a class

- Introduce the lesson by mentioning the fact that some materials are only not useful in combined states hence the need for separation.
- Allow learners to list the different methods of separating mixtures.

Filtration

Activity 1.13: Refer to page 22 of learner's book

In groups

- Begin by asking learners to state some of the properties of components that can determine separation technique.
- Guide them as they carry out activity 1.13.
- Let learners now share their answers on what they think filtration is. Allow them to compare their answers with the one that you will give them.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

b. Conversation

Ask learners probing questions to test their knowledge on how to apply the knowledge of filtration to their daily life

c. Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of filtration to their daily life activities.

Decantation

Activity 1.14: Refer to page 23 of learner's book

In groups

- Begin by asking learners how they would separate a mixture of sand and water. Let them share their answers with the class.
- Let learners appreciate that decantation can be used as a cost cutting method of separating substances while at home.
- Guide them to do activity 1.14 in learners' book. Ask learners probing questions like; why was the mixture stirred? Why was the mixture allowed to settle at the bottom of the beaker? This will enhance their critical thinking.
- Let learners appreciate the fact that decantation is applied in our daily life.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

Check also whether they share responsibilities.

b. Conversation

Ask learners probing questions to test their knowledge on where and how decantation is applied in their daily lives

c. Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of decantation in their daily lives.

Use of separating funnel

Activity 1.15: Refer to page 25 of learner's book

In groups

- Introduce the activity by presenting learners with a challenging question of how to separate kerosene from water. This will trigger critical thinking and problem solving skills.

- Allow them to share their answers with the class. You can then emphasize that separating funnel can be used to separate liquids that are immiscible
- Discuss how to use a separating funnel to separate immiscible liquids. Demonstrate as shown in activity 1.15 in learners' book.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

b. Conversation

Ask learners probing questions to test their knowledge on where to apply the knowledge of using a separating funnel in their daily lives

c. Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of using a separating funnel in their daily life.

Answers to check your progress 1.4: Refer to page 25 of learner's book

1. Check that the learners have mentioned a mixture of low density liquid and high density liquid that do not dissolve in each other.
2. Check that learners have written the correct procedure for separating immiscible liquids.
3. The salt solution dissolves in water.
4. The boiling point increases due to the presence of the non-volatile solute.

Simple distillation

Activity 1.16: Refer to page 26 of learner's book

In groups

- Begin by allowing learners to brainstorm on how alcohol is manufactured to trigger critical thinking.
- Let learners discuss their finding with the rest of the class. Let them appreciate that alcoholic drinks are manufactured through distillation.

- You can then ask learners how they would separate salt from water. Allow them to share their thoughts and methods.
- Briefly explain the process of simple distillation and let learners understand what simple distillation is.
- Guide learners to carry out activity 1.16. let them appreciate the fact that simple distillation can be used as a way of making salty water fresh.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

During class presentation, check for support from group members towards their representative.

b. Conversation

Ask learners probing questions to test their knowledge on where to apply the knowledge of simple distillation

c. Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of simple distillation in their daily life to separate substances.

Fractional distillation

Activity 1.17: Refer to page 27 of learner's book

In groups

- Introduce the activity by reminding learners of simple distillation process.
- Bring to the attention of learners that unlike simple distillation, fractional distillation is used to separate miscible liquids that have close but different boiling points.
- Briefly explain the fractional distillation process and guide learners as they carry out the activity.
- Challenge learners to suggest more places where this separation technique is carried out. Allow them to share with the class.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

During class presentation, check for support from group members towards their representative.

b. Conversation

Ask learners probing questions to test their knowledge on where to apply the knowledge of fractional distillation.

c. Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of fractional distillation.

Paper chromatography

Activity 1.18: Refer to page 28 of learner's book

In groups

- Introduce the activity by giving a crime related case study to trigger their interest and critical thinking skills.
- Bring to the attention of learners that paper chromatography can be used in identifying suspects in a crime scenario. Encourage learners to think of other areas where the technique can be applied.

Expected answers

Testing for performance enhancing drugs in athletes

Checking the level of pesticides, fungicides and contaminants in food and water.

Creating vaccinations

- Briefly explain the chromatography process and let learners understand what chromatography is.
- Let learners carry out activity 1.18. engage learners by asking questions like; why was propanone and not water used? Why did the dyes travel different directions?

Expected answers

Propanone is a good solvent it dissolves the pigments.

Also it is able to travel up the paper to allow separation of the pigments. Water travels slowly and the resolution between the pigments is less unlike propanone where greater amount of resolution is achieved.

- Allow learners to share their answers with the class. Let them compare their answers to the theoretical knowledge.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

During class presentation, check for support from group members towards their representative.

b. Conversation

Ask learners probing questions to test their knowledge on how to apply the knowledge of interpreting a chromatogram to solving crimes.

c. Product

Appraise each learner on:

- Their understanding of how to use chromatography to solve crimes.
- Their acquired skills on how to interpret a chromatogram.

Saturation

Activity 1.19: Refer to page 30 of learner's book

Crystallisation

Activity 1.20: Refer to page 30 of learner's book

In groups

- Begin by asking learners what a crystal is. You can then explain to them what it is. Let them compare their answers to your explanation.

- Let learners know that crystals are formed from saturated solutions.
- Briefly explain to learners what saturation is. Let them understand the process.
- Guide them as they do activity 1.19 and activity 1.20. they should then leave it in a safe place for observations to be done later.
- Ask learners to write a report about their findings of activity 1.20 and present to the class.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

During class presentation, check for support from group members towards their representative.

b. Conversation

Ask learners probing questions to test their knowledge on how to form crystals from a saturated solution.

c. Product

Appraise each learner on:

- Their acquired skill on how to form crystals.

Evaporation

Activity 1.21: Refer to page 31 of learner's book

In groups

- Bring to the attention of learners that evaporation is accompanied by other techniques such as filtration.
- Briefly explain evaporation and let learners understand the process.
- Guide learners to do activity 1.21. ask them to predict what might happen to the mixture when heated.
- Allow them to compare their answers to their practical results.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

During class presentation, check for support from group members towards their representative.

b. Conversation

Ask learners probing questions to test their knowledge on how to apply the evaporation technique in their daily lives.

c. Product

Appraise each learner on:

- Their understanding of where to apply the knowledge of evaporation in their daily lives.

Sublimation

Activity 1.22: Refer to page 32 of learner's book

In groups

- Briefly explain to learners what sublimation is and let them understand the process.
- Let them carry out activity 1.22.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

b. Conversation

Ask learners probing questions to test their knowledge on how to apply sublimation technique in their daily lives.

c. Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of sublimation in their daily lives.

Other methods of separation

Refer to pages 33 of learner's book

In groups

- Bring to the attention of learners that magnetic separation can be used to remove magnetic materials from non-magnetic objects. Encourage learners to think of other areas where this technique can be applied.
- Briefly explain centrifugation and let learners understand what it is.
- You can also explain to them that it is used to separate urine components just like in their books. You can also bring a chart with pictures of the separation steps so that you show the learners.
- Allow learners to explain how they would separate a mixture of maize and beans.
- Let them know that the method of separating maize and beans is known as hand picking.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

b. Conversation

Ask learners probing questions to test their knowledge on how to apply acquired knowledge in their daily lives

c. Product

Appraise each learner on:

- Their understanding of how to use a centrifuge and where it used.

Answer to Check your progress 1.5: Refer to page 34 of learner's book

1.

- (a) The water contains magnesium, sodium and calcium ions.
- (b) Boiling or addition of Sodium carbonate.

2.

- (a) Evaporation
- (b) Evaporation
- (c) small stones

3. Chromatography can be used to separate a mixture that contains any number of components, very small quantities of substances can be effectively detected and separated from a mixture.
4. Solving parental disputes
- 5.

Tea leaves and tea	Filtration
Pulses and stones	Sorting
Mud and water	decantation

6. Saturation is the point at which a solute cannot dissolve into a solution.
Check that learners have listed the crystallization steps correctly.
7. Check that learners have listed the evaporation process.

