Interesting Science fact #6

There are 8 times as many atoms in a teaspoonful of water as there are teaspoonful's of water in the Atlantic ocean.

NATURAL SCIENCES

LESSON PLAN

GRADE 9 TERM 2

A MESSAGE FROM THE NECT

NATIONAL EDUCATION COLLABORATION TRUST (NECT)

Dear Teachers

This learning programme and training is provided by the National Education Collaboration Trust (NECT) on behalf of the Department of Basic Education (DBE)! We hope that this programme provides you with additional skills, methodologies and content knowledge that you can use to teach your learners more effectively.

What is NECT?

In 2012 our government launched the National Development Plan (NDP) as a way to eliminate poverty and reduce inequality by the year 2030. Improving education is an important goal in the NDP which states that **90% of learners will pass Maths, Science and languages with at least 50% by 2030**. This is a very ambitious goal for the DBE to achieve on its own, so the NECT was established in 2015 to assist in improving education.

The NECT has successfully brought together groups of people interested in education to work together to improve education. These groups include the teacher unions, businesses, religious groups, trusts, foundations and NGOs.

What are the learning programmes?

One of the programmes that the NECT implements on behalf of the DBE is the 'District Development Programme'. This programme works directly with district officials, principals, teachers, parents and learners; you are all part of this programme!

The programme began in 2015 with a small group of schools called the **Fresh Start Schools (FSS)**. Curriculum **learning programmes** were developed for **Maths, Science and Language** teachers in FSS who received training and support on their implementation. The FSS teachers remain part of the programme, and we encourage them to mentor and share their experience with other teachers.

The FSS helped the DBE trial the NECT learning programmes so that they could be improved and used by many more teachers. NECT has already begun this scale-up process in its Universalisation Programme and in its Provincialisation Programme.

Everyone using the learning programmes comes from one of these groups; but you are now brought together in the spirit of collaboration that defines the manner in which the NECT works. Teachers with more experience using the learning programmes will deepen their knowledge and understanding, while some teachers will be experiencing the learning programmes for the first time.

Let's work together constructively in the spirit of collaboration so that we can help South Africa eliminate poverty and improve education!

www.nect.org.za

CONTENTS

PROGRAMME ORIENTATION

Welcome to the NECT Natural Sciences learning programme! This CAPS compliant programme consists of:

- A full set of lesson plans for the term (3 X 1 hour lessons per week)
- A resource pack with images to support the lesson plans
- A full colour poster
- An outline of the assessment requirements for the term
- A tracker to help you monitor your progress

Lesson Plan Structure

1. Term 3 lesson plans are structured to run for 8 weeks.
2. Each week, there are three lessons, of the following notional time:

   3 x 1 hour

   This time allocation of 3 hours per week is CAPS aligned.

Lesson Plan Contents

1. The lesson plan starts with a **CONTENTS PAGE** that lists all the topics for the term, together with a breakdown of the lessons for that topic. You will notice that lessons are named by the week and lesson number, for example, Week 8 Lesson 8C.

2. Every topic begins with a 2 - 4 page **TOPIC OVERVIEW**. The topic overview pages are grey, making them easy to identify. The topic overview can be used to introduce the topic to learners. The topic overview includes:

   a. A ***general introduction*** to the topic that states how long the topic runs for, the value of the topic in the final exam and the number of lessons in the topic.

   b. A table showing the ***position of the topic*** in the term.

   c. A ***sequential table*** that shows the prior knowledge required for this topic, the current knowledge and skills that will be covered, and how this topic will be built on in future years. Use this table to give learners an informal quiz to test their prior knowledge. If learners are clearly lacking in the knowledge and skills required, you may need to take a lesson to cover some of the essential content and skills. It is also useful to see what you are preparing learners for next, by closely examining the 'looking forward' column.

   d. A glossary of ***scientific vocabulary***, together with an explanation of each word or phrase. It is a good idea to display these words and their definitions somewhere in the classroom, for the duration of the topic. It is also a good idea to allow learners some time to copy down these words into their personal dictionaries or science exercise books. You must explicitly teach the words and their meanings as and when you encounter these words in the topic. A good way to teach learners new vocabulary is to use 'PATS':

- POINT – if the word is a noun, point at the object or at a picture of the object as you say the word.
- ACT – if the word is a verb, try to act out or gesture to explain the meaning of the word, as you say it.
- TELL – if the word has a more abstract meaning, then tell the learners the meaning of the word. You may need to code switch at this point, but also try to provide a simple English explanation.
- SAY – say the word in a sentence to reinforce the meaning.

e. ***Understanding the uses / value of science****.* It is very important to give learners a sense of how science applies to their daily lives, and of the value that science adds to their lives. Hold a brief discussion on this point when introducing the topic, and invite learners to elaborate on the uses and value that this topic will have to their lives.

f. ***Personal reflection****.* At the end of every topic, come back to the topic overview, and complete this table. In particular, it is important to note your challenges and ideas for future improvement, so that you can improve your teaching the next year.

3. After the topic overview, you will find the **INDIVIDUAL LESSONS.** Every lesson is structured in exactly the same way. This helps you and the learners to anticipate what is coming next, so that you can focus on the content and skills. Together with the title, each lesson plan includes the following:

a. ***Policy and Outcomes****.* This provides you with the CAPS reference, and an overview of the skills that will be covered in the lesson. You can immediately see the science process skills that will be covered, and whether they are lower middle or higher order skills.

b. ***Possible Resources****.* Here, you will see the resources that you should ideally have for the lesson. If you need to use the poster or pages from the resource pack, this will be listed here. There is also a space for improvised resources, and you are invited to add your own ideas here.

c. ***Classroom Management****.* Every lesson starts in the same way. Before the lesson, you must write a question that relates to the previous lesson on the chalkboard. Train your learners to come in to the classroom, to take out their exercise books, and to immediately try to answer this question. This links your lesson to the previous lesson, and it effectively settles your learners.

Once learners have had a few minutes to answer, read the question and discuss the answer. You may want to offer a small reward to the learner who answers first, or best. Get your learners used to this routine.

Next, make sure that you are ready to begin your lesson, have all your resources ready, have notes written up on the chalkboard, and be fully prepared to start. Remember, learners will get restless and misbehave if you do not keep them busy and focussed.

d. ***Accessing Information****.* This section contains the key content that you need to share with learners. Generally, it involves sharing some new information that is written on the chalkboard, explaining this information, and allowing learners some time to copy the information into their exercise books. Train learners to do this quickly and efficiently. Learners must anticipate this part of the lesson, and must have their books, pens, pencils and rulers ready.

Explain to learners that this is an important resource for them, because these are the notes they will revise when preparing for tests and exams.

Checkpoint 1*.* Straight after 'Accessing Information', you will find two checkpoint questions. These questions help you to check that learners understand the new content thus far.

e. ***Conceptual Development****.* At this point, learners will have to complete an activity to think about and apply their new knowledge, or to learn a new skill. This is the most challenging part of the lesson. Make sure that you fully understand what is required, and give learners clear instructions.

Checkpoint 2*.* Straight after 'Conceptual Development, you will find two checkpoint questions. These questions help you to check that learners understand the new concepts and skills that they have engaged with.

f. ***Reference Points for Further Development****.* This is a useful table that lists the relevant sections in each approved textbook. You may choose to do a textbook activity with learners in addition to the lesson plan activity, or even in place of the lesson plan activity. You may also want to give learners an additional activity to do for homework.

g. ***Additional Activities / Reading****.* This is the final section of the lesson plan. This section provides you with web links related to the topic. Try to get into the habit of visiting these links as part of your lesson preparation. As a teacher, it is always a good idea to be more informed than your learners.

4. At the end of the week, make sure that you turn to the **TRACKER,** and make note of your progress. This helps you to monitor your pacing and curriculum coverage. If you fall behind, make a plan to catch up.

5. **POSTER AND RESOURCE PACK.** You will have seen that the *Possible Resource*s ection in the lesson plan will let you know which resources you will need to use in a lesson.

   Please note that you will only be given these resources once. It is important for you to manage and store these resources properly. Do this by:

   - Writing your name on all resources
   - Sticking Resources onto cardboard or paper
   - Laminating all resources, or covering them in contact paper
   - Filing the resource papers in plastic sleeves once you have completed a topic

   Have a dedicated wall or notice board in your classroom for Natural Sciences.

   - Use this space to display the resources for the topic
   - Display the vocabulary words and meaning here, as well as the resources
   - Try to make this an attractive and interesting space
   - Display learners' work on this wall – this gives learners a sense of ownership and pride

6. **ASSESSMENT.** At the end of the lesson plans, you will find the CAPS assessment requirements for the term. You should refer to your prescribed textbooks and departmental resources for examples of the relevant assessments.

Lesson Plan Routine

Train your learners to know and anticipate the routine of Natural Sciences lessons. You will soon see that a good knowledge of this routine will improve time-on-task and general classroom discipline and that you will manage to work at a quicker pace.

Remember, every Natural Sciences lesson follows this routine:

1. **Classroom Management**: settle learners by having two questions written on the chalkboard. Learners take out their exercise books and pens, and immediately answer the questions. Discuss the answers to the questions, and reward the successful learner.
2. **Accessing Information:** have key information written on the chalkboard. Explain this to learners. Allow learners to copy this information into their books.
3. **Checkpoint 1:** ask learners at least two questions to check their understanding.
4. **Conceptual Development:** complete an activity to apply new knowledge or skills.
5. **Checkpoint 2:** ask learners at least two questions to check their understanding.
6. **Reference Points for Further Development:** links to textbook activities – you may choose to use these activities as additional classwork activities, or as homework activities.
7. **Tracker:** fill in your tracker at the end of the lessons to track your progress.

PROGRAMME ORIENTATION

A vehicle to implement CAPS

Teaching Natural Sciences can be exciting and rewarding. These lesson plans have been designed to guide you to implement the CAPS policy in a way that makes the teaching and learning experience rewarding for both the teacher and the learners.

To support the policy's fundamentals of teaching Natural Sciences, these lesson plans use the CAPS content as a basis and:

- provide a variety of teaching techniques and approaches
- promote enjoyment and curiosity
- highlight the relationship between Natural Science and other subjects
- where appropriate, draw on and emphasise cultural contexts and indigenous knowledge systems
- show the relationship between science, learners, their societies and their environments
- aim to prepare learners for economic activity and self-expression

Content and Time Allocation

These lessons plans have been developed to comply with CAPS in respect of both content and time allocation. In developing these lesson plans, consideration of the realities of teachers was taken and to this end, some simple adjustments were made, without deviating from policy, to make the teaching of these lesson plans more achievable. The kinds of adjustments made include using some of the practical tasks in the lesson plans for assessment purposes; and building in time for revision and exams during terms 2 and 4.

CAPS assigns one knowledge strand to form the basis of content in each term. These strands are as follows:

- Term 1: ***Life and Living***
- Term 2: ***Matter and Materials***
- Term 3: ***Energy and Change***
- Term 4: ***Planet Earth and Beyond***

PROGRAMME ORIENTATION

The distribution of these strands across the year is summarised in the table below:

Grade 9			
Term 1	**Term 2**	**Term 3**	**Term 4**
NS Strand	**NS Strand**	**NS Strand**	**NS Strand**
Life and Living	**Matter and Materials**	**Energy and Change**	**Planet Earth and Beyond**
Cells as the basic units of life	Compounds	Forces	The Earth as a system
Systems in the human body	Chemical reactions	Electric cells as energy systems	Mining of mineral resources
Human Reproduction	Reactions of metals with oxygen	Resistance	Atmosphere
Circulatory and respiratory systems	Reactions of non-metals with oxygen	Series and parallel circuits	Birth, life and death of stars
Digestive system	Acids, bases and pH value	Safety with electricity	
	Reactions of acids with bases	Energy and the national electricity grid	
	Reactions of acids with metals	Cost of electrical power	

PROGRAMME ORIENTATION

The time allocation by topic is summarised in the table below.

Remember that one week equates to 3 hours or three lessons of 1 hour each.

	GRADE 7		GRADE 8		GRADE 9	
TERM	**Topic**	**Time in weeks**	**Topic**	**Time in weeks**	**Topic**	**Time in weeks**
Term 1: Life and Living	• The biosphere	1	• Photosynthesis and respiration	2	• Cells as the basic units of life	2
	• Biodiversity	3½	• Interactions and interdependence within the environment	5	• Systems in the human body	2
	• Sexual Reproduction	3½			• Human Reproduction	2
	• Variation	1	• Micro-organism	2	• Circulatory and respiratory systems	1½
					• Digestive system	1½
		(9 wks)		(9 wks)		(9 wks)
Term 2: Matter and Materials	• Properties of materials	2	• Atoms	2	• Compounds	1
	• Separating mixtures	2	• Particle model of matter	5	• Chemical reactions	1
	• Acids, bases and neutrals	2	• Chemical reactions	1	• Reactions of metals with oxygen	1½
	• Introduction to the periodic table of the elements	2			• Reactions of non-metals with oxygen	1
					• Acids, bases and pH value	1
					• Reactions of acids with bases (I)	½
					• Reactions of acids with bases (II)	1
					• Reactions of acids with bases (III)	½
					• Reactions of acids with metals	1
		(8 wks)		(8 wks)		(8 wks)

Term 3: Energy and Change	• Sources of energy • Potential and Kinetic energy • Heat transfer • Insulation and energy saving • Energy transfer to surroundings • The national electricity supply system	1 2 2 2 1 1	• Static electricity • Energy transfer in electrical systems • Series and parallel circuits • Visible light	1 3 2 3	• Forces • Electric cells as energy systems • Resistance • Series and parallel circuits • Safety with electricity • Energy and the national electricity grid • Cost of electrical power	2 ½ 1 2 ½ 1 2
		(9 wks)		(9wks)		(9 wks)
Term 4: Planet Earth and Beyond	• Relationship of the Sun and the Earth • Relationship of the Moon and the Earth • Historical development of astronomy	4 2 2	• The Solar System • Beyond the Solar System • Looking into space	3 3 2	• The Earth as a system • The Lithosphere • Mining of mineral resources • Atmosphere • Birth, life and death of stars	1 2 2 2 1
		(8 wks)		(8 wks)		(8 wks)
TOTALS	34 weeks		34 weeks		34 weeks	

REFLECTING ON THE LESSONS THAT YOU TEACH

It is important to reflect on your teaching. Through reflection, we become aware of what is working and what is not, what we need to change and what we do not. Reflecting on your use of these lesson plans will also help you use them more effectively and efficiently.

These lesson plans have been designed to help you deliver the content and skills associated with CAPS. For this reason, it is very important that you stick to the format and flow of the lessons. CAPS requires a lot of content and skills to be covered – this makes preparation and following the lesson structure very important.

Use the tool below to help you reflect on the lessons that you teach. You do not need to use this for every lesson that you teach – but it is a good idea to use it a few times when you start to use these lessons. This way, you can make sure that you are on track and that you and your learners are getting the most out of the lessons.

LESSON REFLECTION TOOL			
Preparation			
1.	What preparation was done?		
2.	Was preparation sufficient?		
3.	What could have been done better?		
4.	Were all of the necessary resources available?		
Classroom Management			
		Yes	**No**
5.	Was the question written on the board?		
6.	Was the answer written on the board?		
7.	Was the answer discussed with the learners in a meaningful way?		
8.	Overall reflection on this part of the lesson: What was done well? What could have been done better?		

Accessing Information			
		Yes	**No**
9.	Was the text and/ or diagrams written on the chalkboard before the lesson started?		
10.	Was the work on the board neat and easy for the learners to read?		
11.	Was the explanation on the content easy to follow?		
12.	Was the information on the board used effectively to help with the explanations?		
13.	Was any new vocabulary taught effectively? (in context and using strategies like PATS)		
14.	Were the learners actively engaged? (asked questions, asked for their opinions and to give ideas or suggestions)		
15.	Were the checkpoint questions used effectively?		
16.	Overall reflection on this part of the lesson: What was done well? What could have been done better?		

Conceptual Development			
		Yes	**No**
17.	Was the information taught in the 'Accessing Information' part of the lesson used to foreground the activity?		
18.	Were clear instructions given for the conceptual development activity?		
19.	Were the outcomes/answers to the activities explained to the learners?		
20.	Could the learners ask questions and were explanations given?		
21.	Was a model answer supplied to the learners? (written or drawn on the board)		
21.	Were the checkpoint questions used effectively?		
22.	At the end of the lesson, were the learners asked if they had questions or if they needed any explanations?		
23.	Overall reflection on this part of the lesson: What was done well? What could have been done better?		

TOPIC OVERVIEW:
Compounds
Term 2, Weeks 1A – 1C

A. TOPIC OVERVIEW

Term 2, Weeks 1a – 1c

- This topic runs for 1 week.
- It is presented over 3 lessons.
- This topic's position in the term is as follows:

LESSON	WEEK 1			WEEK 2			WEEK 3			WEEK 4			WEEK 5		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

LESSON	WEEK 6			WEEK 7			WEEK 8			WEEK 9			WEEK 10		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

B. SEQUENTIAL TABLE

GRADE 8	GRADE 9	GRADE 10 - 12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Compounds • Bonding in a compound • Chemical bonds • Compounds can be broken down in a decomposition reaction	• Metals, non-metals and semi metals • Elements found in groups have similar chemical properties • Elements on the Periodic Table • Formulae • Naming of compounds	Grade 10 • Pure substances: elements and compounds • Atoms and compounds Grade 11 • Atomic combinations: • molecular structure • Empirical formula and molecular formula of compounds

C. SCIENTIFIC VOCABULARY

Ensure that you teach the following vocabulary at the appropriate place in the topic:

	TERM	EXPLANATION
1.	atom	Basic unit of a chemical element
2.	particle	Small portion of matter
3.	proton	Positively charged sub-atomic particle
4.	neutron	Neutral sub-atomic particle
5.	electron	Negatively charged sub-atomic particle
6.	atomic number	Number that tells us how many protons are inside the nucleus of an atom
7.	mass number	Average number of protons and electrons in the nucleus of an atom
8.	precipitate	Insoluble solid that forms from the reaction of two substances in a solution
9.	bonded	Chemically combined or joined
10.	chemical bond	The force that holds atoms together
11.	subscript	Small number written slightly below the level of the line
12.	suffix	Word ending
13.	prefix	Beginning of a word
14.	compound	Material made up of two or more different elements that are chemically bonded
15.	element	Substance made up of atoms of the same kind
16.	pure substance	Substance which consists of only one type of material and is not mixed with anything else

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

It is important that we know how compounds are formed and what elements are found in different compounds because we use compounds in our daily lives. Some compounds are useful and some compounds are harmful. Examples of useful compounds are: sodium chloride (table salt), sodium hydrogen carbonate (baking powder), and acetone (nail polish remover).

Carbon dioxide, which is a compound of oxygen and hydrogen, is used by plants in the process of photosynthesis. Iron oxide is an example of a harmful compound. Iron oxide is commonly known as rust. If we know how iron oxide forms, we can prevent the formation of rust.

E. PERSONAL REFLECTION

Reflect on your teaching at the end of each topic:

Date completed:	
Lesson successes:	
Lesson challenges:	
Notes for future improvement:	

1 A

Term 2, Week 1, Lesson A
Lesson Title: Revising compounds
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Revise concepts dealt with in Grade 8
CAPS Page Number	63

Lesson Objectives

By the end of the lesson, learners will be able to:

- explain what an atom is
- explain what a compound is
- list three examples of compounds
- describe how compounds are formed and decomposed.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	
2. Observing	✓	7. Raising Questions		12. Recording Information	✓
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 1: Diagram of water molecule and diagram of sodium chloride molecule. Page 2.	Different coloured balls of clay or Papier Mache
Poster: The Periodic Table	Circles cut from different coloured pieces of cardboard or cardboard coloured in with different colours
Projector and lap top with internet	
Different coloured balls (example: polystyrene balls)	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What is an atom?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

An atom is the smallest particle of matter that can exist on its own.

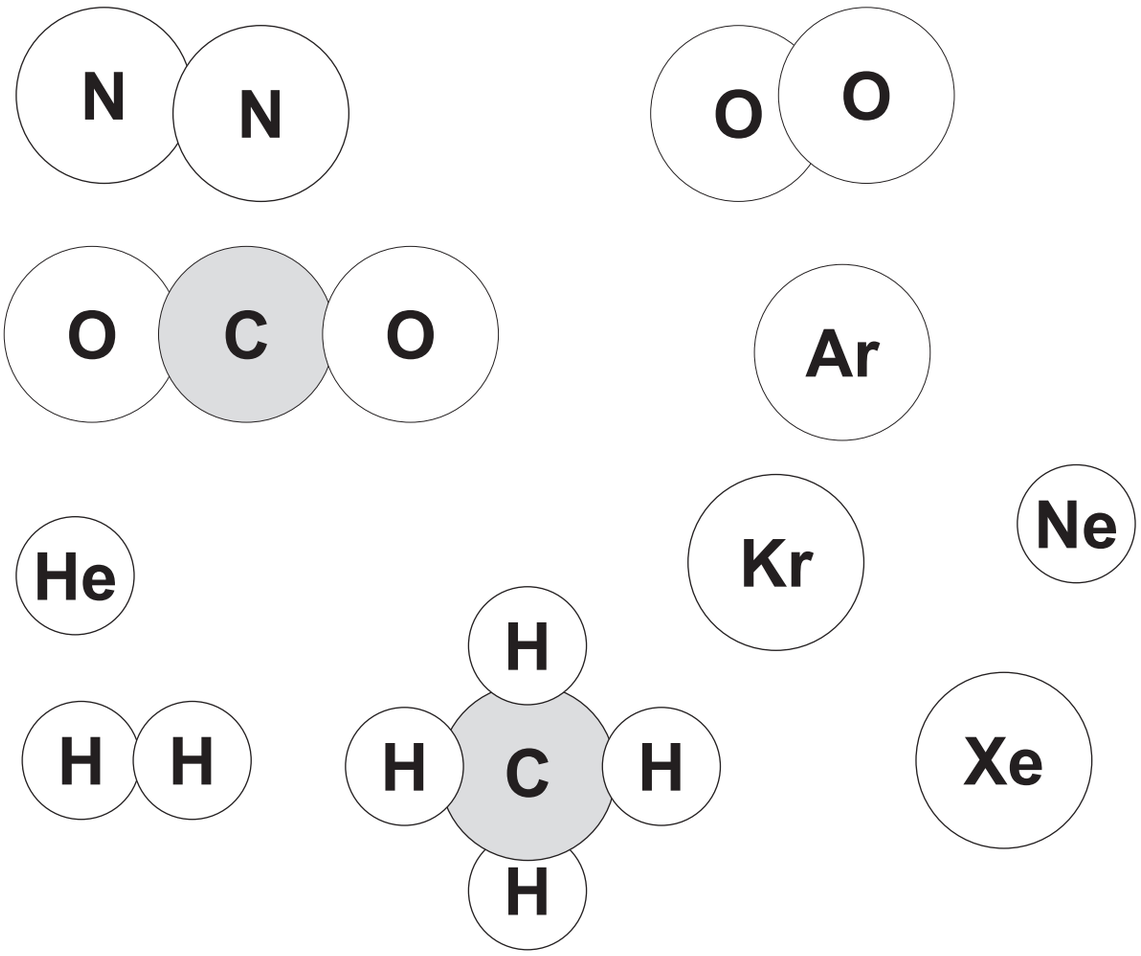
D ACCESSING INFORMATION

1. Draw the following diagrams and write the following information on the chalkboard (always try to do this before the lesson starts):

REVISION OF COMPOUNDS

1. An **atom** is the basic unit of a chemical element.
2. An **element** is a made up of atoms of the same kind.
3. A **compound** is made up of two or more different elements chemically **bonded** together.
4. A **pure substance** consists of only one type of material and is not mixed with anything else.
5. Elements and compounds are both pure substances.

DRAWING OF PURE SUBSTANCES



1. Explain the following to the learners:
   a. An atom is the smallest building block of matter.
   b. Atoms make up elements.
3. Use the poster of the Periodic Table to show that there are 105 known elements.
4. Explain to the learners that:
   a. Every element has a name and a symbol. Point out some examples in the Periodic Table. Remind learners that they learnt about some of the elements in Grade 8.
   b. All the elements are listed in the Periodic Table.
   c. When two or more elements are chemically bonded together, a compound is formed.
5. A pure substance consists of only one type of material and it is not mixed with anything else.
   a. Elements and compounds are pure substances because they consist of only one type of material.
6. Ask the learners if they have any questions.

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. What is the smallest building block of matter?

b. Ask the learners whether the following statement is true or false: Elements and compounds are both pure substances.

Answers to the checkpoint questions are as follows:

a. The atom

b. True

E CONCEPTUAL DEVELOPMENT

1. Be sure to leave the diagrams of pure substances on the chalkboard.
2. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

Table to show the chemical formula and name of some pure substances

Chemical formula	**Element or compound?**
N_2	Element

TASK 1

1. Draw the table in your workbooks.
2. Look at the diagrams of pure substances on the chalkboard.
3. Complete only the first column by writing the chemical formula of each pure substance.

TASK 2

1. On your table, identify whether each substance is an element or a compound. (Nitrogen has been done as an example for you.)

3. Explain Task 1 to the learners as follows:
   a. The table drawn on the chalkboard has two columns.
   b. The first column has the following heading: Chemical formula.
   c. The second column has the following heading: Element or compound.
   d. Note that Row 1, Nitrogen, has been done as an example for you.

e. Work on your own. Look at each diagram of a pure substance on the chalkboard. Work out the chemical formula for each substance. First see how many different atoms there are, and then look at how many types of atoms there are. Remember, if there is more than one atom of the same type, then we write the number as a **subscript** after the symbol.

f. Draw the table in your workbook and complete Column 1.

4. Give learners some time to complete Task 1 in their workbooks. Remind learners to refer to the Poster of the Periodic Table if necessary.
5. Ask learners to share their answers to Task 1 with the class.
6. The completed table is shown below. Fill the formulae on the table on the chalkboard. Note: the pure substances in Column 1 can be listed in any order. Do not fill in Column 2 until learners have completed Task 2.

MODEL ANSWERS

Table to show the chemical formula and name of some pure substances

Chemical formula	**Element or compound?**
N_2	Element
O_2	Element
Ar	Element
Ne	Element
He	Element
CH_4	Compound
CO_2	Compound
Kr	Element
Xe	Element

7. When the learners have completed Task 1, hold a short class discussion on what an element is and what a compound is.
8. Next, get the learners to do Task 2 by identifying the elements and compounds and writing their answer in Column 2.
9. Discuss the answers with the learners.

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. What is the difference between an element and a compound?
b. The chemical formula of water is H_2O. Why is water classified as a compound?

Answers to the checkpoint questions are as follows:

a. An element is a material consisting of one type of atom only, while a compound is a material made up of two or more elements chemically bonded.
a. Water is classified as a compound because it is made up of more than one element. The two elements in water are oxygen and hydrogen.

10. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Compounds	102
Solutions for all	Compounds	97
Spot On	Compounds and chemical reactions	57
Top Class	Compounds	85
Via Afrika	Compounds	76
Platinum	Compounds and chemical reactions	75
Oxford Successful	Compounds	73
Pelican Natural Sciences	Compounds	106-107
Sasol Inzalo Bk A	Compounds	146-150

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. http://www.mstworkbooks.co.za/natural-sciences/gr9/gr9-mm-01.html#toc-id-0 [Compounds]

1 B

Term 2, Week 1, Lesson B
Lesson Title: The Periodic Table of the Elements
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The Periodic Table of the Elements
CAPS Page Number	63

Lesson Objectives

By the end of the lesson, learners will be able to:

- state that the periodic table of the elements is a classification system for the elements
- list three examples of elements
- describe the arrangement of metals, non-metals and semi-metals in the periodic table
- describe the information found in each small block on the Periodic Table.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	
2. Observing		7. Raising Questions		12. Recording Information	✓
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	✓
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 2: Diagram of Periodic Table.	
Poster: The Periodic Table of the Elements	
Projector and lap top with internet	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What is the Periodic Table of the Elements?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

The Periodic Table of the Elements is a classification system for the elements. It is drawn as a table.

D ACCESSING INFORMATION

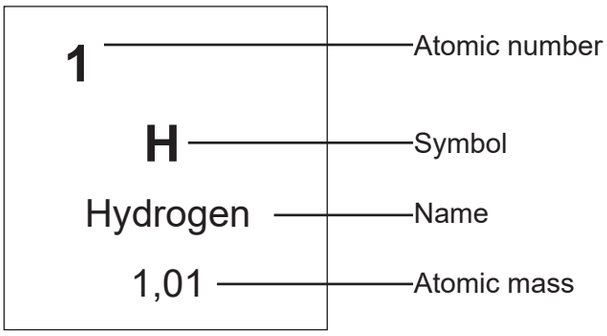
1. Write the following information and draw the following diagram on the chalkboard (always try to do this before the lesson starts):

THE PERIODIC TABLE

1. The Periodic Table is a classification system for the elements.
2. An **element** is a made up of atoms of the same kind. An element is a pure substance that cannot be broken down further.
3. Copper, gold and oxygen are examples of elements.
4. The elements can be classified into metals, non-metals and semi-metals.
5. Each vertical column on the Periodic table is called a group. The elements found in the same groups have similar chemical properties and behave in a similar way.
6. Each element on the Periodic Table has a name, a chemical symbol, an **atomic number** and a mass number.
7. A formula is the ratio of the symbols of the elements and the number of atoms for each symbol in a compound.
8. The metals are found in the middle and on the left-hand side of the Periodic Table.

9. The non-metals are found in the middle and on the right-hand side of the Periodic Table.
10. The semi-metals are found in a zig-zag line between the metals and the non-metals.

Drawing of a block on the Periodic Table



2. Explain that the Periodic Table is a classification system for the elements.

   (Refer to the poster: Periodic Table of the Elements as you explain the structure of the Table).
3. Use the poster of the Periodic Table to show the learners:
   a. The location of the metals, non-metals and semi-metals.
   b. That the elements in the Periodic Table are arranged in three main categories: metals, non-metals and semi-metals.
   c. One element block on the poster.
4. Explain the following:
   a. Each element is written in a separate block in the Periodic Table.
   b. Every element has a name, a symbol, an atomic number (top left-hand corner of the block) and an atomic mass (bottom of the block).
   c. All the elements are listed in the Periodic Table.
   d. The elements in the Periodic Table are arranged in **groups**.
   e. The groups form the vertical columns.
   f. The elements in the same group behave in a similar way.
5. Show the learners the following:
   a. The position of the metals, non-metals and semi-metals in the Periodic Table of the Elements.
   b. The colour-coding used to indicate the metals, non-metals, and semi-metals.
6. Ask the learners if they have any questions.

Checkpoint 1

Ask learners the following questions to check their understanding at this point:

a. What are the three main categories of elements in the Periodic Table of the Elements?
b. What do we call the vertical column of elements in the Periodic Table of the Elements?

Answers to the checkpoint questions are as follows:

a. Metals, non-metals and semi-metals
b. Group

E CONCEPTUAL DEVELOPMENT

1. Divide the class into five groups. Give each group a copy of the Periodic Table of the Elements from the resource pack. Make sure that the poster: Periodic Table of Elements is displayed in the classroom. Draw learners' attention to the poster.
2. Write the following onto the chalkboard (always try to do this before the lesson starts):

INVESTIGATING THE PERIODIC TABLE

Table 1: The names and chemical symbols of some elements

Name of element	**Chemical symbol**
Zinc	Zn
	Cu
Gold	
	Fe
Mercury	
	Mg
Sodium	
	Ca

TASK 1

1. Draw Table 1 in your workbook.
2. Refer to the Periodic Table of the Elements which your teacher has given your group. Refer to the poster: Periodic Table of Elements.
3. Complete the table by writing the name of the element or the chemical symbol (whichever is missing in the table). Zinc has been done as an example for you.

INVESTIGATING THE PERIODIC TABLE

Table 2: Table of one element

5
B
11

Name of element	**Boron**
Chemical symbol of element	
Atomic number of element	
Mass of element	
Names of other elements in the same group as element B	
Metal, non-metal or semi-metal?	

TASK 2

1. Draw Table 2 in your workbook.
2. Study the Periodic Table of the Elements and the poster.
3. Explain Task 1 to the learners as follows:
   a. The table drawn on the chalkboard has two columns.
   b. The first column has the following heading: Name of element.
   c. The second column has the following heading: Chemical symbol.
   d. Note that Row 1, Zinc, has been done as an example for you.
   e. Draw the table in your workbook.
   f. Work in a group. Look at the Poster: Periodic Table of Elements and the Periodic Table of the Elements given to you by your teacher. Use the information from the Periodic table of the Elements to complete Column 1 and Column 2 of your table.
4. Give learners some time to complete Task 1 in their workbooks. Remind learners to refer to the Poster of the Periodic Table if necessary.
5. Ask learners to share their answers to Task 1 with the class.
6. The completed table is shown below. Complete the table on the chalkboard.

Table 1: The names and chemical symbols of some elements

Name of element	**Chemical symbol**
Zinc	Zn
Copper	Cu
Gold	Au
Iron	Fe
Mercury	Hg
Magnesium	Mg
Sodium	Na
Calcium	Ca

7. When the learners have completed Task 1, lead a short class discussion to revise the information provided in an element block.
8. Get learners to do Task 2 by copying and completing Table 2 in their workbooks.
9. Discuss the answers with the learners.
10. The completed table is shown below. Complete the table on the chalkboard.

Table 2: Table of one element

Name of element	**Boron**
Chemical symbol of element	B
Atomic number of element	5
Mass of element	11
Names of other elements in the same group as element B	Aluminum, Gallium, Indium, Thallium
Metal, non-metal or semi-metal?	Metal

Checkpoint 2

Ask learners the following questions to check their understanding at this point:

a. Where on the Periodic Table of the Elements are the metals found?
b. What does the small number on the top right-hand corner of an element block tell us?