Activity 1.23: Refer to page 34 of learner's book

In pairs,

- Learners should classify the substances provided as either mixtures or compounds.
- They should then identify the components that each substance contains.

1.5 Application of separation of mixtures and compounds

Activity 1.24: Refer to page 35 of learner's book

In groups

- Begin by asking learners probing questions about petroleum products and their importance like;

What is the origin of hydrocarbons?

Why do we have different types of fuel i.e. petrol, oil, diesel, jet fuel, kerosene? How are they obtained?

- From the responses, introduce activity 1.24 in learners' book. These are activities intended to bring out the idea of the origin of crude oil and the fractional distillation of crude oil.
- Let learners do some research on the origin of crude oil. Allow them to write a report and share their findings with the class.
- Build on their findings to explain the origin of crude oil as outlined in the learners' book.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

During class presentation, check for support from group members towards their representative.

Check whether they share responsibilities.

b. Conversation

Assess learners' knowledge and understanding by asking questions such as; what is fractional distillation? Why is it used in the separation of crude oil? What are the different components of crude oil and their uses?

c. Product

Appraise each learner on:

- Their understanding of how and why crude oil is separated.
- Their acquired knowledge on the uses of the different components of crude oil in their daily lives.

Answer to check your progress 1.6: Refer to page 38 of learner's book

1.
 - (a) To separate crude oil into useful substances.
 - (b) The hydrocarbons have different boiling points.
 - (c) Learners should be able to explain how crude oil is separated using fractional distillation method.
 - (d) Check the learners work, the laboratory procedure for fractional distillation
- 2.

Compounds-homogenous substance, pure substance, separated by chemical methods such as distillation and chromatography	Mixture- homogenous or heterogeneous, impure substance, separated by physical method
---	--

3. High temperature and high pressure.
4. To separate crude oil and to separate oxygen and nitrogen from air to be used industrially.

Answers to Unit-test 1.1 Refer to learners book page 39-42

1.
 - (a) Luminous and non-luminous flame.
 - (b) **X**- thin outer region, **Y**- blue region, **Z**- yellow region, **W**- almost colourless region
 - (c) Check that learners have listed the differences correctly.
 - (d) Learners should describe activity 1.10 page 16 of learner's book
2. To allow easy observation
3. The learner must provide the precise apparatus used in each case.
4. Mark and award marks appropriately.
5. Let the learners display their understanding of laboratory rules.
6. Table salt and drinking water.
7. Copper is a pure substance while common salt and tap water are mixtures.
8. Simple distillation
9. Learners should explain the application of centrifugation which is applied in this context.
10. Use evaporation technique.
11. Sublimation.
12. It is a false statement. Milk contains a number of components such as dissolved vitamins, mineral salts and fats.
13.
 - a) Solvent front
 - b) Mixture
 - c) Propanone, ethanol
 - d) C is the most soluble and least retained whereas A is the least soluble.
14. Evaporation method. Check learners' work on the crystallization procedure.
15.
 - a) Check that learners have the correct diagram for fractional distillation method.
 - b) Check labels, glass beads provide a large surface area for the rising vapour and condensation.
 - c) Ethanol is collected first.
 - d) It has a lower boiling point therefore it vaporizes and condenses first.
16. Oxygen, water vapour
17. Check whether the learner is able to recognize the close association of Biology and Chemistry and their importance in the field of medicine.

18. V

- (a) Sublimation is a chemical process where a solid turns into a gas without going through a liquid state whereas evaporation is the process by which water changes from liquid to vapour.
- (b) Fraction distillation is a method used to separate a mixture whose boiling points are close to each other whereas simple distillation is used to separate miscible liquids with different boiling points.
- (c) Miscible liquids form homogenous mixture whereas immiscible do not.
- (d) Decantation is a method used to separate liquids from solids of different densities whereas filtration is separation using a funnel.
- (e) Crystallization is the method of obtaining crystals from a saturated solution whereas centrifugation is used in separating mixtures by spinning it at a high speed in a test tube, the solid then settles at the bottom of the test tube.

19.

- (a) The learner should explain how vaccines are important especially in reducing infant mortality thus helping in cutting expenditure on health.
- (b) The increase in harvest due to application of fertilizers in farming should be brought out clearly.
- (c) Efficient transport and communication system allows faster delivery of goods and services the consumer.

20. Ensure all the parts of the report are tackled. Award marks accordingly.

21. Assess learners' knowledge on water treatment process from their answers.

22. C

UNIT 2

Particulate nature of matter, formulae and chemical equations

Refer to Learner's Book pages 43-81

Learn about		Key inquiry questions
<p>Learners should build on what they already know about materials and their properties. They should understand the particulate nature of matter as well as their inter conversion between states of matters in terms of kinetic particle theory and investigate practically the effect of heat on matter and the movement of particles in liquid and gaseous states. (The treatment of Brownian motion is not required).</p> <p>Learners should secure understanding of constructing formulae and chemical equations. They should deduce the formulae of simple and ionic compounds from the relative numbers of atoms and the charges on the ions present, and vice versa. They should construct chemical and ionic equations.</p>		<ul style="list-style-type: none"> How does kinetic theory explain particulate nature of matter? How can we explain chemical reactions in terms of numbers and symbols?
Learning outcomes		
Knowledge and understanding	Skills	Attitudes
<ul style="list-style-type: none"> Understand particulate nature of matter, formulae and chemical equations 	<ul style="list-style-type: none"> Investigate practically the effect of heat on matter Deduce the formulae of simple and ionic compounds from the relative numbers of atoms Investigate practically using appropriate specialist equipment Recording results accurately and in an appropriate way Analysis of the result and looking for patterns 	<ul style="list-style-type: none"> Take responsibility in group work Appreciate explanations of chemical reactions using chemical equations. Be aware of risk and safety to themselves and others
<p>Contribution to the competencies: Communication: communicate information through discussion Co-operation: working together to use appropriate apparatus and suggest experimental procedures, drawing conclusion from evidence, using a variety of measuring devices Critical thinking: setting up electrical circuits, predicting outcome based on present evidence</p>		
<p>Links to other subjects: Physics: particle theory</p>		

Introduction to the Unit

This unit is about the change of state of matter. The activities will help learners to understand that many things in the environment have matter. The substances change from one form to the other under different conditions.

The different activities focus on the changes of matter in nature. This should motivate learners and help them change their attitude towards experiments and presentation of findings.

Competencies to be attained

- Co-operation and interpersonal skills – as learners interact in pairs and engage in class discussion.
- Communicating – as learners discuss and share their answers with the class.
- Critical thinking – As learners think about their findings in the activities and work to do.

Cross-cutting issues

Peace, value and gender Education

Let the learners see the need to accommodate other people's views in a discussion

2.1 The states of matter

Work to do: Refer to pages 43 of learner's book

In groups

- Let learners appreciate the fact that many substances around us can be referred to as matter.
- Now you can define the meaning of matter to the whole class.
- Let learners appreciate the fact that substances undergo changes if subjected to certain conditions.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

During class presentation, check as learners share responsibilities.

b. Conversation

Ask learners probing questions to test their knowledge and understanding on the fact that everything around us is made up of matter.

c. Product

Appraise each learner on:

- Their understanding that matter occurs in three states.

Answer to Check your progress 2.1: Refer to page 44 of learner's book

1. Solid, liquid, gas

2.

(a) The learner to mention things like light and electricity.

(b) They do not have weight.

2.2 Changes of states of matter

Activity 2.1: Investigating melting Refer to page 45 of learner's book

In groups

- Introduce the lesson by asking the learners to name the different states of matter. This will act as a precursor to the change of states of matter.
- Let learners name some of the things that they know can change their form.
- Let learners carry out activity 2.1. guide them as they answer the activity questions in work to do.
- Allow learners to share their answers with the class
- Emphasize on the importance of putting off the Bunsen burner when not in use to save energy.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

During presentation, check for support from group members towards their representative.

b. Conversation

Ask learners probing questions to test their knowledge on the changes of state of matter when subjected to certain conditions.

c. Product

Appraise each learner on:

- Their understanding of how the states of matter can change.