Answers to the checkpoint questions are as follows:

a. The metals are found in the middle and on the left-hand side of the Periodic Table of the Elements.
b. The atomic number (or number of protons or number of electrons) in the nucleus

11. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Compounds	104-109
Solutions for all	Compounds	101-104
Spot On	Compounds and chemical reactions	59-60
Top Class	Compounds	85-88
Via Afrika	Compounds	76-77
Platinum	Compounds and chemical reactions	75
Oxford Successful	Compounds	70-72
Pelican Natural Sciences	Compounds	102-106
Sasol Inzalo Bk A	Compounds	151-159

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. http://www.mstworkbooks.co.za/natural-sciences/gr9/gr9-mm-01.html#toc-id-8 [The Periodic Table]
2. https://www.youtube.com/watch?v=-f-IR05cudY (8min 39sec) [Grade 9 Chemistry: The Periodic Table]

1 C

Term 2, Week 1, Lesson C
Lesson Title: Names of compounds
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Names of compounds
CAPS Page Number	63

Lesson Objectives

By the end of the lesson, learners will be able to:

- state what a compound is
- explain how compounds are named
- describe and use formulae for compounds
- explain what the prefixes ‘mon’, ‘di’ and ‘tri’ indicate in the name of a compound.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	
2. Observing		7. Raising Questions		12. Recording Information	✓
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 2: Diagram of the Periodic Table.	
Resource 3: Model of water molecule and formula for water	
Poster: The Periodic Table of the Elements	
Projector and lap top with internet	
Clay, plasticine or play dough	Papier Mache made with flour, water and glue Coloured crayons, paper and a pair of scissors

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What is a compound made of?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

*Compounds are made of elements that are **chemically bonded** (joined together).*

D ACCESSING INFORMATION

1. Write the following information on the chalkboard (always try to do this before the lesson starts):

NAMING COMPOUNDS, FORMULAE FOR COMPOUNDS

1. Many compounds are named according to their elements.
2. If the compound name ends in 'ide', there are two elements in the compound.
3. If the compound name ends in 'ate', there are three elements in the compound, one of which is oxygen.
4. The prefix indicates how many atoms of a particular element are in the compound:
5. The learners should know the following: 'mono' (one), 'di' (two) and 'tri' (three).
6. Some compounds have common names. Example: water (H_2O); and ammonia (NH_3).
7. The formula of the compound tells you the symbols of the elements in the compound and the ratio of the number of atoms of each element in the compound.
8. The formula for water tells you that there is a ratio of two hydrogen atoms and one oxygen atom.

2. Explain this to the learners as follows:
    a. Many compounds are named according to their elements.
    b. Compounds are made of elements that are chemically bonded (joined together).
    c. The elements in compounds are the elements found in the Periodic Table of the Elements.
3. Use Resource 3 as you explain how the formula for a compound works:
    a. The formula for the compound tells you the symbols of the elements in the compound and the ratio of the number of atoms of each element in the compound. For example, water is a compound made when the elements hydrogen (H) and oxygen (O) are joined together. We use the symbol H for hydrogen and O for oxygen to write the formula for water. Because there are two hydrogen atoms in water, we write the number 2 as a **subscript** after the symbol H for hydrogen. This gives us the formula H_2O for the compound we call water.
    b. When writing the symbol for a molecule, it is important that you use capitals and lower-case letters correctly: each new element must begin with a capital letter.

       An example is: Co is the metal element cobalt, but CO is the poisonous gas carbon monoxide.
4. Explain to learners how to use names of compounds:
    a. If the compound name ends in 'ide', there are two elements in the compound. For example, the compound magnesium sulfide contains two elements, namely magnesium and sulfur.
    b. If the compound name ends in 'ate', there are three elements in the compound, one of which is oxygen. For example, the compound calcium sulfate contains three elements, namely calcium, sulfur and oxygen.
5. Explain to learners how to follow the steps to name a compound*:

   Step 1: Look at the formula for the compound and identify the elements in the compound.

   Step 2: Write down the symbol for the metal first.

   Step 3: If the compound contains only two elements, name the second element and change the ending to 'ide'.

   Step 4: If the compound contains three elements, one of which is oxygen, name the element that is not oxygen and change the ending to 'ate'.

   *Note: There are some exceptions to these rules. For example, NaOH is called sodium hydroxide even through there are three elements in the compound.
6. Draw learners' attention to the fact that the atoms and molecules in molecular drawings do not actually look like the drawings given. The drawings are representations to help them understand chemistry better.
7. Ask the learners if they have any questions.

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

1. Carbon monoxide is a poisonous gas. How many elements are in the compound carbon monoxide?
2. How many atoms of oxygen are there in the carbon dioxide we breathe out?

Answers to the checkpoint questions are as follows:

1. Two (carbon and oxygen)
2. Two ('di' means two)

E CONCEPTUAL DEVELOPMENT

1. This activity will be done in groups.
2. To do this activity, each group will need the following:
   - clay/ plasticine/ dough/ (preferably in a variety of colours)
   - matches/ toothpicks/ straws/ small thin lengths of stick
   - tinfoil (optional)
   - paper scraps for labels
   - tape for sticking
   - prestik (optional)
   - round seeds and/or beads in different colours (optional)
   - pens or markers
3. Ensure you have these materials prepared for each group before the lesson starts.
4. Tell the learners that in this lesson they are going to be constructing models of chemical compounds.
5. Divide the learners into groups of six.
6. Write the following onto the chalkboard (always try to do this before the lesson starts):

PRACTICAL TASK

1. This practical task will be done in groups of 6.
2. Each group will be looking at three chemical compounds.
3. Each person in the group must participate in the planning and construction of the models.
4. Only one set of models will need to be handed in by each group, but each learner must complete the written tasks in their workbooks for further assessment.
5. Each group will need the following materials and equipment to do the investigation:
   - clay/ plasticine/ dough/ (preferably in a variety of colours)
   - matches/ toothpicks/ straws/ small thin lengths of stick
   - tinfoil (optional)
   - paper scraps for labels
   - tape for sticking

- prestik (optional)
- round seeds and/or beads in different colours (optional)
- pens or markers

6. You will need to refer to "The Periodic Table of the Elements" to complete this task

7. Read through the practical task with the learners.
8. Tell the learners that today they are going to be constructing three different models of compound substances.
9. Remind the learners that a compond substance is a substance that is made up of two or more elements that are chemically bonded together.
10. Have each group collect the equipment they will need (as listed on the board) for the task.
11. Write the following "Investigation method" onto the chalkboard

Task 1 (6 marks)

1.1 Using the Periodic Table name the two elements in the compound NaCl.
1.2 What is the name of this compound?
1.3 What is the ratio of the elements in this compound?
1.4 Draw a basic representation of the compound with labels.
1.5 Using the materials you have available, construct a 3-dimensional model of this compound.
1.6 Label the elements on the model.

12. Read through the task with the learners.
13. Remind the learners that a 3-dimensional object is an object that can be seen from all sides.
14. Tell the learners they will need to be creative when making the model.
15. Explain that they will have to look carefully at the materials they have and discuss as a group what will be suitable for constructing the model.
16. Ask them if they have any questions.
17. Tell the learners they have 10 minutes to complete this task.
18. Supervise the learners whilst they complete the task and answer any questions that they may have.
19. After 10 minutes call the learners back to attention.
20. Tell the learners that they are now going to work together as a group to complete task 2.
21. The following will need to be written on the chalkboard:

Task 2 (7 marks)

2.1 Using the Periodic Table name the two elements in the compound $CaBr_2$.
2.2 What is the name of this compound?
2.3 What is the ratio of the elements in this compound?
2.4 Draw a basic representation of the compound with labels.
2.5 Using the materials you have available, construct a 3-dimensional model of this compound.
2.6 Label the elements on the model.

22. Read through task 2 with the learners.
23. Ask them if they have any questions.
24. Tell the learners they have 10 minutes to complete task 2 and to answer the questions in their workbooks.
25. Supervise the learners whilst they complete the task and answer any questions they may have.
26. After 10 minutes call the learners back to attention.
27. Tell the learners that they are now going to work together, as a group, to complete task 3.
28. The following will need to be written on the chalkboard:

Task 3 (7 marks)

3.1 Using the Periodic Table name the three elements in the compound Na_2CO_3.
3.2 What is the name of this compound?
3.3 What is the ratio of the elements in this compound?
3.4 Draw a basic representation of the compound with labels.
3.5 Using the materials you have available, construct a 3-dimensional model of this compound.
3.6 Label the elements on the model.

29. Read through the method with the learners.
30. Ask them if they have any questions.
31. Tell the learners they have 15 minutes to complete this task.
32. Supervise the learners whilst they complete the task and answer any questions they may have.
33. After 15 minutes call the learners back to attention.
34. Ensure that learners have remembered to put their names on their models.
35. Have learners hand in their models and workbooks.
36. Learners must then tidy up practical activity areas and hand back equipment.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Compounds	110-114
Solutions for all	Compounds	105-108
Spot On	Compounds and chemical reactions	60-61
Top Class	Compounds	88-90
Via Afrika	Compounds	79
Platinum	Compounds and chemical reactions	75
Oxford Successful	Compounds	73-75
Pelican Natural Sciences	Compounds	106-110
Sasol Inzalo Bk A	Compounds	160-165

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. http://www.mstworkbooks.co.za/natural-sciences/gr9/gr9-mm-01.html#toc-id-13 [Names of compounds]
2. https://phet.colorado.edu/en/simulation/build-a-molecule [Build a molecule simulator]

TOPIC OVERVIEW:
Chemical reactions
Term 2, Weeks 2A – 2C

A. TOPIC OVERVIEW

- This topic runs for 1 week.
- It is presented over 3 lessons.
- This topic's position in the term is as follows:

LESSON	WEEK 1			WEEK 2			WEEK 3			WEEK 4			WEEK 5		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

LESSON	WEEK 6			WEEK 7			WEEK 8			WEEK 9			WEEK 10		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

B. SEQUENTIAL TABLE

GRADE 8	GRADE 9	GRADE 10 - 12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Atoms • Chemical reactions	• Chemical equations to represent reactions • Balanced equations	Grade 10 • Representing chemical change (balanced chemical equations)

C. SCIENTIFIC VOCABULARY

Ensure that you teach the following vocabulary at the appropriate place in the topic:

	TERM	EXPLANATION
1.	chemical reaction	Chemical process that occurs when two or more substances react to form new substances
2.	reactants	The substances that react in a chemical reaction
3.	products	Substances that are made as a result of a chemical reaction
4.	balanced equation	Equation in which there is exactly the same number of atoms on the reactant side as the product side

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

Chemical reactions occur between substances with certain properties in order to form new substances with different properties. It is important that we know how chemical reactions occur because chemical reactions occur in our daily lives. Rusting is an example of a chemical reaction.

E. PERSONAL REFLECTION

Reflect on your teaching at the end of each topic:

Date completed:	
Lesson successes:	
Lesson challenges:	
Notes for future improvement:	

2 A

Term 2, Week 2, Lesson A
Lesson Title: Introducing chemical reactions
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Chemical equations to represent reactions
CAPS Page Number	64

Lesson Objectives

By the end of the lesson, learners will be able to:

- use models to represent chemical reactions
- use symbols to represent chemical reactions
- explain the use of a subscript in a chemical formula
- explain the significance of the numbers in front of compounds
- explain that no atoms are lost or gained in a chemical reaction.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	✓

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	
2. Observing		7. Raising Questions		12. Recording Information	
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 4: Reactants and products.	
Resource 5: What do the numbers tell us?	
Poster: The Periodic Table of Elements	
Projector and laptop with internet	
Modelling clay or playdough or snap beads	Paper mache (use food colouring to make at least two different colours) Different-coloured circles (two colours) Coloured beans

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What is a chemical reaction?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

A chemical process in which two or more substances react to form new substances.

D ACCESSING INFORMATION

1. Write the following information and draw the following reactions on the chalkboard (always try to do this before the lesson starts):

CHEMICAL REACTIONS

1. Chemical substances can break apart and join together in a chemical reaction.
2. A chemical reaction is a process that occurs when two or more substances react to form new substances.
3. The substances that react in a chemical reaction are called reactants.
4. Substances that are made as a result of a chemical reaction are called products.
5. The subscript number indicates the number of atoms of an element in the compound.
6. The numbers in front of some formulae indicate the ratio in which the molecules react.
7. No atoms are lost or gained in a chemical reaction. They are just rearranged.

CHEMICAL REACTIONS

$2H_2 + O_2 \rightarrow 2H_20$

$CO_2 \rightarrow C + O_2$

2. Use Resource 4 to show products and reactants.
3. Explain to the learners that:
   a. A chemical reaction is a process that occurs when two or more substances react to form new substances.
   b. **Reactants** are the substances that react in a chemical reaction. Hydrogen and oxygen are the reactants in the chemical reaction shown.
   c. **Products** are the substances that are made as a result of a chemical reaction. Water is the product in the chemical reaction shown.
4. Use Resource 5 to show learners what the numbers mean.
5. Explain to the learners that:
   a. The subscript indicates the number of atoms in an element. In the example, there are two hydrogen atoms in the product.
   b. The numbers in front of some formulae indicate the ratio in which the molecules react. In this example, two molecules of hydrogen react with one molecule of oxygen.
   c. We do not write the numeral 1 if there is only one molecule of the element. For example, we do not write $2H_2 + O_2 \rightarrow 2H_210$.
   d. Elements and compounds are pure substances, because they consist of only one type of material.
6. During a chemical reaction, atoms are not lost or gained as the atoms in the reactants are simply rearranged to form new groups of atoms in the product.
7. We can use pictures and models to represent chemical reactions.

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. If a molecule has a subscript of three, what does that tell you?
b. What is the ratio of hydrogen molecules to oxygen molecules in water?

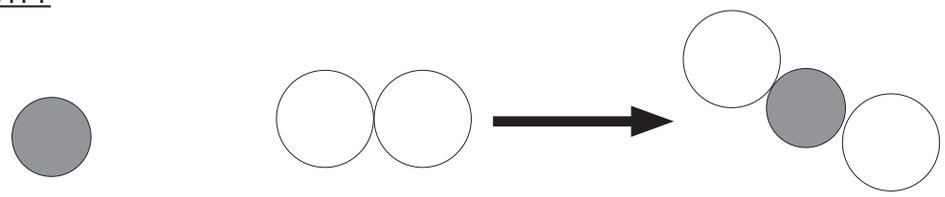
Answers to the checkpoint questions are as follows:

a. The element has three atoms.
b. 2 : 1

E CONCEPTUAL DEVELOPMENT

1. Ensure that the Poster of Elements, and Resources 4 and 5, are displayed in the classroom so that learners can refer to them.
2. Draw and write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY



One carbon atom One oxygen molecule One carbon dioxide molecule

TASK 1

1. Work in groups of three.
2. Build each atom and molecule shown.
3. Arrange the models and arrow to represent a chemical reaction in which carbon reacts with oxygen to form carbon dioxide.

TASK 2

1. Name the reactants and products in the chemical reaction.
2. Explain how the atoms in the reactants rearrange to form the product.
3. Write a formula to represent the chemical reaction between carbon and oxygen that forms carbon dioxide.

3. Explain Task 1 to the learners as follows:
   a. Work in groups of three.
   b. The diagrams show a carbon atom, an oxygen molecule and a carbon dioxide molecule.
   c. Study the diagrams carefully. Note the number of each atom or molecule.
   d. Use the material (for example, playdough) which your teacher has provided to build a model of each atom or molecule.
   e. Place the models and the arrow in such a way that you represent a chemical reaction in which carbon reacts with oxygen to form carbon dioxide.
4. When the learners have completed Task 1, discuss and compare their models.
5. Next, get the learners to do Task 2 as follows:
   a. Remind learners to refer to the Poster of the Periodic Table and Resources 4 and 5, as they answer the questions in their workbooks.
   b. Learners should work on their own to answer the questions in their workbooks.
6. The answers to the questions are provided below. Check the answers with the learners.

1. *Reactants: carbon and oxygen.*

   Product: carbon dioxide
2. *One carbon atom reacts with two oxygen atoms to form CO_2.*
3. *$C + O_2 \rightarrow CO_2$*

7. Discuss the answers with the learners.

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. The chemical equation for zinc oxide is 2ZnO. How many different reactants are there?

b. Is this statement true or false? The subscript number indicates the number of compounds found in the formula.

Answers to the checkpoint questions are as follows:

a. Two – zinc and oxygen

b. False. The subscript number indicates the number of atoms of an element found in the formula.

8. Discuss the answers with the learners.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Chemical reactions	115-116
Solutions for all	Chemical reactions	112-113
Spot On	Compounds and chemical reactions	62-63
Top Class	Chemical reactions	91-93
Via Afrika	Chemical reactions	80-82
Platinum	Compounds and chemical reactions	75
Oxford Successful	Chemical reactions	76-77
Pelican Natural Sciences	Chemical reactions	115-119
Sasol Inzalo Bk A	Chemical reactions	172-179

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?v=Tz00efBcsjo (2min 6sec) [Chemical Reactions in Everyday Life]
2. https://www.youtube.com/watch?v=iUdU3I0zZGk (8min 21sec) [Introduction to Chemical Reactions]

2 B

Term 2, Week 2, Lesson B
Lesson Title: Balanced equations
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Balanced equations
CAPS Page Number	64

Lesson Objectives

By the end of the lesson, learners will be able to:

- identify balanced and unbalanced equations for chemical reactions
- write equations in such a way that the number and type of atoms of the reactants are the same as the number and type of atoms of the product
- write equations for chemical reactions using the format: reaction (on lhs), reaction arrow, product (on rhs)
- describe the law of conservation of matter.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	
2. Observing		7. Raising Questions		12. Recording Information	✓
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 4: Reactants and products.	Paper mache (use food colouring to make at least two different colours) Different-coloured circles (two colours)
Resource 5: What do the numbers tell us?	
Resource 6: Balanced chemical equations	
Poster: The Periodic Table of Elements	
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What is the product of a chemical reaction?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

A substance that is made as a result of a chemical reaction.