2.3 Physical and chemical changes of matter

Activity 2.2: Investigating changes that occur when ice is heated

Refer to page 46 of learner's book

Activity 2.3: Investigating melting and sublimation

Refer to page 49 of learner's book

Activity 2.4: Investigating physical changes

Refer to page 51 of learner's book

In groups

- Introduce the lesson by stating that matter undergoes two types of changes.
- Tell learners that when matter undergoes change, it can form a new product or no new product can be formed.
- Let learners carry out activities 2.2, 2.3 and 2.4 in learners' book
- Guide the learners as they answer the work to do in the activities. This will enhance their critical thinking and problem solving skills.
- Let learners appreciate the fact that physical change does not lead to formation of new substances.
- Emphasize on the need to take care while heating substances. Learners should display mastery of laboratory rules as the experiment proceeds.

Assessment opportunity

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

During presentation, check for support from group members towards their representative.

b. Conversation

Ask learners questions to assess whether they have acquired curiosity in exploring physical phenomena in their daily lives. This will also help you in assessing their attitude towards changes of state in matter in relation to financial management especially for those products at home that can undergo physical changes if not well stored.

c. Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of physical change of matter to their daily lives.

Chemical changes

Activity 2.5: Refer to page 53 of learner's book

In groups

- Introduce the lesson by stating the fact that unlike the physical change, chemical changes lead to the formation of new products
- Let the learners appreciate the application of this sub unit in real life by carrying out activity 2.5 in learners' book.
- Guide learners to answer the work to do questions in the activities. This will enhance their critical thinking and problem solving skills.
- Allow them to share their answers with the class.
- Let learners appreciate the fact that some substances undergo change to form new products.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

During class presentation, check for support from group members towards their representative.

b. Conversation

Assess knowledge and understanding from the way learners answer the questions on work to do.

c. Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of chemical changes in their everyday lives.

Answer to check your progress: 2.2 Refer to page 54 of learner's book

1. To prevent it from melting.
2.
 - i. Chemical
 - ii. Physical
 - iii. Chemical
3.
 - i. Yellow, white, Physical change
 - ii. Purple gas, solid iodine, sublimation
4. Check that learners have gotten the correct difference in chemical and physical changes.
5. a.True b.False c.True d.True
6.
 - i. chemical change because the banana is ripening, there's change in colour and texture
 - ii. fermentation will have taken place, that's a chemical process.

2.4 and 2.5 Kinetic theory of matter

Activity 2.6: Investigating movement of particles Refer to page 55 of learner's book

In groups

- Introduce the lesson by explaining that matter consist of particles arranged in a particular way.
- Mention that the arrangement of particles in different states of matter is due to inter-particle forces between them. The forces determine the movement of the particles.
- Use the chalkboard for illustrate this explanation.
- Provide learners with bottles and marbles so that they can demonstrate the three states of matter following procedure in activity 2.6.
- Allow learners to share their summary report from the activity with their class.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

During presentation of the report, check for support from group members towards their representative.

b. Conversation

Ask learners probing questions to test their knowledge and understanding on kinetic theory. This is also to assess whether they have developed confidence in the kinetic theory.

c. Product

Appraise each learner on:

- Their acquired skills on how to draw and describe the arrangement of particles in solids, liquids and gases.
- Their understanding as to why certain substances they come across in their daily lives that have specific characteristics applying the knowledge of kinetic theory.

Answer to Check your progress 2.3: Refer to page 57 of learner's book

1.
 - a) melting
 - b) freezing
2. check that learners have correct diagrams for solid, liquid and gases.
3.
 - (i) **PR** – Temperature increases. Heat energy supplied increases the kinetic energy of solid particles making them to vibrate faster.
 - (ii) **QR** – Temperature remains constant. Heat energy supplied is used to break the inter-particle forces of attraction holding the solid particles together. The solid thus melts.
 - (iii) **RS** – Temperature increases. Heat energy supplied increases the kinetic energy of the liquid particles. They thus vibrate faster.
 - (iv) **ST** – Temperature remains constant. Heat energy is used to break the inter-particle forces of attraction holding the liquid particles together. The liquid thus evaporates changing to gas.

Diffusion

Work to do: Refer to page 58 of learner's book

As a class

- Allow learners to link the movement of gas particles to diffusion resulting in compost pits and pit latrines being built a distance away from the school and home.

Activity 2.7: Investigating diffusion

Refer to page 58 of learner's book

Activity 2.8: Investigating diffusion in gases

Refer to page 59 of learner's book

In pairs

- Allow learners to carry out activities 2.7 and 2.8 in learners' book.
- Challenge learners by asking them to give more examples where diffusion takes place.
- Allow learners to predict on what will happen in both activities. Let them then compare their predictions to their practical results.
- Allow them to share with the class the reasons why they think that occurred in each activity.
- Let them appreciate the fact that diffusion is due to movement of particles from a region of high concentration to a region of low concentration.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly to other group members.

During class presentation, check for support from group members towards their representative.

b. Conversation

Ask learners probing questions to test their knowledge and understanding on the factors that affect diffusion. They can then relate this to their daily lives.

c. Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of diffusion in their daily lives whenever they can feel certain smells from a distance.

Brownian motion

Work to do: Refer to page 60 of learner's book

In pairs,

- Begin by asking learners to observe what happens to the pollen grains when put in a container that contains water.
- You can then explain to them what Brownian motion is and how it came about.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with their partners.

b. Conversation

Ask learners probing questions to assess their attitude towards Brownian motion. This is also to test their knowledge and understanding on how to apply the Brownian motion theory on their daily lives.

c. Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of Brownian motion to their daily lives.

Answer to Check your progress 2.4: Refer to page 61 of learner's book

1. The learners should draw well labelled setups to demonstrate diffusion.
2. Let application of diffusion be brought out clearly.
3. Learners must be able to compare movement of particles in air and liquid.
4. Learner should link the explanation to Brownian motion.
5. Increase in temperature results in increase in pressure causing the fine powder to dissolve in water.

6. Ammonia gas has less dense particles therefore its particles move faster than those of concentrated hydrochloric acid.

2.6 Definition of elements, atoms and molecule

Activity 2.9: Refer to page 62 of learner's book

As a class

- Introduce the lesson by asking the learners to remember what matter is.
- Allow learners to carry out activity 2.9 in learners' book. Let them appreciate the fact that the atom is the smallest particle into which an element can be divided without losing its properties.
- Briefly explain the meaning of atom, element and a molecule and let the learners understand what they mean.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the class discussion observe and listen to each and every learner's contribution to the discussion. Check whether learners articulate and share their ideas clearly with other class members.

b. Conversation

Ask learners oral questions to assess knowledge and understanding. This will also help in assessing their attitude towards the role that an atom as a building unit of matter and its uniqueness.

c. Product

Appraise each learner on:

- Their understanding of atoms, elements and compounds.

2.7 Symbols of chemical elements

Work to do: Refer to page 63 of learner's book

As a class

- Introduce the lesson by use of a guided discovery to enable learners to create linkage between specific names of people and symbols of elements.
- Bring to the attention of learner's that just like names are specific to people, symbols too are specific to elements.
- Briefly guide learners in writing symbols of some chemical elements.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the class discussion observe and listen to each and every learner's contribution to the discussion. Check whether learners articulate and share their ideas clearly with their class members.

b. Conversation

Ask learners diagnostic questions during the lesson such as writing chemical symbols of random elements in the periodic table to assess knowledge and understanding. You will also be able to assess their attitudes by finding out if they appreciate the use of symbols in representing elements.

c. Product

Appraise each learner on:

- Their acquired skill in writing the symbols of different chemical elements.
- Their understanding of how to apply the knowledge of chemical symbols while in the laboratory.

Answer to check your progress 2.5: Refer to page 64 of learner's book

1. An atom is the smallest particle of an element.
2. An element is a type of matter composed of atoms that all have the same atomic number whereas a molecule is the smallest particle of a substance that retains the chemical and physical properties of the substance and is composed of two or more atoms.
3. Check that learners are conversant with the 20 elements.

2.8 Main components of an atom

Refer to page 65 of learner's book

As a class

- Introduce the lesson by guiding learners towards understanding the components and the arrangement in an atom. Try to create a picture of the arrangement of the components of the atom by the use of an orange.
- Briefly highlight the components of the atom, their relative masses and charges.
- Ask learners to point out the differences and similarities among the sub-atomic particles.

2.9 Atomic characteristics Refer to page 65 of learner's book

As a class

- Allow learner to remind themselves of the components of the atom.
- Briefly explain the meaning of proton number, atomic number and mass number.
- Let learners internalize the symbols of the atomic number and mass number.
- Guide learners in finding the number of neutrons, protons in given examples.

Answer to Check your progress 2.6: Refer to page 67 of learner's book

1. $A=Z+N$ (learners must use the formula to calculate the mass number of carbon atom).
2. $N=A-Z$ (learners must use the formula to calculate the number of neutrons in calcium atom).

2.10 Electronic configuration

Work to do: Refer to page 67 of learner's book

As a class

- Introduce the lesson by simulation i.e. guided discovery to enable learners understand how the electrons are arranged in the energy levels. Use the analogy of the atomic 'city' where there are 3 neighbourhoods:
 - 1st neighbourhood – has one low cost stone house only
 - 2nd neighbourhood – has four middle cost stone houses only
 - 3rd neighbourhood – has one high cost stone house only

All these houses must be built away from the city centre. The further away they are from the city centre the more expensive the houses are. From the atomic cities vocabulary list, houses are settled according to wealth and the ability to pay higher. Therefore, wealth increases as we move from the city centre

The city plan is as follows:

City = atom

People = electrons

Neighbourhood = energy levels

Wealth = energy

City centre = nucleus

- Introduce work to do, guide learners as they create a model of an atom.

- Let learners understand that there are unique energy levels which carry more than the expected number of electrons.
- Guide learners in writing electronic configuration of some of the elements.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the class discussion observe and listen to each and every learner's contribution to the discussion. Check whether learners articulate and share their ideas clearly with other class members. Check also whether they share responsibilities.

b. Conversation

Ask learners probing questions to test their knowledge on how to write the electronic configuration of elements.

c. Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of electronic configuration to write the electronic configuration of the 20 elements in the periodic table.

Answer to check your progress 2.7: Refer to page 71 of learner's book

1. Understanding the meaning of elements and compounds will enable the learner to classify the substances.
2. Mastery of chemical elements is required for the learner to answer this question correctly.
3.
 - (a) Pb is the symbol of Lead
 - (b) Lead is poisonous
 - (c) Recycling
4. Check that learners have the correct diagram on electron arrangement of fluorine 2.7 and aluminium 2.8.3.
5. Check that learners have correctly calculated the number of protons, neutrons and electrons of each element. Check also the formula used. (Refer to page 66 of learner's book for the formulas).

2.11 Elements and compounds Refer to page 71 of learner's book

As a class

- Let learners recall the meaning of atom and molecule as you introduce the lesson.
- Bring to the attention of learners that the atoms of an element makes up a molecule and different atoms may combine to form compounds
- Briefly explain the meaning of elements and compounds.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the class discussion observe and listen to each and every learner's contribution to the discussion. Check whether learners articulate and share their ideas clearly with other class members.

b. Conversation

Ask learners probing questions to test their knowledge on the difference between elements and compounds. Assess whether they appreciate the fact that molecules can be compounds but compounds cannot be molecules.

c. Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of compounds and elements to classify a list of substances they use in their daily lives.

2.12 Formation of ions Refer to page 71 of learner's book

As a class

- Begin by letting learners know that atoms react so that they can attain stability.
- Introduce the concept of noble gas electronic configuration.
- Briefly explain the meaning of the terms ionization energy, electron affinity, cations and anions.
- Let learners internalize the concept of noble gas electron configuration by doing more examples.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the class discussion observe and listen to each and every learner's contribution to the discussion. Check whether learners articulate and share their ideas clearly with other class members.

b. Conversation

Ask learners to illustrate ion formation to assess knowledge and understanding and skills acquisition.

c. Product

Appraise each learner on:

- Their understanding of need of to share in order for atoms to gain stability.

Answer to Check your progress 2.8: Refer to page 73 of learner's book

1. Duplet implies the state of an atom having 2 electrons in the outermost energy level while octet is when an atom has 8 electrons in the outermost energy level.
2.
 - (a) 2.8
 - (b) Mass number-20; atomic number-10
 - (c) Mass number - atomic number (20-10) =10
 - (d) Atomic number – number of protons in the nucleus of an atom; mass number – total number of protons and neutrons.
3. Refer to page 73 of learner's book. Check that learners have used the examples provided to come up with the ion formation of aluminium.
4. Isotopes. This is because they have same atomic numbers but different mass numbers.
5. (a) $A - Z$ (27 - 13) = 14
 - (b) 13
 - (c) 2.8.3
- 6.

Sub atomic particle	symbol	charge	Location
electron	e-	-1	Outside nucleus
neutron	n	0	Nucleus
protons	p	+1	nucleus

7. Easy identification.

2.13 and 2.14 Radicals and valence of elements Refer to page 73-74 of learner's book

As a class

- Begin the lesson by asking learners to illustrate how ions are formed using the knowledge acquired from the previous lesson.
- Let learners appreciate that atoms can occur in groups, each group having its charge. In this state, they are called radicals
- Guide learners in discussing radicals and giving more examples this way, their co-operation and interpersonal skills are improved.
- Let learners state valencies given radicals.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the class discussion observe and listen to each and every learner's contribution to the discussion. Check whether learners articulate and share their ideas clearly with other class members.

b. Conversation

Ask learners probing questions to test their knowledge and understanding of valencies and radicals. Also, to assess their attitudes by finding out if they appreciate the fact that it is the valence electrons that actually take part in a reaction.

c. Product

Appraise each learner on:

- Their acquired skill of representing atoms of certain elements using their symbols, atomic numbers and mass numbers.

2.15 Chemical formulae and nomenclature

Activity 2.9: Refer to page 74 of learner's book

Combining power of non-metals

Refer to page 76 of learner's book

In groups,

- Introduce the lesson by asking the learners to explain why atoms lose or gain electrons as previously learnt.
- Emphasize the fact that although atoms attain stability after losing or gaining electrons, they become electrically charged and can bond with atom of the opposite charge hence forming chemical formulae.
- Guide the learners in discussing how chemical formulae of different compounds are formed. Use chalkboard for illustrations.
- Give learners more questions and ask them to write their chemical formulae.
- Allow learners to discuss their findings with the class.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

Check whether they share responsibilities.

b. Conversation

Ask learners to write chemical formulas of certain elements to assess their knowledge and understanding.

c. Product

Appraise each learner on:

- Their acquired skills in writing chemical formulas.

Writing simple balanced chemical equation Refer to page 77 of learner's book

As a class,

- Begin by reminding learners that writing the correct formulae is a good foundation for writing balanced equations.
- Inform learners that an equation is used to describe a reaction and the balancing part of the equation simply describes the amount of reactants used and the amount of products formed.

- It is also important to remind learners that the arrow sign indicates formation of a product and the plus sign means “reacts with”. You can show this by using an example from the learner’s book.
- Familiarize learners with the notations used in equations to describe the states of reactants and products in a chemical reaction as shown in table 2.10 in the learner’s book.
- Let learners know that equations without this state symbols do not have enough information.
- Remember that this is one of the topics that learners believe to be difficult. Balancing of equations is very important in chemistry. When learners do not understand this, they have problems in every topic because there is no part in chemistry where chemical equations are not required.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the class discussion observe and listen to each and every learner’s contribution to the discussion. Check whether learners articulate and share their ideas clearly with their class members. Check on their confidence as they ask questions where they do not understand.

b. Conversation

Ask learners probing questions to test their knowledge on how to write and balance chemical equations.

c. Product

Appraise each learner on:

- Their acquired skill on how to write correct and balanced equations.

Answers to Unit Test 2.1 Refer to page 80 of learner’s book

1.