D ACCESSING INFORMATION

1. Write the following information and draw the following balanced chemical reaction on the chalkboard (always try to do this before the lesson starts):

BALANCED EQUATIONS

1. We always write the reactant/s on the left-hand side of the reaction arrow and the product/s on the right-hand side of the reaction arrow.
2. A balanced equation has the same number of atoms on each side of the reaction arrow.
3. No atoms are lost or gained in a chemical reaction. They are just rearranged. This is called the Law of Conservation of Matter.

A BALANCED CHEMICAL REACTION

$Cu + Cl_2 \longrightarrow CuCl_2$

2. Use Resource 6 to show balanced chemical reactions.
3. Explain to the learners that in the $CuCl_2$ example:
   a. There are two chlorine atoms and one copper atom in the reactant (on the left- hand side). The chlorine atoms are bonded.
   b. There are two chlorine atoms and one copper atom in the product (on the right- hand side). The atoms are bonded.
   c. The same number of atoms appears on each side of the reaction arrow, so we can say that the chemical reaction is balanced.
   d. No atoms have been gained or lost in the chemical reaction.
4. Explain to the learners that in the CO_2 example:
   a. There are two oxygen atoms (bonded) and one carbon atom in the reactant (on the left-hand side). The carbon atom is not bonded to the oxygen atoms.
   b. There are two oxygen atoms and one carbon atom in the product (on the right- hand side). The atoms are bonded.
   c. The same number of atoms appears on each side of the reaction arrow, so we can say that the chemical reaction is balanced.
   d. During the chemical reaction, the bonded atoms in the reactant broke and formed new bonds in the product.
   e. No atoms have been gained or lost in the chemical reaction.

Checkpoint 1

Ask learners the following questions to check their understanding at this point:

a. If there are three atoms in the reactant, how many atoms should there be in the product, if it is a balanced equation?
b. If there are two atoms in the product, how many atoms should there be in the reactant, if it is a balanced equation.

Answers to the checkpoint questions are as follows:

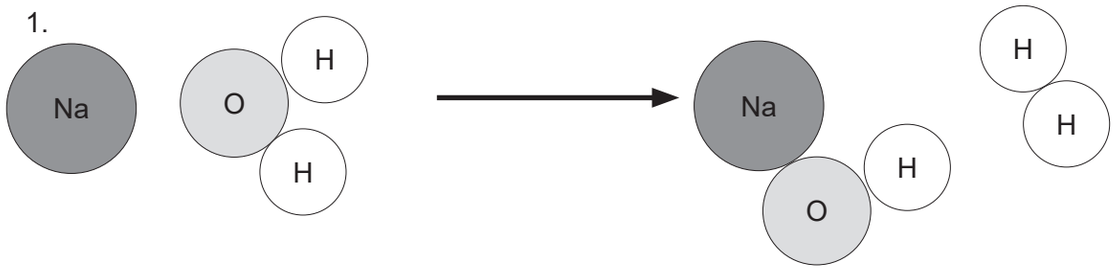
a. Three atom
b. Two atoms

E CONCEPTUAL DEVELOPMENT

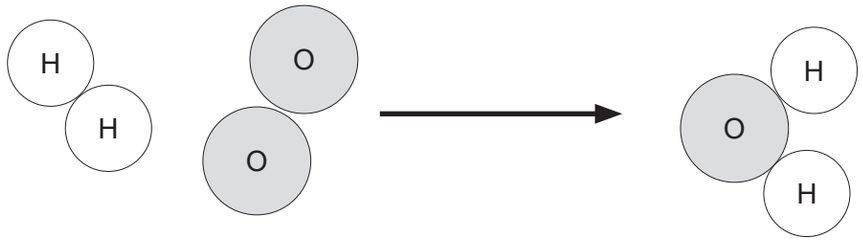
1. Ensure that the Poster of Elements and Resources 4, 5 and 6 are displayed in the classroom so that learners can refer to them.
2. Draw the following two chemical reactions on the chalkboard (always try to do this before the lesson starts):

ACTIVITY

1.



2.



TASK 1

For each reaction:

1. Check whether the same elements are present in the reactant and product.

TASK 2

For each reaction:

1. Count the number of atoms in the reactant and product.
2. Check whether the same number of atoms is present in the reactant and product.
3. State whether the chemical reaction is balanced. Give a reason for your answer.

4. Explain Task 1 to the learners as follows:
   a. Work with a partner.
   b. Each diagram shows a chemical reaction expressed as follows:
      reactant/s → product/s.
   c. Study the reaction diagrams carefully. Note the elements in the reactant and product of each reaction.
   d. If the same elements are not present in the reactant/s and the product/s of a reaction, then the reaction cannot be balanced.

5. When the learners have completed Task 1, discuss their answers.
6. Next, get the learners to do Task 2 as follows:
   a. Work with a partner.
   b. Study the reaction diagrams carefully. Note the number of atoms in the reactant and product of each reaction.
   c. If the same number of atoms is not present in the reactant/s and the product/s of a reaction, then the reaction cannot be balanced.
7. The answers to the questions are provided below. Check the answers with the learners.

MODEL ANSWERS

TASK 1

1. *Chemical reaction 1: The same elements (namely sodium, hydrogen and oxygen) are present in the reactants and products.*
2. *Chemical reaction 2: The same elements (hydrogen and oxygen) are present in the reactants and products.*

TASK 2

1. *Chemical reaction 1: There is one sodium, one oxygen and two hydrogen atoms on the left, but one sodium, one oxygen and three hydrogen atoms on the left.*
2. *Chemical reaction 2: There are two oxygen atoms and two hydrogen atoms on the left, but one oxygen atom and two hydrogen atoms on the right.*
3. *Chemical reaction 1 is not balanced because there is not the same number of atoms in the reactant and product.*
4. *Chemical reaction 2: is not balanced because there is not the same number of atoms in the reactant and product.*

8. Discuss the answers with the learners. Add further explanations if necessary.

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. How do we check whether a chemical equation is balanced?
b. During a chemical reaction, atoms are not lost or gained. What do we call the law that describes this?

Answers to the checkpoint questions are as follows:

a. The same elements and the same number of atoms must be present in the reactant and the product.
b. Law of Conservation of Matter

9. Ask learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Solutions for All	Chemical reactions	116
Via Afrika	Chemical reactions	113-118
Oxford Successful	Compounds and chemical reactions	64-66
Pearson: Spot On	Chemical reactions	93-95
Pearson: Platinum	Chemical reactions	82-83
Shuters Top Class	Compounds and chemical reactions	75
Step-by-Step	Chemical reactions	78-79
Pelican Natural Sciences	Chemical reactions	119-122
Sasol Inzalo Bk A	Chemical reactions	180-185

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?v=JCyjLPYXl1I (3min 47sec) [What Is The Law of Conservation of Mass]
2. https://www.youtube.com/watch?v=oDVswHfZJzY (9min 37sec) [How to Balance Chemical Equations - Simple Method for Beginners]
3. https://phet.colorado.edu/en/simulation/balancing-chemical-equations [Balancing chemical equations Phet simulation]

2 C

Term 2, Week 2, Lesson C
Lesson Title: Balancing chemical equations organisms
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Balancing equations
CAPS Page Number	64

Lesson Objectives

By the end of the lesson, learners will be able to:

- write equations in such a way that the number and type of atoms of the reactants are the same as the number and type of atoms of the product
- write equations for chemical reactions using the format: reaction (on lhs), reaction arrow, product (on rHS).

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	
2. Observing		7. Raising Questions		12. Recording Information	✓
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 6: Balanced chemical equations. Page 13	
Resource 7: Balancing the equation for brown rusty coating. Page 14	
Poster: The Periodic Table of Elements	
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What is a balanced chemical reaction?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

An equation in which there is exactly the same number of atoms on the reactant side (or left-hand side) as the product side (or right-hand side).

D ACCESSING INFORMATION

1. Write the following information and the accompanying balanced chemical reaction on the chalkboard (always try to do this before the lesson starts):

BALANCING EQUATIONS

1. When you write a chemical equation it must be balanced.
2. In a balanced equation the total number and type of atoms in the reactants are the same as in the products.
3. You cannot change the composition of a molecule or atom in order to balance a chemical equation, but you can change the number of molecules or atoms.
4. When balancing an equation, do not change the small numbers. Only change the big numbers. By doing this, you change the number of molecules.
5. By changing the number of molecules or atoms, you are able to conserve or keep the matter in the chemical reaction.

TOPIC: Chemical reaction

AN UNBALANCED EQUATION

$Fe + O_2 \rightarrow Fe_2O_3$ (brown rusty coating)

A BALANCED EQUATION

$4Fe + 3O_2 \rightarrow 2Fe_2O_3$

1. Use Resource 7 to show learners an example of how to balance a chemical equation.
2. Explain to the learners that in the Fe_2O_3 (brown rusty coating) example:
    a. The first equation is unbalanced because there is not the same number of Fe atoms on the reactant side and product side; and O atoms on the reactant side and product side of the reaction arrow.
    b. In the first equation, there is one Fe atom on the reactant side and two Fe atoms on the product side.
    c. In the first equation, there are two O atoms on the reactant side and three O atoms on the product side.
    d. The second equation is balanced because there are the same number of Fe atoms on the reactant side as on the product side. The same number of O atoms appears on the reactant side as on the product side of the reaction arrow.
    e. In the second equation, there are four Fe atoms on the reactant side and four Fe atoms on the product side of the reaction arrow.
    f. In the second equation, there are six O atoms on the reactant side and six Fe atoms on the product side of the reaction arrow.

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. How do you balance a chemical equation?
b. Is this statement true or false? In a balanced equation, the number of atoms on the left-hand side of the reaction arrow should be the same as the number of molecules on the right-hand side of the arrow.

Answers to the checkpoint questions are as follows:

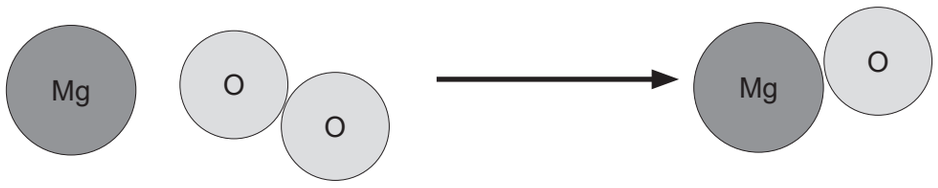
a. A chemical equation is balanced by changing the big numbers in front of the formula so that there is the same number and type of atoms on both sides of the reaction arrow.
b. False

E CONCEPTUAL DEVELOPMENT

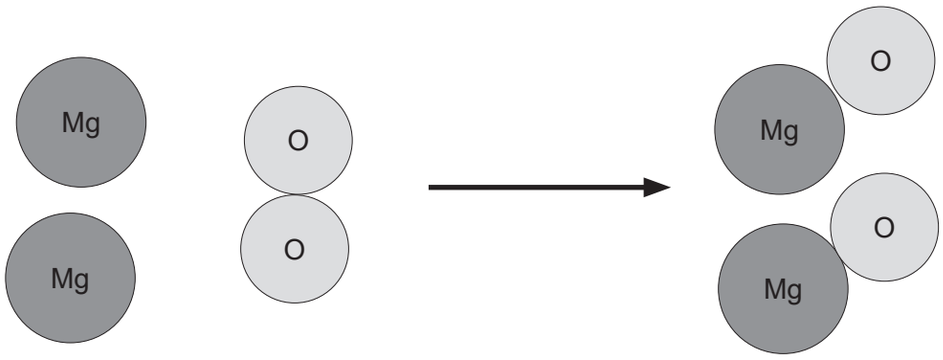
1. Ensure that the Poster of Elements and Resources 6 and 7 are displayed in the classroom so that learners can refer to them.
2. Draw the following two chemical reactions on the chalkboard (always try to do this before the lesson starts):

ACTIVITY

1.



2.



TASK 1

For each reaction:

1. Write the chemical equation

TASK 2

For each reaction:

1. State whether the equation is balanced or unbalanced. Give reasons for your answers.
2. Explain what was done in order to balance the unbalanced equation.

3. Explain to the learners the activity as follows:
   a. Work with a partner.
   b. Each diagram shows a chemical reaction.
   c. Study the reaction diagrams carefully.
   d. Write the chemical equation for each reaction. Use this format:
   e. reactant/s → product/s
4. When the learners have completed Task 1, discuss their answers. Where necessary, correct chemical equations before learners do Task 2.

5. Next, get the learners to do Task 2 as follows:
   a. Work with a partner.
   b. Study your two chemical equations carefully.
   c. Using what you learnt in the previous lesson, decide whether or not each equation is balanced.
6. You will find that one of the equations is not balanced. Explain what was done to balance the equation.
7. The answers to the questions are provided below. Check the answers with the learners.

MODEL ANSWERS

TASK 1

1. *Chemical equation 1: $Mg + O_2 \rightarrow MgO$*
   Chemical equation 2: $2Mg + O_2 \rightarrow 2MgO$

TASK 2

1. *Chemical equation 1: This equation is not balanced. Although there is one magnesium atom on each side of the reaction arrow, there are two oxygen atoms on the reactant side but only one oxygen atom on the product side of the reactant arrow.*

   Chemical equation 2: This equation is balanced. There are two oxygen atoms on the reactant side and two oxygen atoms on the product side. There are two magnesium atoms on the reactant side and two magnesium atoms on the product side.
2. *An additional magnesium atom was added in order to balance the equation.*

8. Discuss the answers with the learners. Add further explanations as necessary.

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. What needs to be done to balance the following equation?

   $Na + O_2 \rightarrow Na_2O$

   What needs to be done to balance the following equation?

b. $NH_3 + Cl_2 \rightarrow N_2 + HCl$

Answers to the checkpoint questions are as follows:

a. By changing the number in front of Na to four, another three Na atoms are added to the reactant side.

   By increasing the number in front of Na_2O to two, another two Na atoms are added and one O atom is added to the product side.

The balanced equation is:

$4Na + O_2 \rightarrow 2Na_2O$.

b. By changing the number in front of NH_3 to two, one N atom and 3 H atoms are added to the reactant side.

By changing the number in front of Cl_2 to three, four Cl atoms are added to the reactant side.

By increasing the number in front of HCl to six, another five H and five Cl atoms are added to the product side.

The balanced equation is:

$2NH_3 + 3Cl_2 \rightarrow N_2 + 6HCl$.

9. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Chemical reactions	116
Solutions for all	Chemical reactions	119-120
Spot On	Compounds and chemical reactions	64-66
Top Class	Chemical reactions	93-95
Via Afrika	Chemical reactions	82-83
Platinum	Compounds and chemical reactions	75
Oxford Successful	Chemical reactions	78-79
Pelican Natural Sciences	Chemical reactions	119-122
Sasol Inzalo Bk A	Chemical reactions	186-191

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://phet.colorado.edu/en/simulation/balancing-chemical-equations [Balancing chemical equations Phet simulation]
2. https://www.youtube.com/watch?v=UGf60kq_ZDI (8min 59sec) [Balancing Chemical Equations - Chemistry Tutorial]
3. https://www.youtube.com/watch?v=2Juem0IcifE (8min 53sec) [How to balance a Chemical Equation EASY]

TOPIC OVERVIEW:
Reactions of metals with oxygen
Term 2, Weeks 3A – 4A

A. TOPIC OVERVIEW

Term 2, Weeks 3a – 4a

- This topic runs for 1½ weeks.
- It is presented over 4 lessons.
- This topic's position in the term is as follows:

LESSON	WEEK 1			WEEK 2			WEEK 3			WEEK 4			WEEK 5		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

LESSON	WEEK 6			WEEK 7			WEEK 8			WEEK 9			WEEK 10		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

B. SEQUENTIAL TABLE

GRADE 8	GRADE 9	GRADE 10 - 12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Some properties of metals, semi-metals and non-metals	• The general reaction of metals with oxygen • Reaction of iron with oxygen • Reaction of magnesium with oxygen • Formation of rust	Grade 10 • Describe matter from the concepts: atoms, elements, compounds, chemical reactions • Illustrate the conservation of atoms and non-conservation of molecules during chemical reactions using models of reactant molecules Grade 11 • Atomic combinations: • molecular structure • Empirical formula and molecular formula of compounds

C. SCIENTIFIC VOCABULARY

Ensure that you teach the following vocabulary at the appropriate place in the topic:

	TERM	EXPLANATION
1.	combustion	Rapid chemical reaction with oxygen that produces heat and light
2.	oxide	Compound formed when an element reacts with oxygen
3.	metal oxide	Compound formed when a metal reacts with oxygen
4.	rusting	Slow chemical reaction of iron with oxygen in the air, in the presence of water
5.	corrosion	Process where a metal is damaged or weakened by a chemical reaction
6.	metal	Material that conducts electricity and which is malleable and shiny
7.	flammable	Can burn
8.	electroplating	Process of coating a metal object with a thin layer of another metal by means of electrolysis
9.	electrolysis	The use of electricity to break a compound
10.	odourless	Has no smell
11.	oxidation	Chemical reaction in which a material gives up electrons, for example, when the material combines with oxygen
12.	atmosphere	Layer of air which surrounds the Earth

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

It is important that we know about reactions of metals with oxygen as these reactions have an affect on our everyday lives. Rust is the result of the reaction of iron with oxygen. Knowledge of what causes rust helps us to prevent rust.