Cation/anion	OH ⁻	SO ₄ ²⁻	NO ₃ ⁻	CO ₃ ²⁻
Ca ²⁺	Ca(OH) ₂	CaSO ₄	Ca(NO ₃) ₂	CaCO ₃
Na ⁺	NaOH	Na ₂ SO ₄	NaNO ₃	Na ₂ CO ₃
NH ₄ ⁺	(NH ₄)OH	(NH ₄) ₂ SO ₄	(NH ₄)NO ₃	(NH ₄) ₂ CO ₃
Cu ²⁺	Cu(OH) ₂	CuSO ₄	Cu(NO ₃) ₂	CuCO ₃
K ⁺	KOH	K ₂ SO ₄	KNO ₃	K ₂ CO ₃

2. (a) Let learners give names and not symbols.
(b) Mark correct formula only
3. C
4. C
5. Check that learners have the correct drawing of how calcium and oxygen gain stability.
6.
 - (a) 19
 - (b) $39 - 19 = 20$
 - (c) 2.8.8.1
 - (d) check learners work for correct drawings.
 - (e) Losing
7. Check learners' work for the correct definitions.
8. Check learners' books for the differentiation between solid, liquid and gaseous particles.
9. Burning splint was a permanent/chemical change because a new substance was formed which makes it irreversible. Ice went through physical change. The process is reversible.
10. Rust is a chemical change.
11.
 - (a) $\text{Zn(s)} + 2\text{HCl (aq)} \longrightarrow \text{ZnCl}_2\text{(aq)} + \text{H}_2\text{(g)}$
 - (b) $\text{CuO(s)} + \text{H}_2\text{(g)} \longrightarrow \text{Cu(s)} + \text{H}_2\text{O (l)}$
 - (c) $\text{CuCO}_3\text{(s)} + 2\text{HCl (aq)} \longrightarrow \text{CuCl}_2\text{(aq)} + \text{CO}_2\text{(g)} + \text{H}_2\text{O (l)}$

UNIT
3

Acids, bases and salts

Refer to Learner's Book pages 82-106

Learn about		Key inquiry questions
<p>Learners should build on what they already know and understand about the properties and production of acids, bases, indicators and salts, and design and perform practical experiments to investigate their properties.</p> <p>Learners should understand pH as a measure of acidity, pH scale and the use of universal indicator in determining the pH range of a given solution.</p> <p>Learners should investigate and compare properties of strong and weak acids in terms of the extent of ionisation and describe the reaction between hydrogen ions and hydroxide ions to produce water, $H^+ + OH^- \longrightarrow H_2O$, as neutralisation.</p>		<ul style="list-style-type: none"> How do you determine the acidic and basic nature of given substances? Use the universal indicator to determine the pH range of a given solution? How can you distinguish a range of salts?
Learning outcomes		
Knowledge and understanding	Skills	Attitudes
<ul style="list-style-type: none"> Understand the properties and uses of acids, bases, indicators and salts. 	<ul style="list-style-type: none"> Perform practical experiments to investigate the properties of acids, bases and salts. Investigate and compare properties of strong and weak acids. Use information to identify patterns, report trends and draw inferences. Present reasoned explanations for phenomena, patterns and relationships. 	<ul style="list-style-type: none"> Adapt behaviour to suit different situations and be aware of the need to work safely.
<p>Contribution to the competencies:</p> <p>Critical and creative thinking: through experimentation and investigation process.</p> <p>Communication: through collecting experimental data and presenting the findings to the class.</p> <p>Co-operation: in problem solving.</p>		
<p>Links to other subjects:</p> <p>Agriculture: indicators help in identifying soil pH, bases used to neutralize acidic soil, citrus fruits.</p> <p>Biology: digestion of protein and starch.</p> <p>Physics: production of electricity from car battery.</p>		

Introduction to the unit

This unit will help learners further understand acids, bases and salts. There are many opportunities within this unit for learners to improve their knowledge, communication and critical thinking. There are many discussions to be held about acidity and basicity and learners should be encouraged to communicate clearly and effectively in order to share their knowledge for the benefit of others.

Competencies to be attained

1. Co-operation

During group discussions, pair works and class works- let learners engage one another by giving a chance for all to participate. Also, you can allow rotational presentations within the group members. Further, encourage learners to be tolerant to other learners' views and to understand that people should not necessarily be right always.

2. Communication

Communication in English will be improved when learners freely participate in the discussions and presentations. Encourage all learners irrespective of their abilities to participate in the discussions, during presentations by asking questions and during question and answer sessions to either introduce or wrap up the lessons.

All learners should also be encouraged to write summary notes at the end of the lesson as this will help improve their writing skills.

3. Critical and creative thinking

This competence will be developed by learners as they answer the probing questions and as they discuss the results of the various practical activities.

This competence will also come about as learners think about their findings in the activities and as they give out their suggestions on why this is the case.

Cross-cutting issues

1. Environment awareness and sustainability.

Bring to the attention of learners the fact that acids and bases are corrosive and therefore they need to dispose the liquids and empty containers carefully to avoid environmental degradation.

2. Life Skills

Let learners understand that they can take a career in chemistry and work in factories that produce acids, bases and salts. They can work as quality assurance officers or as technical people so they should take the study in this unit seriously.

3. Peace and values education

All learners should be encouraged to participate during lessons and group activities. Special arrangements should be made to take care of learners with special needs. For example, provide braille for blind learners, large print text for those with sight problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during practical sessions.

Activity: picture discussion Refer to page 81 of learner's book

In groups

- The pictures illustrate items made from acids and bases
- It is important that before you begin the lessons, learners should be able to identify the items in the picture. It is also important that they should be able to explain the reason for their answers for each picture.

Expected answers

Car batteries are mildly acidic, gastrin- alkaline, soap- alkaline

House hold items: vinegar (acidic), baking soda (basic) etc.

3.1 Definition of acid, base, indicator and salt

Activity 3.1: Refer to page 83 of learner's book

In pairs

- Begin by cautioning learners not to eat anything in the laboratory.
- Allow them to carry out activity 3.1. let them present their findings to the class. From their presentation build up on it and help them to explain what acid, base, alkalis are. Use examples to show these.

Activity 3.2: Refer to page 85 of learner's book

In groups

- Allow learners to brainstorm on what indicators are. Let them share their findings with the class. From the presentation, contribute by explaining to them what indicators are.
- Guide learners as they carry out activity 3.2.
- Allow them to predict the colours formed by the litmus papers when immersed in acidic and basic solutions.
- Let learners compare their predictions to their practical findings.

Activity 3.3: Refer to page 86 of learner's book

In groups

- Allow learners to carry out activity 3.3.
- From the activity and the findings, ask learners what salts are.
- Let them share their answers with the class.
- You can then wind up by telling them what salts are and how salts are made.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussions the three activities, observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

b. Conversation

Ask learners structured questions to assess knowledge and understanding of whether they can describe the existence of acids and bases in nature and their uses in daily life.

This will also allow you to assess their attitudes towards the fact that acids and bases react to form salt and water.

c. Product

Appraise each learner on:

- Their understanding of the difference between acids, bases and alkalis.
- Their acquired skill in using litmus paper to measure the acidity and basicity of a substance.

3.2 Properties of acids and bases

Activity 3.4: To determine properties of acids

Refer to page 87 of learner's book

Activity 3.5: To determine properties of bases

Refer to page 88 of learner's book

In groups

- Begin the lesson by asking learners to use knowledge from the previous lesson to discuss some of the properties of acids and bases.
- Allow learners to share their answers with the class.

- Guide learners as they carry out activity 3.4 and 3.5.
- Let them compare their previous answers to the practical findings and share with the class. You can also add a few missed points to their presentations.
- Display the substances you want the students to test for acidity and basicity in activity 3.6.
- Allow learners to fill their answers in a table and present to the class.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

During class presentation, check for support from group members towards their representative.

b. Conversation

Ask learners probing questions to test their knowledge on the properties of acids and bases and how to determine whether a substance is acidic or basic.

c. Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of acidity and basicity to their daily lives.

3.3 Strong and weak acids and bases

Activity 3.7: Refer to page 89 of learner's book

In groups

- Review with learners what they learnt earlier on dissociation of acids and bases.
- Allow learners to carry out activity 3.7 to determine the strength of acids and bases.
- Let learners discuss their results in groups and classify the solutions as either weak or strong.
- Allow learners to discuss and define the terms strong and weak acids and bases.
- You can build from that and explain further what strong and weak acids and bases are, not forgetting to mention that there is also the neutral which is neither acidic nor basic.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

During class presentation, check for support from group members towards their representative.

b. Conversation

Ask learners probing questions to test their knowledge on how to interpret the universal indicator when an acid or base is said to be strong or weak.

c. Product

Appraise each learner on:

- How they use the knowledge gained to determine the strength of an acid or base in their daily lives.

Activity 3.8: Refer to page 90 of learner's book

In groups

- Allow the learners to predict what will happen to the bulb when a both strong and weak acids and bases are used.
- Allow them to carry out the activity. Let learners then compare and share their predictions and answers with the class.
- Explain to learners the difference between the strength of a base and an acid to their concentration (molarity).
- Give a few examples of strong and weak acids using chemical equations of their dissociation reactions.
- Guide learners to define a strong base and a weak base. Give examples of strong bases and weak bases and use chemical equations to show how they undergo dissociation reactions.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share

their ideas clearly with other group members.

During class presentation, check for support from group members towards their representative.

b. Conversation

Ask learners probing questions to test their knowledge on how the strength of an acid or base affects electrical conductivity.

c. Product

Appraise each learner on:

- Their understanding of how to relate electrical conductivity to the strength of an acid or base.

Answer to Check your progress 3.1: Refer to page 92 of learner's book

1.
 - (a)
 - (i) Strong acid dissociates completely in water to give all its hydrogen ions. Weak acid dissolves partially.
 - (ii) Strong base dissociates completely giving all its hydroxide ions in aqueous solution. Weak base dissolves partially.
 - (iii) Refer to page 90 of learners' book for examples.
 - (b) Kill germs in the food eaten and prevent harmful bacteria from entering the gastrointestinal tract.
2.
 - (a) Commercial
 - (b) Natural, commercial
 - (c) Commercial
 - (d) Commercial
 - (e) Commercial
3. Bases - toothpaste, limewater, baking soda, yoghurt
Acids - pineapple, lime juice
4.
 - (a) True
 - (b) True
 - (c) False
5. Test using litmus indicator- acid turns litmus red; base turns litmus blue.
6. Refer to page 89 of learners' book for the difference between acids and bases.

3.4 Simple acid-base Indicators

Activity 3.9: Refer to page 92 of learner's book

Activity 3.10: Refer to page 93 of learner's book

In groups

- Use the analogy in the activity to explain the need to test acids and bases. Thereafter tell learners what indicators are, ways of preparing them and their use.
- With that, introduce Activity 3.10 on how to prepare acid-base indicators.
- Allow learners to tabulate their results and share with the class
- Engage learners in a discussion based on their findings from the activity. Discuss the various types of indicators citing examples.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

During class presentation, check for support from group members towards their representative. Also check whether they share responsibilities.

b. Conversation

Ask learners probing questions to test their knowledge on how to apply the knowledge of indicator preparation in their daily lives when they need to test for acidity or basicity of a substance.

c. Product

Appraise each learner on:

- Their acquired skill on how to prepare an indicator.

Activity 3.11: To determine level of acidity or basicity Refer to page 95 of learner's book

In groups

- Let learners determine colour changes in indicators through this experiment.
- They should tabulate their findings. Thereafter engage them in a discussion on the colour changes with different solutions tested.

- Wind up the lesson by allowing learners to group the various materials either as acids or bases based on their results.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

During class presentation, check for support from group members towards their representative.

b. Conversation

Ask learners probing questions to test their knowledge on whether they can test for acidity or basicity using different indicators.

c. Product

Appraise each learner on:

- Their acquired skill of how to determine whether a substance is acidic or basic using different indicators.

3.5 The pH scale and pH meter

Activity 3.12: Research activity Refer to page 96 of learner's book

Activity 3.13: Determining PH of different substances Refer to page 97 of learner's book

Activity 3.14: PH meter Refer to page 99 of learner's book

In groups

- Begin the lesson by introducing activity 3.12. Let learners do a research using the guiding questions.
- They will write a report which they will present in class. Link the presentation to measuring pH of a solution.
- Organise learners to carry out Activity 3.13. Let them determine pH of various solutions as directed in the learner's book. Instruct them to present their observation in a table format.
- Using their observations explain the use of a universal indicator to determine the pH values using a pH chart.

- Discuss with the learners' pH values and their categories as strong, weak and neutral citing examples.
- Explain the pH scale and the colours observed.
- Guide learners how to use pH- metre in Activity 3.14 take them through the procedure as directed in the learner's book. Thereafter engage the learners in a discussion involving the pH metre and its use.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the group discussion observe and listen to each and every learner's contribution to the discussion as you go to each group. Check whether learners articulate and share their ideas clearly with other group members.

During class presentation, check for support from group members towards their representative.

b. Conversation

Ask learners probing questions to test their knowledge on how to use the PH scale and PH meter to measure the acidity and alkalinity of solutions.

c. Product

Appraise each learner on:

- Their understanding of how to use and handle the PH metre and the PH scale.

Answer to Check your progress 3.2: Refer to page 100 of learner's book

1. Use the procedure from activity 3.10 in learners' book to prepare an indicator from hibiscus flowers.
2. Phenolphthalein (colourless-pink), methyl blue (pink-yellow), litmus paper (red-blue)
3. It determines the kind of reaction it will have.
4.
 - (a) Violet
 - (b) pH 6
 - (c) Violet – at pH 7.5 which is above neutral
 - (d) Add lime to the soil to increase its pH.

3.6 Uses of acids and bases

Activity 3.15: Refer to page 100 of learner's book

As a class,

- It is important that learners identify the items in the pictures and their uses.
- Encourage learners to share their thoughts with the class.

Expected answers

Acid car battery

Detergents used for removing stains – mostly basic

Medicine - basic

- Let learners come up with application of acids and bases in our daily lives. From their presentations, discuss with them the applications of acids and bases they take notes.

Dangers associated with acids and bases

Activity 3.16: Refer to page 101 of learner's book

Individually,

- Ask learners about the dangers associated with acids and bases. Allow them to research and come up with ideas on how acid and bases affect our lives.
- From their suggestions build on it as you explain the dangers acids and bases possess to organisms and the environment.
- End the lesson by cautioning learners against misuse of acids and bases.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation

During the class discussion observe and listen to each and every learner's contribution to the discussion. Check whether learners articulate and share their ideas clearly with other class members.

During class presentation, check for confidence in learners and use of good English.

b. Conversation

Ask learners probing questions to find out if learners are able to explain the application and dangers associated with acids and bases.

c. Product

Appraise each learner on:

- Their understanding of how useful acids and bases could be if they are not misused.

Answer to check your progress 3.3: Refer to page 103 of learner's book

1.
 - (a) The degree of acidity or alkalinity of a solution
 - (b) Acid-A, B, C; Bases-D, E
 - (c) S
 - (i) E
 - (ii) A
 - (iii) F
 - (iv) B, C
2.
 - (a) True
 - (b) False
 - (c) False
 - (d) False
 - (e) False
3.
 - (a) Preservative
 - (b) fertilizer production
 - (c) chemical production industries
 - (d) Cleaning agent
4. The gas is poisonous; one can wear a fascial mask.

3.7 Types of salts

Activity 3.15: Refer to page 104 of learner's book

In pairs

- Introduce the lesson by reminding learners of what a salt is as learnt in the previous lesson when sodium was reacted with chlorine to form sodium chloride.
- Ask learners to name other salts they know other than table salt. Let learners mention the importance of table salt.
- Now allow learners to do the research activity 3.15 in the learners' book. Provide pamphlets and handouts to help them research. This is meant to introduce learners into the world of research and hence boost their research skills.