When you know how reactions of metals with oxygen work, you can use the knowledge to produce specific products, or to prevent specific reactions.

E. PERSONAL REFLECTION

Reflect on your teaching at the end of each topic:

Date completed:	
Lesson successes:	
Lesson challenges:	
Notes for future improvement:	

3 A

Term 2, Week 3, Lesson A
Lesson Title: General reaction of metals with oxygen
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	General reaction of metals with oxygen
CAPS Page Number	65

Lesson Objectives

By the end of the lesson, learners will be able to:

- explain that some metals react with oxygen during burning
- describe the formation of a metal oxide
- give the general equation for the reaction of a metal with oxygen.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	
2. Observing		7. Raising Questions		12. Recording Information	✓
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	

TOPIC: Reaction of metals with oxygen

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 8: Flashcards.	
Resource 9: Flashcards.	
Prestik or equivalent	
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

Is oxygen a metal or a non-metal?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

Oxygen is a non-metal.

D ACCESSING INFORMATION

1. Write the following information on the chalkboard (always try to do this before the lesson starts):

GENERAL REACTION OF METALS WITH OXYGEN

1. A metal is a material that conducts electricity, and which is malleable and shiny.
2. Oxygen is colourless and odourless.
3. About 21% of the atmosphere consists of oxygen.
4. Some metals react with oxygen during burning (combustion).
5. Combustion produces heat and light.
6. When a substance reacts with oxygen, the reaction is called oxidation.
7. When a metal is oxidised, a new compound called an oxide is formed.

THE GENERAL EQUATION FOR OXIDATION

metal + oxygen → metal oxide

2. Make sure that the poster of the Periodic Table of Elements is on display in the classroom.

   Explain the following to the learners:

   a. Oxygen is a non-metal – get learners to find the element oxygen on the Periodic Table and to provide information about it.
   Answer: It is element number 8 and is a non-metal.

   b. Oxygen is a gas at room temperature.

   c. About 21% of the **atmosphere** consists of oxygen, so there is oxygen in the air we breathe.

   d. Some metals, for example, iron, react with oxygen during burning.

   e. Another word for the process of burning is combustion.

   f. Combustion is usually a rapid reaction that produces heat and light.

3. Use the flashcards (Resource 8 and 9) as you discuss the general reaction of metals with oxygen.

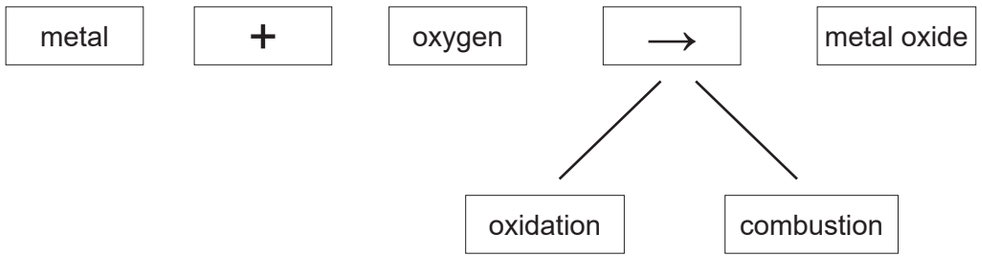
   a. When a substance reacts with oxygen, the reaction is called **oxidation**.

   b. When a metal is burned in air, the metal reacts with the oxygen in the air and a **metal oxide** is formed.

   c. Not all metals react with the oxygen in air to form metal oxides, because some metals are unreactive.

   d. Some metals burn in the presence of oxygen. This process is called combustion.

   e. The flashcard display could look something like this:



Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. What is the product of the process of oxidation?

b. What are the two reactants in the process of oxidation?

Answers to the checkpoint questions are as follows:

a. Metal oxide

b. Metal and oxygen

E CONCEPTUAL DEVELOPMENT

1. Be sure to leave the flashcard display of the general reaction of a metal with oxygen on the chalkboard. Also display the poster of the Periodic Table of Elements.
2. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

TABLE TO SHOW REACTANTS AND PRODUCTS IN THE OXIDATION PROCESS

Reactants	**Metal oxide formed**
Sodium and oxygen	
	Potassium oxide
	Calcium oxide
Zinc and oxygen	
Copper and oxygen	

TASK 1

1. Draw the table in your workbooks.
2. Fill in the missing spaces by writing in the reactants or the product.

TASK 2

1. Write the reaction equation (in words) for the formation of calcium oxide.
2. Write the reaction equation (using chemical symbols) for the oxidation of copper and oxygen.

3. Explain Task 1 to the learners as follows:
   a. The table drawn on the chalkboard has two columns.
   b. The first column has the following heading: Reactants.
   c. The second column has the following heading: Metal oxide formed.
   d. Work on your own. Complete the table by writing in the product if you have been given the reactant, or the reactant if you have been given the product. Give learners some time to complete Task 1 in their workbooks. Remind learners to refer to the Poster of the Periodic Table of Elements, if necessary.
4. Ask learners to share their answers to Task 1 with the class.
5. The completed table is shown below. Fill in the missing reactants and products on the table on the chalkboard.
6. Model Answers: Task 1

MODEL ANSWER: TASK 1

TABLE TO SHOW REACTANTS AND PRODUCTS IN THE OXIDATION PROCESS

Reactants	**Metal oxide formed**
Sodium and oxygen	Sodium oxide
Potassium and oxygen	Potassium oxide
Calcium and oxygen	Calcium oxide
Zinc and oxygen	Zinc oxide
Copper and oxygen	Copper oxide

7. When the learners have completed Task 1, hold a short class discussion on what a reaction equation is: a reaction equation shows the reactants on the left-hand side of the equation arrow and the product/s on the right-hand side of the equation arrow.
8. Next, get the learners to do Task 2 by writing two reaction equations, one in words and one using chemical symbols (refer learners to the Periodic Table of Elements for this).
9. Discuss the answers with the learners.
10. *Model answers: Task 2*

MODEL ANSWER: TASK 2

1. Calcium + oxygen → calcium oxide
2. Cu + O → CuO

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. Is this statement true or false? The chemical equation for oxidation does not need to be balanced.
b. What is the name of the process in which a metal is burned in the presence of oxygen?

Answers to the checkpoint questions are as follows:

a. False
b. Combustion

11. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Reactions of metals with oxygen	117
Solutions for all	Reactions of metals with oxygen	122
Spot On	Reaction of metals and non-metals with oxygen	68
Top Class	Reactions of metals with oxygen	96
Via Afrika	Reactions of metals with oxygen	84
Platinum	Reaction of metals and non-metals with oxygen	89
Oxford Successful	Reactions of metals with oxygen	80
Pelican Natural Sciences	Reactions of metals with oxygen	131-133
Sasol Inzalo Bk A	Reactions of metals with oxygen	194-195 200-201

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?v=Lk1V0buHEFs (3min 26sec) [Reaction of metals with oxygen]

3 B

Term 2, Week 3, Lesson B
Lesson Title: The reaction of iron with oxygen
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The reaction of iron with oxygen
CAPS Page Number	65

Lesson Objectives

By the end of the lesson, learners will be able to:

- explain that some metals react with oxygen during burning
- describe the formation of a metal oxide
- give the general equation for the reaction of a metal with oxygen.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	
2. Observing	✓	7. Raising Questions		12. Recording Information	✓
3. Comparing		8. Predicting	✓	13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	

TOPIC: Reaction of metals with oxygen

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
The Periodic Table of Elements	
Resource 8: Flashcards.	
Resource 9: Flashcards.	
Resource 10: Flashcards.	
Prestik or equivalent	
Bunsen burner, matches, steel wool, tongs, jug of water (in case steel wool starts burning too rapidly)	Candle, blunt pair of scissors/ pliers to hold the steel wool

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What is the general reaction of a metal with oxygen?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

metal + oxygen → metal oxide

D ACCESSING INFORMATION

1. Write the following information on the chalkboard (always try to do this before the lesson starts):

REACTION OF IRON WITH OXYGEN

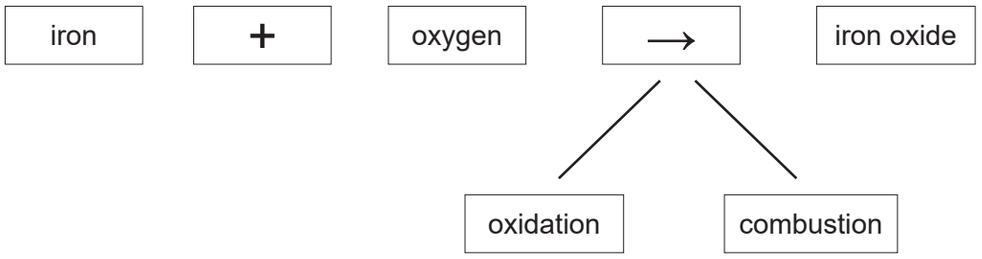
1. Iron is a metal.
2. Combustion occurs when iron burns in the presence of oxygen.
3. Oxygen is present in the air.
4. When the metal iron is burned in air (which contains oxygen), the reaction forms iron oxide as a product.
5. Iron oxide is a reddish-brown powder.

WORD EQUATION FOR REACTION OF IRON WITH OXYGEN

iron + oxygen → iron oxide

TOPIC: Reaction of metals with oxygen

1. Make sure that the poster of the Periodic Table of Elements is on display in the classroom.
2. Get learners to find oxygen and iron on the Periodic Table of Elements and to explain how they know that iron is a metal and oxygen is a non-metal.
    a. Explain the following to the learners:
    b. Oxygen (O) is a non-metal – it appears on the left-hand side of the Periodic Table of Elements along with the other non-metals. Also, the key on the Periodic Table of Elements indicates that oxygen is a non-metal.
    c. Iron (Fe) is a metal – it is in the middle of the Periodic Table of Elements along with the other metals. Also, the key on the Periodic Table of Elements indicates that iron is a metal.
    d. Steel wool contains the element iron.
4. Remind learners that oxygen is present in the air around them.
5. Demonstrate the reaction of iron with oxygen.
    a. Safety precaution: Steel wool gets very hot when it burns and can produce sparks. Ensure that learners cannot touch the burning steel wool and that they stand far enough away from the demonstration not to be burned by sparks. Use the Bunsen burner or the candle with caution.
    b. Get learners to observe as you demonstrate the reaction of iron with oxygen. Remind learners that they must watch carefully as they will need to answer questions later. Learners must particularly note the colour of the flame, and the colour of the iron oxide which is formed.
    c. To demonstrate the reaction of iron with oxygen, use the tongs to hold the steel wool in the flame of the Bunsen burner. Learners should observe what happens.
6. Place all the flashcards from Resources 8, 9 and 10 on a desk. Ask one of the learners to select the relevant flashcards and show on the chalkboard the equation of the reaction of iron with oxygen.
    a. The flashcard display could look something like this:



Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. What is the name of the oxidation process in which iron is burned?
b. What are the two reactants in the process of oxidation of iron?

Answers to the checkpoint questions are as follows:

a. Combustion
b. Iron and oxygen

E CONCEPTUAL DEVELOPMENT

1. Remove the flashcard display of the reaction of iron with oxygen from the chalkboard. Leave the poster of the Periodic Table of Elements on display.
2. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

1. Word equation for the reaction of iron with oxygen:
   _____ + _____ → _____
2. Symbol equation for the reaction of iron with oxygen (unbalanced):
   ____ + ____ → _____
3. Symbol equation for the reaction of iron with oxygen (balanced):
   ____ + ____ → _____

TASK 1

1. Copy and complete equations 1 and 2 in your workbook.

TASK 2

1. Copy and complete equation 3 in your workbook.

3. Explain Task 1 to the learners as follows:
   a. Word equation 1 is incomplete.
   b. The two spaces on the left of the reaction arrow are for the reactants (written in words).
   c. The space on the right of the reaction arrow is for the product (written in words) of the oxidation reaction.
   d. Work on your own. Complete the word equation by writing in the word names for the reactants and the product.
   e. Symbol equation 2 is incomplete.

f. The two spaces on the left of the reaction arrow are for the reactants (written using chemical symbols).

g. The space on the right of the reaction arrow is for the product of the oxidation reaction (written using chemical symbol).

h. Work on your own. Complete the symbol equation by writing in the symbols for the reactants and the product.

9. Ask learners to share their answers to Task 1 with the class.

4. The completed equations are shown below. Fill in the missing words and symbols on the equations on the chalkboard.

5. Model answers: Task 1

TASK 1

1. iron + oxygen → iron oxide
2. $Fe + O_2 \rightarrow Fe_2O_2$ (unbalanced)

6. When the learners have completed Task 1, hold a short class discussion to revise:

a. A balanced equation: In a balanced equation the total number and type of atoms in the reactants is the same as in the products.

b. How to balance an equation: Balance an equation by changing the big numbers in order to change the number of molecules and, in so doing, change the number of atoms.

7. Next, get the learners to do Task 2 by balancing equation 3.

8. Discuss the answers with the learners.

9. Model answer: Task 2

TASK 2

1. $4Fe + 3O_2 \rightarrow 2Fe_2O_3$

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. What is the molecular formula for iron oxide?

b. What is the colour of the iron oxide which is formed as the product of the oxidisation of iron?

Answers to the checkpoint questions are as follows:

a. Fe_2O_3

b. Reddish-brown

10. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Solutions for All	Reactions of metals with oxygen	117
Via Afrika	Reactions of metals with oxygen	124
Oxford Successful	Reaction of metals and non-metals with oxygen	68
Pearson: Spot On	Reactions of metals with oxygen	96-98
Pearson: Platinum	Reactions of metals with oxygen	85
Shuters Top Class	Reaction of metals and non-metals with oxygen	89
Step-by-Step	Reactions of metals with oxygen	80-81
Pelican Natural Sciences	Reactions of metals with oxygen	133-134
Sasol Inzalo Bk A	Reactions of metals with oxygen	195-197

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?time_continue=54&v=5MDH92VxPEQ (1min 56sec) [Burn steel wool]

3 C

Term 2, Week 3, Lesson C
Lesson Title: The reaction of magnesium with oxygen
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The reaction of magnesium with oxygen
CAPS Page Number	65

Lesson Objectives

By the end of the lesson, learners will be able to:

- describe what happens when magnesium is oxidised
- give the general equation for the reaction of magnesium with oxygen.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	
2. Observing	✓	7. Raising Questions		12. Recording Information	✓
3. Comparing		8. Predicting	✓	13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	

TOPIC: Reaction of metals with oxygen

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Periodic Table of Elements	
Resource 8: Flashcards.	
Resource 9: Flashcards.	
Resource 10: Flashcards.	
Prestik or equivalent	
Bunsen burner, matches, magnesium ribbon, tongs, safety glasses, jug of water (in case magnesium ribbon starts burning too rapidly)	Candle, blunt pair of scissors/ pliers to hold the magnesium ribbon

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What do we call the product of the reaction of iron with oxygen?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

To transport blood containing oxygen to the body cells and to transport carbon dioxide away from the body cells

D ACCESSING INFORMATION

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

REACTION OF MAGNESIUM WITH OXYGEN

1. Magnesium is a metal.
2. When magnesium is burned in air (which contains oxygen), the reaction forms magnesium oxide as a product.
3. Magnesium oxide is a white powder.

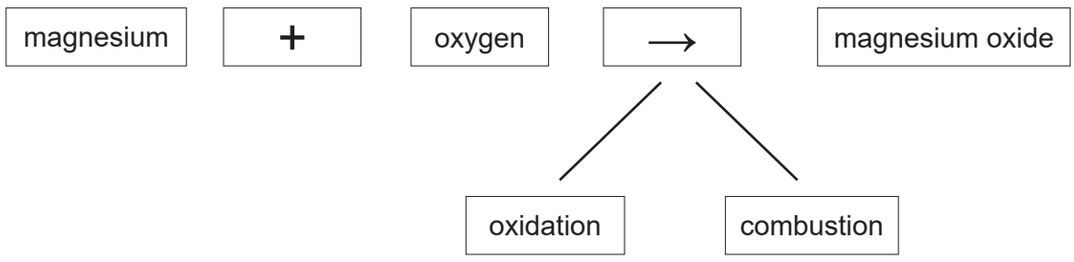
WORD EQUATION FOR REACTION OF MAGNESIUM WITH OXYGEN

iron + oxygen → iron oxide

2. Make sure that the poster of the Periodic Table of Elements is on display in the classroom.
3. Get learners to find magnesium on the Periodic Table of Elements and to explain how they know that magnesium is a metal.

   Explain the following to the learners:

   a. Magnesium (Mg) is a metal – it is on the left side of the Periodic Table of Elements along with the other metals. Also, the key on the Periodic Table of Elements indicates that iron is a metal.
   b. Magnesium is **flammable**.
4. Remind learners that oxygen is a non-metal and is a gas at room temperature.
5. Demonstrate the reaction of magnesium with oxygen.
   a. Safety precaution: The light from burning magnesium is blinding white. As you have to handle the burning magnesium, you must wear safety glasses. Tell the learners that they should not look at the flame directly, but should look at the side of the flame. Use the Bunsen burner or a candle with caution.
   b. Get learners to observe as you demonstrate the reaction of magnesium with oxygen. Remind learners that they must watch carefully as they will need to answer questions later. Learners must particularly note the colour of the flame, and the colour of the magnesium oxide which is formed.
   c. To demonstrate the reaction of magnesium with oxygen, use the tongs to hold the magnesium ribbon in the flame of the Bunsen burner. Learners should observe what happens.
   d. Note: Keep the product of the reaction of magnesium and oxygen in a safe place. You will need it for the lesson on reactions of acids with metal oxides.
6. Place all the flashcards from Resources 8, 9 and 10 on a desk. Ask one of the learners to select the relevant flashcards and show the equation of the reaction of magnesium with oxygen on the chalkboard.
   a. The flashcard display could look something like this:



TOPIC: Reaction of metals with oxygen

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. What is the name of the oxidation process in which magnesium is burned?

b. What product is formed in the process of oxidation of magnesium?