- Monitor how learners are doing the activity. Assist learners that cannot access information.
- Let learners try filling the blank spaces. They should first discuss and make a conclusion before filling the gaps. Discussion will boost cooperation and interpersonal skills of the learners.
- After the activity, ask learners to present their group findings and how they have filled the table. This will boost communication skills of the learners.
- Narrow down to the types of salts i.e. normal, acid salt and basic salt. Help learners understand these terms and give examples.

Assessment opportunity

Check whether the lesson objectives have been met by:

a. Observation

During the discussion observe and listen to each and every learner's contribution to the discussion. Check whether learners articulate and share their ideas clearly with other group members.

During class presentation, check for support from their partners.

b. Conversation

1. Ask questions such as:

- Define a salt.
- Differentiate between acid, normal, dibasic and monobasic acids

Give learners different salts and tell them to identify the acids from which they were derived. Also give them different metals and acids and ask them to mention the name of the salts formed by each combination.

This way you will be assessing knowledge and understanding.

c. Product

Appraise each learner on:

- Their understanding of how salts are formed.

Answer to check your progress 3.4: Refer to page 106 of learner's book

1. a) Nitrates b) Chlorides c) Carbonates d) Sulphates
2. a) Both normal and acid salts.
b) Normal salts only.
c) Both normal and acid salts.
d) Normal salts.
3. a) Sodium nitrate
b) Calcium hydrogen carbonate.
c) Ammonium chloride.
d) Potassium hydrogen sulphate.

4.

Name of salt	Formulae of salt	Source (acid)
Zinc nitrate	ZnNO_3	Nitric acid
Potassium sulphate	K_2SO_4	Sulphuric acid
Sodium chloride	NaCl	Hydrochloric acid
Ammonium sulphate	NH_4SO_3	Sulphuric acid

UNIT
4

Redox Reaction

Refer to Learner's Book pages 107-128

Learn about		Key inquiry questions
<p>Learners should work in groups to investigate the oxidation state (oxidation numbers) and the degree of oxidation of an atom in a chemical compound and how they might be determined. They should know and understand what is meant by redox reaction and oxidizing and reducing agents such as using aqueous potassium iodide and acidified potassium permanganate (VII) to identify oxidizing and reducing agents. They should know the activity series and understand its use in predicting displacement products.</p>		<ul style="list-style-type: none"> How do we identify oxidation and reduction reactions? How do we distinguish oxidizing agents from reducing agents?
Learning outcomes		
Knowledge and understanding	Skills	Attitudes
<ul style="list-style-type: none"> Understand redox reactions. Know the activity series and understand its use in predicting displacement products. 	<ul style="list-style-type: none"> Investigate the oxidation state (oxidation numbers) and the degree of oxidation. Use aqueous potassium iodide and acidified potassium permanganate (VII) to identify oxidizing and reducing agents Use information to identify patterns, report trends and draw inferences. Present reasoned explanations for phenomena, patterns and relationships. 	<ul style="list-style-type: none"> Adapt behaviour to suit different situations.
<p>Contribution to the competencies: Critical and creative thinking: investigation of reducing and oxidizing agents. Communication: presentation of group work. Co-operation: team work.</p>		
<p>Links to other subjects: Physics: batteries</p>		

Introduction to the unit

Redox reactions are reactions in which one species is reduced and another is oxidized. Therefore the oxidation state of the species involved must change. These reactions are important for a number of applications, including energy storage devices (batteries), photographic processing, and energy production and utilization in living systems including humans.

Reduction: A process in which an atom gains an electron and therefore decreases (or reduces its oxidation number). Basically the positive character of the species is reduced.

Oxidation: A process in which an atom loses an electron and therefore increases its oxidation number. In other words, the positive character of the species is increased.

Historically, the term “oxidation” was used because the redox reactions that were first systematically investigated took place in oxygen, with oxygen being reduced and the other species being oxidized, hence the term oxidation reaction. However, it was later realized that this case (oxidation reactions involving oxygen) was just one possible scenario.

Competencies to be attained

1. Co-operation

During group discussions, pair works and class works- let learners engage one another by giving a chance for all to participate. Also, you can allow rotational presentations within the group members. Further, encourage learners to be tolerant to other learners' views and to understand that people should not necessarily be right always.

2. Communication

Communication in English will be improved when learners freely participate in the discussions and presentations. Encourage all learners irrespective of their abilities

to participate in the discussions, during presentations by asking questions and during question and answer sessions to either introduce or wrap up the lessons.

All learners should also be encouraged to write summary notes at the end of the lesson as this will help improve their writing skills.

3. Critical and creative thinking

This competence will be developed by learners as they answer the probing questions and as they discuss the results of the various practical activities.

This competence will also come about as learners think about their findings in the activities and as they give out their suggestions on why this is the case.

Cross-cutting issues

Inclusive learning

All learners should be encouraged to participate during lessons and group activities. Special arrangements should be made to take care of learners with special needs. For example, provide brail for blind learners, large print text for those with sight problems and allocate physically challenged learners to others to assist them during field trips and practical activities. Further, this category should be given tasks that they can manage during practical sessions.

4.1 Oxidation and reduction process

Activity 4.1: Action of dry hydrogen on heated copper (II) oxide Refer to page 108 of learner's book

Activity 4.2: Reaction of iron III oxide with hydrogen gas Refer to page 109 of learner's book

In groups

- Begin the lesson with a brainstorm with learners on oxidation reactions they recall in terms of burning substances.
- Allow learners to share their answers with the class. Let them also give reasons for their answers.
- Explain to learners the three broad definition of oxidation and reduction. Make it clear so that they do not get confused.
- You can then allow them to carry out activity 4.1. let them predict the results before they carry out the activity.
- Allow learners to compare their results to the predictions.
- Allow learners to come up with the procedure for activity 4.2
- Allow them to set-up the apparatus as in activity 4.1 but using iron III oxide.
- Let them pass hydrogen gas for some time over heated iron III oxide.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation and listening

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

During class presentations, observe learners' engagement and participation in the discussions, their curiosity to learn new things.

b. Conversation

Ask learners probing questions to test their understanding on the oxidation reduction process.

The learners should also talk amongst themselves on the same issues to gauge their knowledge.

c. Product

Appraise each learner on:

- Their understanding of how to apply the knowledge of oxidation reduction to chemical equations.
- Their ability to use reference materials for research.

Other examples of redox reactions

a) Reaction of metals with cold water

Activity 4.3: To investigate the reaction of sodium with water Refer to page 110 of learner's book

In groups

- Allow learners to predict what happens when a metal reacts with water.
- Let them share their answers with the class. Encourage learners to support their answers using chemical equations.
- Guide them to carry out activity 4.3. let them compare their answers to their predictions.

b) Reaction of metals with acids

Activity 4.4: To investigate the reaction of magnesium with dilute sulphuric acid Refer to page 111 of learner's book

In groups

- Allow learners to come up with a procedure of reacting a metal with dilute sulphuric acid.
- The apparatus and chemicals have been provided.
- Dilute Sulphuric acid should be put in a boiling tube.
- Add a piece of magnesium. Let them note down their observations.

- Guide them in testing the gas produced using a burning splint. What observation is made?

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation and listening

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

During class presentations, observe learner's engagement and participation in the discussions.

b. Conversation

Ask learners probing questions to test their understanding on oxidation reduction when metals react with acids or water.

The learners should also talk amongst themselves on the same issues to gauge their knowledge.

c. Product

Appraise each learner on:

- Their acquired skills on how to determine oxidation reduction in a reaction.

Answer to check your progress 4.1: Refer to page 111 of learner's book

1.
 - a) $\text{Zn(s)} + \text{H}_2\text{SO}_4(\text{aq}) \longrightarrow \text{ZnSO}_4(\text{aq}) + \text{H}_2(\text{g})$ (Zinc is oxidized whereas dilute Sulphuric acid is reduced)
 - b) $\text{Fe(s)} + 2\text{HCl(aq)} \longrightarrow \text{FeCl}_2(\text{aq}) + \text{H}_2(\text{g})$
2. The red-brown colour indicates the presence of iron III, Fe^{3+} ions. Hydrogen peroxide removed an electron from iron II ions to form Iron III ions. This results in oxidation. Hydrogen peroxide on the other hand is reduced to form water.
(Check learners' work to ensure they have gotten the equation correct and the explanation.)