Answers to the checkpoint questions are as follows:

a. Combustion

b. Magnesium oxide

E CONCEPTUAL DEVELOPMENT

1. Remove the flashcard display of the reaction of magnesium with oxygen from the chalkboard. Leave the poster of the Periodic Table of Elements on display.
2. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

1. Word equation for the reaction of magnesium with oxygen:
   _____ + _____ → _____
2. Symbol equation for the reaction of magnesium with oxygen (unbalanced):
   ____ + ____ → _____
3. Symbol equation for the reaction of magnesium with oxygen (balanced):
   ____ + ____ → _____

TASK 1

1. Copy and complete equations 1 and 2 in your workbook.

TASK 2

1. Copy and complete equation 3 in your workbook.

4. Explain Task 1 to the learners as follows:
   a. Word equation 1 is incomplete.
   b. The two spaces on the left of the reaction arrow are for the reactants (written in words).
   c. The space on the right of the reaction arrow is for the product (written in words) of the oxidation reaction.
   d. Work on your own. Complete the word equation by writing in the word names for the reactants and the product.
   e. Symbol equation 2 is incomplete.

f. The two spaces on the left of the reaction arrow are for the reactants (written using chemical symbols).

g. The space on the right of the reaction arrow is for the product of the oxidation reaction (written using chemical symbols).

h. Work on your own. Complete the word equation by writing in the symbols for the reactants and the product.

5. Ask learners to share their answers to Task 1 with the class.
6. The completed equations are shown below. Fill in the missing words and symbols on the equations on the chalkboard.
7. Model answers: Task 1

TASK 1

1. magnesium + oxygen → magnesium oxide
2. $Mg + O_2 \rightarrow MgO$ (unbalanced)

8. When the learners have completed Task 1, hold a short class discussion to revise:
   a. A balanced equation: In a balanced equation the total number and type of atoms in the reactants are the same as in the products.
   b. How to balance an equation: Balance an equation by changing the big numbers in order to change the number of molecules and, in so doing, change the number of atoms.
9. Next, get the learners to do Task 2 by balancing equation 3.
10. Discuss the answers with the learners.
11. Model answer: Task 2

TASK 2

1. $2Mg + O_2 \rightarrow 2MgO$ (balanced)

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. What is the molecular formula for magnesium oxide?

b. What is the colour of the magnesium oxide powder which is formed as the product of the oxidisation of magnesium?

Answers to the checkpoint questions are as follows:

a. MgO

b. White

12. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Reactions of metals with oxygen	118
Solutions for all	Reactions of metals with oxygen	125
Spot On	Reaction of metals and non-metals with oxygen	69
Top Class	Reactions of metals with oxygen	98-99
Via Afrika	Reactions of metals with oxygen	85-87
Platinum	Reaction of metals and non-metals with oxygen	89
Oxford Successful	Reactions of metals with oxygen	81-82
Pelican Natural Sciences	Reactions of metals with oxygen	134
Sasol InzaloBk A	Reactions of metals with oxygen	197-199

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?time_continue=2&v=5UJTR-LA1z4 (2min 47sec) [Burning of magnesium and properties]

4 A

Term 2, Week 4, Lesson A
Lesson Title: Rust
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The formation of rust
CAPS Page Number	65

Lesson Objectives

By the end of the lesson, learners will be able to:

- explain that rust is formed as the result of a slow chemical reaction of iron metal with oxygen in the presence of moisture
- explain that the reaction of iron metal with oxygen is a slow reaction which forms a complex compound, a part of which is iron oxide
- explain that rust is a form of corrosion
- describe and explain two ways of preventing rust.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	✓

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	✓
2. Observing		7. Raising Questions		12. Recording Information	✓
3. Comparing		8. Predicting	✓	13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	✓

TOPIC: Reaction of metals with oxygen

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Periodic Table of the elements	
Resource 11: Rusted bicycle.	
Five test tubes with test tube rack, one test tube stopper, five clean iron nails, half a teaspoon calcium carbonate, teaspoon, distilled water, tap water, marking pen to label test tubes 1-5	Five glass containers (example baby food bottles) to use instead of test tubes and test tube holder; cling wrap to use instead of test tube stopper

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What is $7e_2O_3$?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

Iron oxide

D ACCESSING INFORMATION

1. Write the following information on the chalkboard (always try to do this before the lesson starts):

THE FORMATION OF RUST

1. **Rusting** is a slow chemical reaction of iron metal with oxygen and water.
2. A complex compound is formed as a result of the reaction.
3. Part of the compound formed is iron oxide (Fe_2O_3).
4. Rust is a form of **corrosion**.
5. We can prevent the formation of rust by painting or **electroplating** a product which contains iron.
6. Electroplating is the process of coating a metal object with a thin layer of another metal by means of **electrolysis**.
7. Electrolysis is the process of dipping an iron or steel object in a zinc-based or chromium-based solution through which an electric current is passed.

WORD EQUATION FOR REACTION OF MAGNESIUM WITH OXYGEN

iron + oxygen → iron oxide

2. Make sure that the poster of the Periodic Table of Elements is on display in the classroom.
3. Advance preparation: ensure that you have all the resources for the investigation.
4. Demonstrate an investigation into rusting:
    a. Learners observe as you set up the investigation as follows:

		Notes for teacher
Test tube 1	Place a nail in the test tube. Use a stopper to seal test tube.	This is the control for the experiment.
Test tube 2	Place a nail in the test tube. Cover the nail with tap water.	Tap water contains dissolved oxygen. The test tube is not sealed.
Test tube 3	Place half teaspoon of calcium carbonate in a test tube. Place a nail in the test tube.	Oxygen in air will be able to reach the nail, but calcium carbonate will absorb the moisture. Calcium carbonate is a drying agent.
Test tube 4	Place a nail in the test tube. Cover the nail with cooled boiled water. Use a stopper/ cling wrap to close the test tube.	Water is boiled to remove dissolved oxygen. The test tube is closed so that no further oxygen can enter.

    b. Explain to learners that the test tubes will be placed in a safe place for about a week (to allow time for rusting, if any, to occur). Return to this part of Lesson 4A during Lesson 5A.
6. Use Resource 11 – photograph of a rusted item – to hold a class discussion on the problems caused by rusting and ways to prevent rusting:
    a. Rusting is a form of corrosion.
    b. Corrosion is the gradual destruction of materials due to chemical reactions.
    c. Some metals, for example, iron, corrode easily.
    d. Rusting usually makes the object or material useless. For this reason, we try to prevent rusting.
    e. Water and oxygen are needed for iron to rust. We can use this knowledge to prevent rusting.
    f. When iron reacts with water and oxygen it forms iron hydroxide. When the iron hydroxide dries out, the water is lost and iron oxide is formed.
    g. We can prevent rusting by painting iron because the layer of paint prevents water and oxygen from coming into contact with the iron.

h. Electroplating is the process of coating a metal object with a thin layer of another metal by means of electrolysis.

i. Electrolysis is the process of dipping an iron or steel object in a zinc-based or chromium-based solution through which an electric current is passed. The zinc or chromium atoms then are deposited on the surface of the iron or steel.

j. Not only do painting and electroplating prevent the rust reaction from occurring, they also improve the appearance of the object.

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. What is corrosion?

b. What conditions are required for the formation of rust on an iron object?

Answers to the checkpoint questions are as follows:

a. Corrosion is the gradual destruction of material due to chemical reactions.

b. Water and oxygen

E CONCEPTUAL DEVELOPMENT

1. Leave the poster of the Periodic Table of Elements on display.
2. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

1. When iron reacts with _____and _____it forms_____. When the iron hydroxide dries out, the water is lost and _____ is formed. The chemical formula for the product of the reaction is _____.

iron oxide	iron dioxide	Fe_2O_3	metal	water	oxygen	zinc	Fe_3O_2

2. Chromium atoms are deposited on the iron object.
   An iron object is dipped in the chromium-based solution.
   An electric current is passed through a chromium-based solution.

TASK 1

1. Copy and complete the sentences in your workbook. Use words and formulae from the word box.

TASK 2

1. Write the three steps for the process of electroplating in the correct sequence.

3. Explain Task 1 to the learners as follows:
   a. The sentences describing the formation of rust are incomplete.
   b. Look at the words and formulae in the word box below the sentences.
   c. Work on your own. Copy and complete the sentences. Use words and formulae from the word box.
4. Ask learners to share their answers to Task 1 with the class.
5. The completed sentences are shown below. Fill in the missing words and formula in the sentences on the chalkboard.
6. Model answer: Task 1

TASK 1

1. *When iron reacts with water and oxygen it forms iron hydroxide. When the iron hydroxide dries out, the water is lost and iron oxide is formed. The chemical formula for the product of the reaction is Fe_2O_3.*

7. When the learners have completed Task 1, hold a short class discussion to revise rust. (Remember that rust is a form of corrosion which occurs when iron oxide is formed.)
8. Next, get the learners to do Task 2 by writing the steps in the process of electroplating in the correct order.
9. Discuss the answers with the learners.
10. Model answer: Task 2

TASK 2

1. *An electric current is passed through a chromium-based solution.*
   An iron object is dipped in the chromium-based solution.
   Chromium atoms are deposited on the iron object

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. What are two ways of preventing rust on an iron or steel object?
b. How does electroplating prevent rust on an iron object?

Answers to the checkpoint questions are as follows:

a. Painting and electroplating
b. Electroplating coats an iron object with zinc or chromium and so prevents the rust/ oxidation process from occurring.

11. Ask learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Reactions of metals with oxygen	119
Solutions for all	Reactions of metals with oxygen	125-128
Spot On	Reaction of metals and non-metals with oxygen	70-71
Top Class	Reactions of metals with oxygen	99-100
Via Afrika	Reactions of metals with oxygen	87-89
Platinum	Reaction of metals and non-metals with oxygen	89
Oxford Successful	Reactions of metals with oxygen	82-85
Pelican Natural Sciences	Reactions of metals with oxygen	135-136
Sasol InzaloBk A	Reactions of metals with oxygen	202-208

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?v=XMr4vse7Ybo (2min 13sec) [Corrosion and rust]

TOPIC OVERVIEW:

Reactions of non-metals with oxygen

Term 2, Weeks 4B – 5A

A. TOPIC OVERVIEW

Term 2, Weeks 4b – 5a

- This topic runs for 1 week.
- It is presented over 3 lessons.
- This topic's position in the term is as follows:

LESSON	WEEK 1			WEEK 2			WEEK 3			WEEK 4			WEEK 5		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

LESSON	WEEK 6			WEEK 7			WEEK 8			WEEK 9			WEEK 10		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

B. SEQUENTIAL TABLE

GRADE 8	GRADE 9	GRADE 10 - 12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Elements • Compounds • Chemical reactions	• The general reaction of non-metals with oxygen • Reaction of carbon with oxygen • Reaction of sulfur with oxygen	Grade 10 • Representing chemical change • Reaction equations • Particles substances are made of

C. SCIENTIFIC VOCABULARY

Ensure that you teach the following vocabulary at the appropriate place in the topic:

	TERM	EXPLANATION
1.	non-metal oxide	Compound formed when a non-metal reacts with oxygen
2.	acid rain	Rain that is more acidic than usual
3.	non-metal	Element that does not have the properties of a metal, for example, carbon
4.	oxide	An oxide is a chemical compound that contains at least one oxygen atom and one other element.
5.	diatomic molecule	Molecule composed of only two atoms
6.	friction	Contact force that is created when two objects move over each other; opposes the direction of motion
7.	ignite	Catch fire/ start to burn
8.	combustion	The process of burning

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

It is important that we know about reactions of non-metals with oxygen as these reactions have an effect on our everyday lives. Acid rain is the product of the reaction of carbon or sulfur with oxygen. Knowledge of what causes it helps us to prevent acid rain, which can be dangerous and damage buildings and other structures.

When you know how the reactions of non-metals with oxygen work, you can use the knowledge to produce specific products, or to prevent specific reactions.

E. PERSONAL REFLECTION

Reflect on your teaching at the end of each topic:

Date completed:	
Lesson successes:	
Lesson challenges:	
Notes for future improvement:	

4 B

Term 2, Week 4, Lesson B
Lesson Title: General reaction of non-metals with oxygen
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The general reaction of non-metals with oxygen
CAPS Page Number	66

Lesson Objectives

By the end of the lesson, learners will be able to:

- explain that some non-metals react with oxygen to form non-metal oxides
- give the general equation for the reaction of a non-metal with oxygen.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	
2. Observing		7. Raising Questions		12. Recording Information	
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Periodic Table of Elements	
Box of matches	
Resources 8-10: Flashcards for reaction of a non-metal with oxygen.	
Resource 12: Flashcards for reaction of a non-metal with oxygen.	
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

> If the general reaction of a metal with oxygen is metal + oxygen → metal oxide, what is the general reaction of a non-metal with oxygen?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

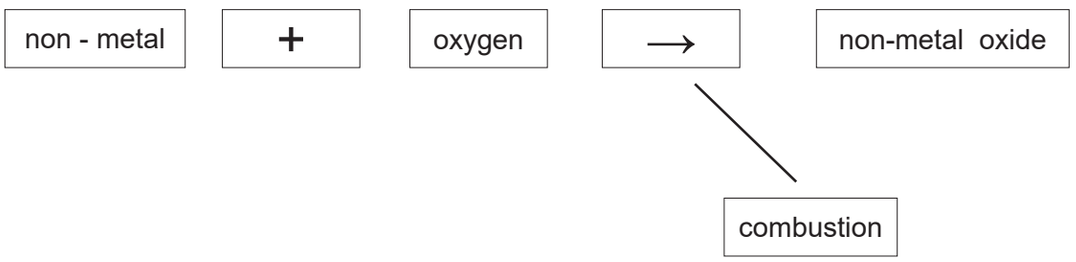
> *non-metal + oxygen → non-metal oxide*

D ACCESSING INFORMATION

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

> GENERAL REACTION OF NON-METALS WITH OXYGEN
>
> 1. A non-metal is an element that does not have the properties of a metal.
> 2. Oxygen forms a diatomic molecule (O_2).
> 3. When non-metals react with oxygen the product is a non-metal oxide.
> 4. The reactants when a non-metal reacts with oxygen are the non-metal and oxygen.
> 5. Some non-metals combust (burn) more easily than others in the presence of oxygen.
> 6. When a substance reacts with oxygen, the reaction is called oxidation.
>
> THE GENERAL EQUATION FOR THE REACTION OF A NON-METAL WITH OXYGEN
>
> non-metal + oxygen → non-metal oxide

2. Make sure that the poster of the Periodic Chart of the Elements is on display in the classroom.
3. Explain the following to the learners:
   a. Oxygen is a non-metal.
   b. In the same way that some metals react with oxygen, some non-metals react with oxygen.
   c. Another word for the process of burning is **combustion**.
   d. Combustion is usually a rapid reaction that produces heat and light.
   e. Some non-metals combust more easily than others in the presence of oxygen.
   f. Some non-metals, for example, phosphorous, combust very easily in the presence of oxygen. In fact, a pure form of phosphorous combusts so easily in the presence of oxygen that it will self-combust (start burning on its own).
4. Use the matches and the match box to demonstrate the combustion of phosphorous in the presence of oxygen.
   a. Explain that the striking surface of the matchbox is made up of a mixture of substances, one of which is red phosphorous. The match heads are dipped in a mixture which contains potassium chlorate and sulfur.
   b. When you strike a match, the **friction** causes the red phosphorous to react with the potassium chlorate in the presence of oxygen and the match will **ignite**.
   c. Demonstrate by striking the match along the side surface of the matchbox.
5. Use the flashcards (Resources 8-10 and 12) as you discuss the general reaction of non-metals with oxygen.
   a. When a non-metal is burned in air, the metal reacts with the oxygen in the air and a **non-metal oxide** is formed.
   b. Some non-metals burn in the presence of oxygen. This process is called **combustion**.
   c. The flashcard display could look something like this:



Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. What is the name of the process in which a non-metal is burned in the presence of oxygen?
b. What are the two reactants in the reaction of a non-metal with oxygen?

Answers to the checkpoint questions are as follows:

a. Combustion
b. Non-metal and oxygen

E CONCEPTUAL DEVELOPMENT

1. Leave the flashcard display of the general reaction of a non-metal with oxygen on the chalkboard. Also display the poster of the Periodic Table of Elements.
2. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

1. $P + O_2 \rightarrow P_2O_5$
2. $N + O_2 \rightarrow NO$
3. $NO + O_2 \rightarrow NO_2$

TASK 1

1. Name the two reactants in each reaction.

TASK 2

1. Balance the equations for each reaction.

3. Remind learners about how compounds are named (Lesson 1C):

   P_2O_5 is phosphorous pentoxide

   NO is nitrogen oxide

   NO_2 is nitrogen dioxide.

4. Explain Task 1 to the learners as follows:
   a. Each of the three reactions shows the reaction of two non-metals with each other.
   b. Refer to the Periodic Table of the Elements. Write down the names of the reactants in each reaction. Use this format:

      Name of reactant 1 + name of reactant 2 $\rightarrow$ P_2O_5

5. Ask learners to share their answers to Task 1 with the class.
6. The answers for Task 1 are given below. Fill the missing reactants in the reactions written on the chalkboard.

7. Model answer: Task 1

TASK 1

1. Phosphorous + oxygen → P_2O_5
2. Nitrogen + oxygen → NO
3. Nitrogen oxide + oxygen → NO_2

8. When the learners have completed Task 1, hold a short class discussion on what a reaction equation is.

   A reaction equation shows the reactants on the left-hand side of the equation arrow and the product/s on the right-hand side of the equation arrow.

9. Next, get the learners to do Task 2 by balancing the equation. Remind learners that in a balanced equation the number and type of atoms on the left-hand side of the reaction arrow must be the same as the number and type of atoms on the right-hand side of the arrow.
10. Discuss the answers with the learners.
11. Model answer: Task 2

TASK 2

1. $4P + 5O_2 \rightarrow 2P_2O_5$
2. $2N + O_2 \rightarrow 2NO$
3. $2NO + O_2 \rightarrow 2NO_2$

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. What is the product of the general reaction of a non-metal with oxygen?
b. Sulfur is not shiny and does not have good electrical or thermal conductivity. Is sulfur a metal? Justify your answer.

Answers to the checkpoint questions are as follows:

a. Non-metal oxide
b. No. Sulfur does not have the characteristics of a metal.

12. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Reactions of non-metals with oxygen	117
Solutions for all	Reactions of non-metals with oxygen	131
Spot On	Reaction of metals and non-metals with oxygen	67
Top Class	Reactions of non-metals with oxygen	102
Via Afrika	Reactions of non-metals with oxygen	84
Platinum	Reaction of metals and non-metals with oxygen	89
Oxford Successful	Reactions of non-metals with oxygen	86
Pelican Natural Sciences	Reactions of non-metals with oxygen	140
Sasol Inzalo Bk A	The general reaction of non-metals with oxygen	212

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://chem.libretexts.org/Core/Inorganic_Chemistry/Descriptive_Chemistry/Main_Group_Reactions/Reactions_of_Main_Group_Elements_with_Oxygen [Reactions of main group elements with oxygen]

4 C

Term 2, Week 4, Lesson C
Lesson Title: The reaction of carbon with oxygen
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The reaction of carbon with oxygen
CAPS Page Number	66

Lesson Objectives

By the end of the lesson, learners will be able to:

- explain that some non-metals react with oxygen to form non-metal oxides
- give the general equation for the reaction of a non-metal with oxygen.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	
2. Observing		7. Raising Questions		12. Recording Information	
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	

TOPIC: Reaction of non-metals with oxygen

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Periodic Table of the Elements	
Plastic beads or modelling clay or play dough	Plasticine or Paper Mache
Resources 8-10, 12: Flashcards	
Projector and laptop with internet	
Two flashcards containing the words 'carbon' and 'carbon dioxide'	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What is the general reaction of a non-metal with oxygen?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

non-metal + oxygen → non-metal oxide

D ACCESSING INFORMATION

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

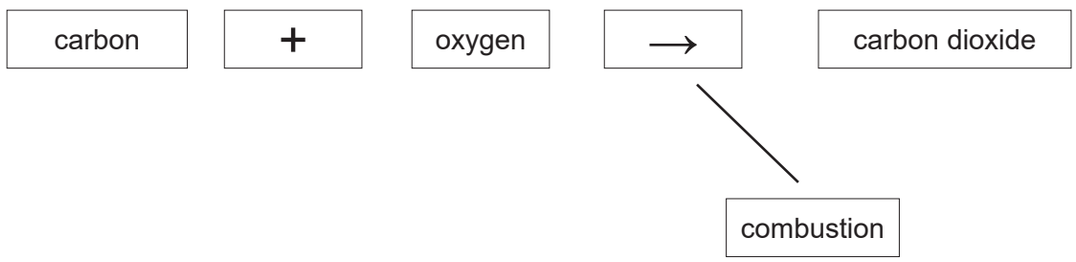
GENERAL REACTION OF CARBON WITH OXYGEN

1. When the non-metal carbon is burnt in oxygen, carbon dioxide is produced.
2. The reactants in the reaction are carbon and oxygen.
3. The product in the reaction is carbon dioxide.
4. When carbon is burned in the presence of oxygen it burns with an orange glow.
5. Carbon dioxide turns clear limewater milky.
6. Charcoal and coal briquettes are substances that are made up mainly of carbon.

THE EQUATION FOR THE REACTION OF CARBON WITH OXYGEN:

carbon + oxygen → carbon dioxide

2. Make sure that the poster of the Periodic Table of Elements is on display in the classroom.
3. Explain the following to the learners:
   a. The charcoal or coal briquettes we use for fires or braais combust (burn) with an orange glow in the presence of oxygen.
   b. Burning charcoal is an example of a reaction of carbon with oxygen.
   c. The two reactants in the process are carbon and oxygen, both of which are non-metals.
   d. The product of the reaction is carbon dioxide.
4. Use the flashcards (Resources 8-11, 12) as you discuss the reaction of carbon with oxygen. Make two flashcards of your own – one with the word 'carbon', and one with the word 'carbon dioxide'.
   a. When carbon is burned in air, it reacts with the oxygen in the air and carbon dioxide is formed.
   b. Carbon dioxide, the product of the reaction, is a non-metal oxide.
   c. The flashcard display could look something like this:



Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. What is name of the product formed when carbon reacts with oxygen?
b. What are the two reactants in the reaction of carbon with oxygen?

Answers to the checkpoint questions are as follows:

a. Carbon dioxide
b. Carbon and oxygen

TOPIC: Reaction of non-metals with oxygen

E CONCEPTUAL DEVELOPMENT

1. Leave the flashcard display of the general reaction of carbon with oxygen on the chalkboard. Also display the poster of the Periodic Table.
2. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

Drawn representation of the reaction of carbon with oxygen

TASK 1

1. Build a model to represent the reaction of carbon and oxygen.

TASK 2

1. Write the balanced chemical equation for the reaction of carbon with oxygen.

3. Explain Task 1 to the learners as follows:
   a. The drawing is a representation of the reaction of carbon with oxygen.
   a. Identify the type and number of reactants in the reaction.
   b. Use the plastic beads or plasticine to build the reactants.
   c. Use the plastic beads or plasticine to show how the reactant atoms rearrange to form the product.
4. Ask learners to share their models for Task 1 with the class.
5. Model answer: Task 1

TASK 1

6. When the learners have completed Task 1, hold a short class discussion on what their model should look like: The two non-metals (oxygen and carbon) in the reactant are not bonded to each other. However, the two oxygen atoms are bonded to form an oxygen molecule. The atoms in the product are bonded to each other.
7. Next, get the learners to do Task 2 by writing the balanced chemical equation for the reaction of carbon with oxygen. Remind learners that in a balanced equation the number and type of atoms on the left-hand side of the reaction arrow must be the same as the number and type of atoms on the right-hand side of the arrow.

8. Model answer: Task 2

TASK 2

1. $C + O_2 \rightarrow CO_2$

9. Discuss the answer with the learners. Draw learners' attention to the fact that the equation is already balanced. There is one carbon atom in the reactant and one carbon atom in the product. There are two oxygen atoms in the reactant and two oxygen atoms in the product.

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. Is this statement true or false? $C + O_2 \rightarrow CO_2$ is an unbalanced equation. Justify your answer.
b. Is this statement true or false? The reaction of carbon and oxygen is a reaction of two non-metals with each other.

Answers to the checkpoint questions are as follows:

a. False. It is balanced because there are exactly the same number and type of atoms on each side of the reaction arrow.
b. True

10. Ask the learners if they have any questions and provide answers and explanations

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Reactions of non-metals with oxygen	117
Solutions for all	Reactions of non-metals with oxygen	131
Spot On	Reaction of metals and non-metals with oxygen	67
Top Class	Reactions of non-metals with oxygen	102
Via Afrika	Reactions of non-metals with oxygen	84
Platinum	Reaction of metals and non-metals with oxygen	89
Oxford Successful	Reactions of non-metals with oxygen	86
Pelican Natural Sciences	Reactions of non-metals with oxygen	140
Sasol Inzalo Bk A	The reaction of carbon with oxygen	212

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?v=O5oLSSjjRzw (38sec) [Carbon burning in air]

5 A

Term 2, Week 5, Lesson A
Lesson Title:The reaction of sulfur with oxygen (with the conclusion to the rusting investigation in Lesson 4A)
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The reaction of sulfur with oxygen
CAPS Page Number	66

Lesson Objectives

By the end of the lesson, learners will be able to:

- list the conditions for the formation of rust (from lesson 4a)
- give the word equation for the reaction of sulfur with oxygen
- give the chemical equation for the reaction of sulfur with oxygen.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	✓
2. Observing		7. Raising Questions		12. Recording Information	
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	

TOPIC: Reaction of non-metals with oxygen

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Periodic Table of the elements	
Test tubes 1-4 from lesson 4A (rusting)	
Plastic beads or modelling clay or play dough	Plasticine or Paper Mache
Resources 8-10, 12: Flashcards	
Projector and laptop with internet	
Two flashcards containing the words 'sulfur' and 'sulfur dioxide'	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

> What is the chemical formula for rust?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

> Fe_2O_3

D ACCESSING INFORMATION

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

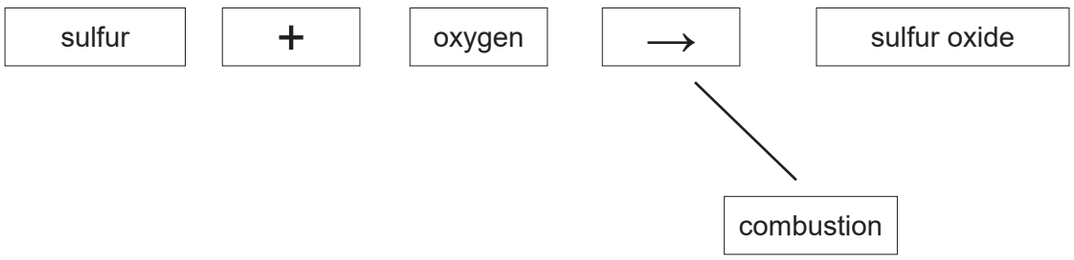
> THE FORMATION OF RUST
>
> 1. When iron reacts with water and oxygen it forms iron hydroxide. When the iron hydroxide dries out, the water is lost, and iron oxide is formed. The chemical formula for the product of the reaction is Fe_2O_3.
>
> GENERAL REACTION OF SULFUR WITH OXYGEN
>
> 1. When the non-metal sulfur is burnt in oxygen, sulfur dioxide is produced.
> 2. The reactants in the reaction are sulfur and oxygen.
> 3. The product in the reaction is sulfur dioxide.
> 4. When sulfur is burned in the presence of oxygen, it burns with a bright blue flame.
> 5. Sulfur dioxide is a whitish gas.
> 6. Acid rain contains carbon dioxide and sulfur dioxide.

TOPIC: Reaction of non-metals with oxygen

THE EQUATION FOR THE REACTION OF SULFUR WITH OXYGEN

sulfur + oxygen → sulfur dioxide

2. Make sure that the poster of the Periodic Chart of the Elements is on display in the classroom.
3. Explain the following to the learners:
   b. Sulfur combusts (burns) with a bright blue flame in the presence of oxygen.
   c. Burning sulfur is an example of a reaction of sulfur with oxygen.
   d. The two reactants in the process are sulfur and oxygen, both of which are non-metals.
   e. The product of the reaction is sulfur dioxide.
4. Use the flashcards (Resources 8-11; 12) as you discuss the reaction of sulfur with oxygen. Make two flashcards of your own – one with the word sulfur, and one with the word sulfur dioxide.
   a. When sulfur is burned in air, it reacts with the oxygen in the air and sulfur dioxide is formed.
   b. Sulfur dioxide, the product of the reaction, is a non-metal oxide.
   c. The flashcard display could look something like this:



5. Explain to learners that the coal we burn in South Africa to generate electricity is made mainly of carbon, but also has a high sulfur content. When coal is burned in the presence of oxygen, carbon dioxide and sulfur dioxide are the products of the reaction and are released into the atmosphere. Both non-metal oxides dissolve in rain water and return to the Earth's surface as acid rain.

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. What is name of the product formed when sulfur reacts with oxygen?
b. What is the name of two non-metal oxides that are found in acid rain?

Answers to the checkpoint questions are as follows:

a. Sulfur dioxide
b. Carbon dioxide and sulfur dioxide

E CONCEPTUAL DEVELOPMENT

1. Have the four test tubes from the rust investigation set up as in Lesson 4A available.
2. Leave the flashcard display of the general reaction of sulfur with oxygen on the chalkboard. Also display the poster of the Periodic Table.
3. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

		Amount of rust
Test tube 1	Iron nail in test tube. Test tube sealed.	Very little
Test tube 2	Iron nail in test tube. Nail covered with tap water.	Most
Test tube 3	Calcium carbonate in test tube. Iron nail in test tube.	Very little
Test tube 4	Iron nail in test tube. Nail covered with cooled boiled water. Test tube sealed.	Very little

Drawn representation of the reaction of sulfur with oxygen

TASK 1

1. Explain why the nail in test tube 2 had the most rust.

TASK 2

1. Build a model to represent the reaction of sulfur and oxygen.
2. Write the balanced chemical equation for the reaction of sulfur with oxygen.

4. Explain Task 1 to the learners as follows:
   a. The table shows that the iron nail in test tube 2 had the most rust.
   b. The conditions for rusting are a metal such as iron, oxygen and moisture (water).
   c. Calcium carbonate is a drying agent.
   d. Water is boiled to remove dissolved oxygen.
   e. Think about the conditions for rust that were present or absent in each test tube as you answer the question.
5. Ask learners to share their answer to Task 1 with the class.

6. Model answer: Task 1

TASK 1

The nail in test tube 2 had the most rust because all the conditions for rust were present: an iron nail, oxygen in the air and tap water which contains dissolved oxygen.

7. When the learners have completed Task 1, hold a short class discussion on the fact that it was only in test tube 2 that all conditions for the formation of rust were present.
8. Next, get the learners to do Task 2 by building a model of the chemical equation of the reaction of sulfur with oxygen, and by writing the balanced chemical equation for the reaction of sulfur with oxygen. Learners should be able to do this quickly as it is the same concept as the reaction of carbon with oxygen which they learned about in Lesson 4C.
   a. The drawing is a representation of the reaction of carbon with oxygen.
   b. Identify the type and number of reactants in the reaction.
   c. Use the plastic beads or plasticine to build the reactants.
   d. Use the plastic beads or plasticine to show how the reactant atoms rearrange to form the product.
9. Model answer: Task 2

TASK 2

1. The model should look like this:

2. Balanced chemical equation for the reaction of sulfur with oxygen:

   $S + O_2 \rightarrow SO_2$

10. Discuss the answer with the learners. Draw learners' attention to the fact that the equation is already balanced. There is one sulfur atom in the reactant and one sulfur atom in the product. There are two oxygen atoms in the reactant and two oxygen atoms in the product.

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. What are the conditions for the formation of rust?
b. What are the two reactants in the reaction of sulfur with oxygen?

Answers to the checkpoint questions are as follows:

a. Iron, moisture (water)
b. Sulfur and oxygen

11. Ask the learners if they have any questions and provide answers and explanation.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Reactions of non-metals with oxygen	117
Solutions for all	Reactions of non-metals with oxygen	131
Spot On	Reaction of metals and non-metals with oxygen	67
Top Class	Reactions of non-metals with oxygen	102
Via Afrika	Reactions of non-metals with oxygen	84
Platinum	Reaction of metals and non-metals with oxygen	89
Oxford Successful	Reactions of non-metals with oxygen	86
Pelican Natural Sciences	Reactions of non-metals with oxygen	140
Sasol Inzalo Bk A	The reaction of carbon with oxygen	212

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?v=jij5JYOTlJU (3min 18sec) [Burning Sulphur in oxygen]

TOPIC OVERVIEW:
Acids, bases and pH value
Term 2, Weeks 5B – 6A

A. TOPIC OVERVIEW

Term 2, Weeks 5b – 6a

- This topic runs for 1 week.
- It is presented over 3 lessons.
- This topic's position in the term is as follows:

LESSON	WEEK 1			WEEK 2			WEEK 3			WEEK 4			WEEK 5		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

LESSON	WEEK 6			WEEK 7			WEEK 8			WEEK 9			WEEK 10		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

B. SEQUENTIAL TABLE

GRADE 8	GRADE 9	GRADE 10 - 12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Tastes of substances • Properties of acids, bases and neutrals • Use of litmus paper as an indicator	• The concept of pH value • Acids, bases and neutral substances • Chemical indicators	Grade 10 • Chemical reaction types in water solution Grade 11 • Neutral indicators for acids and bases • Acid-base theories and equations

C. SCIENTIFIC VOCABULARY

Ensure that you teach the following vocabulary at the appropriate place in the topic:

	TERM	EXPLANATION
1.	pH	Number between 0 and 14 that tells us how acidic or basic a substance is
2.	alkali	Base that can dissolve in water
3.	acid	Substance with a pH between 0 and 7

4.	base	Substance with a pH between 7 and 14
5.	corrosive	Property of a substance that dissolves (eats away) metals and other strong materials
6.	neutral	Substance that is not an acid or a base, with a pH of 7
7.	indicator	A dye that is turned different colours by acids, bases and neutral substances
8.	universal indicator	pH indicator made up of different substances so that it produces colour changes across the whole pH range
9.	independent variable	The one thing that the experimenter changes in an experiment
10.	dependent variable	The quantity or quality that is measured or observed in an experiment. pH is an example of a dependent variable
11.	pH scale	Scale of pH values. Shows numbers from 1 to 14, with 7 as the middle (neutral) point.