4.2 Oxidising and reducing agents

Activity 4.5: Refer to page 112 of learner's book

In pairs

- Provide learners with the necessary materials that they need to carry out their research.
- Allow them to share their answers with the class on what oxidising and reducing agents are. Build up to their findings and explain to them what oxidising and reducing agents are using the information from the learners' books.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation and listening

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

During class presentations, observe learner's engagement and participation in the discussions.

b. Conversation

Ask learners probing questions to test their understanding on oxidising and reducing agents. You can even give an example of a reaction and ask them to identify the oxidising and reducing agent in the reaction.

The learners should also talk amongst themselves on the same to gauge their knowledge.

c. Product

Appraise each learner on:

- Their understanding of how to identify an oxidising and reducing agent in a reaction.
- Their acquired skills in using reference materials for research

Activity 4.6: To investigate the reaction between an iron II compound and hydrogen peroxide Refer to page 112 of learner's book

In groups

- Guide learners to carry out activity 4.6.
- Let them predict what will happen at every step when carrying out the activity. Allow them to share with the class.
- Let learners share their predictions with the class.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation and listening

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

During class presentations, observe learner's engagement and participation in the discussions.

b. Conversation

Ask learners probing questions to test their knowledge and understanding on oxidising and reducing agents in a chemical reaction.

c. Product

Appraise each learner on:

- Their acquired skills to identify an oxidising and reducing agent in a reaction.

Activity 4.7: To investigate reducing property of potassium iodide Refer to page 114 of learner's book

Activity 4.8: Investigating oxidising property of potassium permanganate

Refer to page 115 of learner's book

In groups

- Allow learners to predict what will happen in every step of the activities.
- Let them share their predictions and compare to their results.
- Allow them to also explain their practical results. Encourage them to use terms like oxidation and reduction.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation and listening

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

During class presentations, observe learner's engagement and participation in the discussions.

b. Conversation

Ask learners probing questions to test their knowledge and understanding on identifying when a reaction is said to have undergone reduction or oxidation.

To also identify the reducing agent and oxidising agent from the colour changes in the reaction.

The learners should also talk amongst themselves on the same issues to gauge their knowledge.

4.3 Oxidation numbers

Activity 4.9: Refer to page 116 of learner's book

Individually

- Allow learners to carry out the research on the rules of oxidation numbers.
- Let them share their finding with the class.

(Let the session be as interactive as possible. Each learner should be given an opportunity to share their findings.)

- You can then start discussing with the learners how oxidation numbers are included in elements.
- From previous knowledge ask them to suggest elements with different valencies.
- Ask the students to name compounds of the same elements that they know.
- Discuss the arbitrary rules for assigning oxidation numbers and the examples showing how to calculate oxidation numbers in compounds.
- Explain to learners the need for writing and balancing redox equations.
- Explain to them the need to first write half equations.
- Discuss half equation for reduction and oxidation reactions.
- Take the students through the rules for balancing redox equations.
- Lead the students in writing and balancing overall redox equations following the rules for balancing redox equations.
- Use examples suggested in the learners' book to illustrate this.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation and listening

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

During class presentations, observe learner's engagement and participation in the discussions.

b. Conversation

Ask learners probing questions to test their understanding calculating oxidation numbers. The learners should also discuss as a class to gauge their knowledge.

c. Product

Appraise each learner on:

- Their understanding on how to calculate oxidation numbers.

Answer to check your progress 4.2: Refer to page 119 of learner's book

1.
 - (a) Oxidation is gain of oxygen or loss of hydrogen; reduction is gain of hydrogen or loss of oxygen.
 - (b) Oxidizing and reducing agent- refer to learners' book under "oxidising and reducing agents".
2.
 - (i) +1
 - (ii) +4
 - (iii) +6
 - (iv) +2

(check learners' books for correct calculation of oxidation numbers. Following the rules will enable the learners in calculating the correct oxidation numbers for nitrogen.)
3.
 - (i) +5
 - (ii) +4
 - (iii) +4 & +6
 - (iv) -2
4.
 - (i) +7
 - (ii) +2
 - (iii) +4
5. Check learners' books for correct oxidation numbers and names of compounds formed.
6. Check for correct oxidation numbers.

7.

- (i) Reduction
- (ii) Reduction
- (iii) Redox
- (iv) Oxidation
- (v) Redox
- (vi) Oxidation
- (vii) Redox

4.4 The reactivity series

Activity 4.10: Reaction of metals with oxygen Refer to page 120 of learner's book

In pairs

- Brainstorm to get the product of the reaction of metals with oxygen
- Ask learners to write the observation and write an equation for the reaction.
- Ask them to write an ionic equation for the reaction.
- Let them point out the species that will lose and gain electrons.
- Let learners explain the metal that was most reactive giving reasons to their answers.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation and listening

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

During class presentations, observe learner's engagement and participation in the discussions.

b. Conversation

Ask learners probing questions to test their understanding on the fact that metals in the reactivity series react differently with oxygen.

The learners should also talk amongst themselves on the same issues to gauge their knowledge.

c. Product

Appraise each learner on:

- Their understanding that metals higher in the reactivity series are most reactive than the ones lower in the reactivity series.

Competition for combined oxygen

Activity 4.11: reaction of magnesium with carbon (IV) oxide Refer to page 121 of learner's book

In groups

- Ask learners if they are able to predict accurately the way the reaction will proceed
- Remind them of the reactivity series of metals and how displacement of ions takes place.
- Allow learners to compare their prediction to their results.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation and listening

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

During class presentations, observe learner's engagement and participation in the discussions.

b. Conversation

The learners should also talk amongst themselves to gauge their knowledge.

Activity 4.12: To investigate the competition for combined oxygen by metals

Refer to page 122 of learner's book

In groups

- Allow learners to predict how the reaction will proceed.
- Guide them to carry out activity 4.12. ask them to tabulate their results so that they can share their findings with the class.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation and listening

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

During class presentations, observe learner's engagement and participation in the discussions.

b. Conversation

The learners should also talk amongst themselves to gauge their knowledge. This can also be assessed from their predictions.

c. Product

Appraise each learner on:

- Their acquired skills to come up with the correct chemical equations.
- Their understanding of the reactivity series.

Using reactivity series in predicting displacement reactions as redox reactions

Activity 4.13: Reacting zinc metal with copper II sulphate solution Refer to page 125 of learner's book

In groups

- Ask learners to recall the meaning of redox reaction.
- Allow learners to predict accurately how the reaction will proceed.
- Remind learners of the e reactivity series of metals and how displacement of ions takes place.
- Guide them as they carry out activity 4.13.
- Discuss how displacement of ions occur during reduction-oxidation process.

Assessment opportunities

Check whether the lesson objectives have been met by:

a. Observation and listening

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

During class presentations, observe learner's engagement and participation in the discussions.

b. Conversation

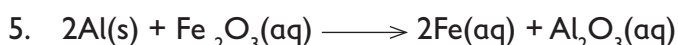
Ask learners probing questions to test their understanding displacement reactions.

Answer to check your progress 4.3: Refer to page 128 of learner's book

1. The experiment should involve reacting metals in the reactivity series with oxygen to determine the most and least reactive.
2. K, Na, Ca, Mg, Zn, Cu
3.
 - (a) Check that the learners have the correct ionic equation between chlorine and potassium bromide.
 - (b) Chlorine is more reactive than bromine. Chlorine displaces bromine from potassium bromide. Therefore, when chlorine is added to potassium bromide, the mixture turns brown due to the formation of bromine.
- 4.

Metal salt solution	magnesium	Copper	Zinc
Magnesium sulphate	×	√	√
Copper II sulphate	√	×	√
Zinc sulphate	√	√	×

(ii) mark correct equations where the reactions took place.



Aluminium is more reactive than Iron, it displaces iron from iron (III) oxide. The aluminum removes oxygen from Iron (III) oxide.

6. (i) Chromium

(ii) Iodine

(iii) Chromium (VI) oxide

(iv) Iodine