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

Knowledge about the reaction of acids with bases can help us. Indigestion is often caused by extra stomach acid. We can get relief by using a base or alkali to neutralise the acid. When acid rain causes the soil to become too acidic, it can be neutralised by adding an alkali or base.

E. PERSONAL REFLECTION

Reflect on your teaching at the end of each topic:

Date completed:	
Lesson successes:	
Lesson challenges:	
Notes for future improvement:	

5 B

Term 2, Week 5, Lesson B
Lesson Title: Introducing acids, bases and pH
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The concept of pH value
CAPS Page Number	67

Lesson Objectives

By the end of the lesson, learners will be able to:

- explain that ph is a measure of how acidic or basic a substance is
- state that acids have a ph in the range of 0 to 7 and that strong acids have low ph values
- state that bases have a ph in the range of 7 to 14 and that strong bases have high ph values
- state that a neutral substance has a ph of 7
- list the characteristics of acids and bases.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	✓
2. Observing	✓	7. Raising Questions		12. Recording Information	✓
3. Comparing		8. Predicting		13. Interpreting Information	
4. Measuring		9. Hypothesizing	✓	14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	✓

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
At least one example of a weak acid, for example, lemon juice or vinegar	
At least one example of a weak base (liquid form), for example, hair shampoo or dishwashing liquid	
Neutral substance: pure (distilled) water	
Three beakers	Plastic cups or mugs
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What is the pH of a neutral substance?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

7

D ACCESSING INFORMATION

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACIDS, BASES AND pH VALUE

1. An acid is a substance with a pH between 0 and 7.
2. A base is a substance with a pH between 7 and 14.
3. pH is a measure of how acidic or basic a substance is.
4. pH is a number between 0 and 14.
5. Acids taste sour and feel rough.
6. Bases taste bitter and feel slippery.
7. Some acids and some bases are dangerous.

2. Explain this to the learners as follows:
   a. **Acids** and **bases** are all around us – we use them every day.
   b. Both acids and bases can be strong or weak.
   c. Strong acids have a low **pH** value – close to 1.
   d. Strong acids are dangerous to taste or feel and can cause serious burns.
   e. Strong acids are **corrosive** – they can eat away metals and other strong materials.
   f. Acids can be useful – the acid in our stomach helps us to digest our food.
   g. Some fruit and fruit drinks are acidic.
   h. Strong bases have a high pH value – close to 14.
   i. A base that can dissolve in water is called an **alkali**.
   j. Strong bases are dangerous to taste or feel and can cause serious burns.
   k. A **neutral** substance has a pH of 7.
3. Use the samples of the weak acid, weak base and neutral substance. Safety precaution: do not use a strong acid or base. Place each sample in a separate beaker so that learners cannot read what the sample is. Do not tell learners what each sample is.
   a. Call one learner to the front of the class. Other learners should observe and take notes on each sample during the discussion.
   b. Remind learners that strong acids and strong bases are dangerous and that you are using weak acids and bases. They should NOT allow strong bases or acids to touch their skin or eyes, and they should not taste any substance unless an adult has told them that it is safe to do so.
   c. Place a small amount of the acid on the back of the learner's hand. Call this sample A. Ask the learner to rub the substance over his/her skin and to describe to the class how it feels and smells.
   d. Get a learner to taste a small amount of sample A and to describe to the class how it feels and smells.
   e. Repeat steps 3b and 3c with the base and the neutral substance. Call these samples B and C.

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. What am I? I have a pH of 3.
b. What am I? I have a pH of 11.

Answers to the checkpoint questions are as follows:

a. Acid
b. Base

E CONCEPTUAL DEVELOPMENT

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

Sample	Taste	Feel	Acid, base or neutral	Estimated pH
A				
B				
C				

TASK 1

1. Complete the taste and feel columns.

TASK 2

1. Complete the acid, base or neutral column and the estimated pH column.

2. Explain Task 1 to the learners as follows:
   a. Columns 2, 3, 4 and 5 of the table are empty.
   b. Use the notes you have written in your exercise, as well as the notes you took during the demonstration to complete columns 2 and 3.
3. Ask learners to share their answers to Task 1 with the class.
4. Fill the missing details in columns 2 and 3 of the table written on the chalkboard.
5. Model answer: Task 1

TASK 1

Sample	***Taste***	***Feel***	***Acid, base or neutral***	***Estimated pH***
A	*sour*	*rough on skin*		
B	*bitter*	*slippery*		
C	*neutral/ no taste*	*wet*		

6. When the learners have completed Task 1, hold a short class discussion on what an acid, base and neutral substance is. Be sure to discuss the pH or pH range of each.
7. Next, get the learners to do Task 2 by completing columns 4 and 5 of the table. Remind learners that, without measuring the pH (which they will do in the next lesson), they are only able to give an estimate of the pH of the acid and the base.
8. Fill the missing details in columns 4 and 5 of the table written on the chalkboard.

9. Model answer: Task 2

TASK 2

Sample	***Taste***	***Feel***	***Acid, base or neutral***	***Estimated pH***
A	*sour*	*rough on skin*	*acid*	*4 - 6*
B	*bitter*	*slippery*	*base*	*8 - 10*
C	*neutral/ no taste*	*wet*	*neutral*	*7*

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. What am I? I have a pH of 13.
b. What am I? I have a pH of 2.

Answers to the checkpoint questions are as follows:

a. Strong base
b. Strong acid

10. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Acids and bases and pH value	127
Solutions for all	Acids and bases and pH value	137
Spot On	Acids and bases and pH value	75
Top Class	Acids, bases and pH value	106
Via Afrika	Acids, bases and pH value	93
Platinum	Acids, bases and pH value	99
Oxford Successful	Acids, bases and pH value	88
Pelican Natural Sciences	Acids, bases and pH value	149
Sasol Inzalo Bk A	Acids, bases and pH value	224

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?v=Jfa2wxpJJBA (5 min) [Acids and Bases]

5 C

Term 2, Week 5, Lesson C
Lesson Title: pH indicators
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The concept of pH value
CAPS Page Number	67

Lesson Objectives

By the end of the lesson, learners will be able to:

- use chemical indicators to establish whether a substance is an acid, base or neutral.
- differentiate between a dependent and an independent variable.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	✓
2. Observing	✓	7. Raising Questions		12. Recording Information	
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying	✓	10. Planning Investigations		15. Scientific Process	✓

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Indicator made from red cabbage leaves and distilled water (do this as part of your advance preparation for lesson)	
Distilled water, vinegar, bicarbonate of soda, three beakers, labelled 1, 2 and 3, tablespoon, teaspoon	Three small glass jars (for example, baby food containers)
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. How to make red cabbage indicator: chop the red cabbage leaves finely, put about ten heaped tablespoons of chopped leaves into a pot. Add distilled water – use as little as possible so that the indicator is strong. Cook the leaves for 15 minutes. Decant the liquid (it should be red in colour) and cool completely. Half fill each of the three beakers with red cabbage indicator.
3. Write the following question onto the chalkboard before the lesson starts:

What are two characteristics of an acid?

4. Learners should enter the classroom and answer the question in their workbooks.
5. Discuss the answer with the learners.
6. Write the model answer onto the chalkboard.

It tastes sour, and is rough on the skin.

D ACCESSING INFORMATION

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

USE OF INDICATORS TO FIND pH VALUE

1. An indicator is a dye that turns a different colour in acids, bases or neutral substances.
2. We use indicators to tell us whether a substance is an acid, base or neutral.
3. We can use red cabbage water as a pH indicator.
4. Red cabbage water is reddish-pink in acid, purple in a neutral substance and bluish-green in a base.
5. The independent variable is the one thing that the experimenter changes in an experiment.
6. The dependent variable is the quantity or quality that is measured or observed in an experiment. pH is an example of a dependent variable.

2. Explain the following to the learners:
   a. The independent variable is the one thing that the experimenter changes in an experiment.
   b. The **dependent variable** is the quantity or quality that is measured or observed in an experiment. pH is an example of a dependent variable.
   c. We use an indicator to indicate (show) whether a substance is an acid, base or neutral substance.
   d. We can buy chemical indicators, for example, litmus paper which you used in Grade 7, or we can make our own indicators.
   e. We can make **indicators** from red cabbage leaves or red onions. These indicators are not as accurate as chemical indicators such as the universal indicator you will use in the next lesson, but they do indicate whether a substance is an acid, base or neutral.
   f. Red cabbage water is:
      - reddish-pink in acid
      - purple in a neutral substance
      - bluish-green in a base.
3. Learners observe the colour changes as you add the following:

   Beaker 1: Add a solution of 1 teaspoon bicarbonate dissolved in 3 tablespoons distilled water.

   Beaker 2: Add 3 tablespoons distilled water.

   Beaker 3: Add 3 tablespoons vinegar.

   Note: Do not tell learners what each substance is.

   Learners record the colour changes in each beaker.

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. What colour will the cabbage water be after an acid has been added?
b. What colour will the cabbage water be after a base has been added?

Answers to the checkpoint questions are as follows:

a. Reddish-pink
b. Bluish green

E CONCEPTUAL DEVELOPMENT

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

Beaker	Colour of cabbage water after substance has been added	Classify the substance as acid, base or neutral	Estimated pH	Actual pH
1				
2				
3				

TASK 1

1. What is the independent variable in the experiment?
2. What is the dependent variable in the experiment?

TASK 2

1. Complete the table.

2. Explain Task 1 to the learners as follows:
   a. In this experiment, there was one thing that the experimenter changed for each of the beakers. This is the independent variable – write it down as the answer to Question 1.
   b. In this experiment, there was one thing that changed according to what was put into the beaker. This is the dependent variable as it depends on what was done differently in each beaker – write it down as the answer to Question 2.
3. Ask learners to share their answers to Task 1 with the class.
4. Model answer: Task 1

TASK 1

1. *The substance being tested.*
2. *The pH of the substance being tested.*

5. When the learners have completed Task 1, hold a short class discussion on dependent and independent variables. Remind them that the dependent variable depends on (is affected by) the independent variable.
6. Next, get the learners to do Task 2 by completing columns 2 and 3 of the table.
   a. Remind learners that cabbage water cannot give an accurate measure of pH but can indicate whether the substance is an acid, base or neutral substance. From this indication, an estimated pH range can be given.
   b. Remind learners that, for safety reasons, none of the substances is a strong acid or base. This information will help them when they estimate pH.
   c. Fill the missing details in columns 4 and 5 of the table written on the chalkboard.

7. Model answer: Task 2

TASK 2

Beaker	***Colour of cabbage water after substance has been added***	***Classify the substance as acid, base or neutral***	***Estimated pH***	***Actual pH***
1	*bluish green*	*base*	*8-11*	*Answers will vary*
2	*purple*	*neutral*	*7*	
3	*reddish-pink*	*acid*	*3-6*	

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. Is the different substance added to each beaker the dependent or independent variable?

b. Sugar solution is a neutral substance. What colour will the cabbage water turn when sugar solution is added?

Answers to the checkpoint questions are as follows:

a. Independent

b. Purple

8. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Acids and bases and pH value	127
Solutions for all	Acids and bases and pH value	137
Spot On	Acids and bases and pH value	75
Top Class	Acids, bases and pH value	106
Via Afrika	Acids, bases and pH value	93
Platinum	Acids, bases and pH value	99
Oxford Successful	Acids, bases and pH value	88
Pelican Natural Sciences	Acids, bases and pH value	149
Sasol Inzalo Bk A	Acids, bases and pH value	224

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?time_continue=58&v=PYYowXOEZZE (1min 10sec) [Red cabbage chemistry]

6 A

Term 2, Week 6, Lesson A
Lesson Title: Universal indicators
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The concept of pH value
CAPS Page Number	67

Lesson Objectives

By the end of the lesson, learners will be able to:

- explain that universal indicators can indicate the full range of pH values on the pH scale.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	
2. Observing	✓	7. Raising Questions		12. Recording Information	✓
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying	✓	10. Planning Investigations		15. Scientific Process	

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 13: The pH scale.	
A universal indicator with colour chart	
10 test tubes with test tube racks	Small glass containers
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What is an indicator?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

A dye that is turned different colours by acids, bases and neutral substances

D ACCESSING INFORMATION

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

A UNIVERSAL INDICATOR

1. A **universal indicator** is a pH indicator made up of different substances so that it produces colour changes across the whole pH range.
2. A universal indicator produces the following colour changes:
   strong acid – red
   neutral – green
   strong base – purple.

2. Use Resource 13 showing universal indicator colours. Explain the following to the learners:
   a. We use an indicator to indicate (show) whether a substance is an acid, base or neutral substance.
   b. Indicators made from red cabbage leaves or red onions are not as accurate as chemical indicators such as universal indicator.
   c. A universal indicator is a pH indicator made up of different substances so that it produces colour changes across the whole pH range.

d. A universal indicator is available in liquid or paper form. The paper form can only be used if the substance is in liquid form.
e. A universal indicator has a colour chart that shows the full pH range from 1 – 14.
f. Acids change the colour towards the yellow, orange and red side of the colour scale.
g. Bases change the colour towards the blue and purple side of the colour scale.
h. Neutral substances change the colour of universal indicator to green.

3. Advance preparation: Prepare 10 test tubes. Each test tube should be about ¾ full. Place one liquid in each test tube and make a small label stating what liquid is in each test tube.
4. Use the following 10 liquids: black Ceylon tea, rooibos tea without milk, milk, black coffee, fruit juice, fizzy drink, lemon juice, vinegar, tartaric acid, liquid soap, solution of bicarbonate of soda and water.
5. Draw the table on the chalkboard as follows (always try to do this before the lesson starts):

DEMONSTRATION USING UNIVERSAL INDICATOR COLOUR CHART

Test tube no.	**Liquid**	**Colour of liquid**	**Colour change after adding universal colour indicator**
1.	Black Ceylon tea		
2.	Black Rooibos tea		
3.	Milk		
4.	Black coffee		
5.	Fruit juice		
6.	Fizzy juice		
7.	Lemon juice		
8.	Vinegar		
9.	Liquid soap		
10.	Bicarbonate of soda and water		

6. Learners will observe the colour changes which occur when a universal indicator is added to different household substances.

   Safety precaution: Some household substances are corrosive. Drain cleaner and pool acid are particularly corrosive. Avoid contact with skin, eyes and clothing. Do not eat or drink any chemicals. First Aid treatment for acid or base spills or splashes is to rinse the affected area immediately with lots of water.

   To conduct the demonstration:

   a. Call two learners to the front of the class.
   b. Learners must fill in the original colour on the table.
   c. Add the universal indicator to the first test tube.

d. After the universal indicator has been added, these learners will match the colour in the test tube with the universal indicator colour chart.
e. Repeat the exercise and add a drop of universal indicator to each test tube. Do this one test tube at a time. Each time tell learners what liquid is in the test tube.
f. Learners should record the name of the liquid and the colour on the indicator colour chart (they get this information from the two learners).
g. Discuss the answers and fill them in on the table on the chalkboard.

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. If the colour on the indicator chart is red, is the substance an acid or a base?
b. On a universal indicator colour chart, what colour is a neutral substance?

Answers to the checkpoint questions are as follows:

a. Acid
b. Green

E CONCEPTUAL DEVELOPMENT

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

Table 1 showing the colour of universal indicator paper

Substance	Colour of indicator paper	Classify as acid, base or neutral	pH value
A	purple		
B	green		
C	yellow-orange		
D	orange		
E	blue		

Table 2 showing pH of some substances

Substance	pH	Colour on universal indicator colour chart	Description
Hydrochloric (stomach) acid	1	red	strong acid
Milk	6		
Ammonia	11		
Sodium hydroxide (drain cleaner)	14		

TASK 1

1. Complete Table 1.

TASK 2

1. Complete Table 2.

2. Explain this task to the learners as follows:
   a. Refer to Resource 13 – the universal indicator colour chart.
   b. These are not the results of the demonstration.
   c. Look at the colour of the indicator paper. Use this information to classify the substance as an acid, base or neutral substance. Write the answers in column 2 of Table 1.
   d. Look at the colour of the indicator paper. Use this information to give the pH of the substance. Write this information in Column 3 of Table 1.
2. Ask learners to share their answers to Task 1 with the class.
3. Fill in the missing details in columns 2 and 3 of the table written on the chalkboard.
4. Model answer: Task 1

TASK 1

Table 1

Substance	***Colour of indicator paper***	***Classify as acid, base or neutra***	***pH value***
A	*purple*	*base*	*14*
B	*green*	*neutral*	*7*
C	*yellow-orange*	*acid*	*5-6*
D	*orange*	*acid*	*5*
E	*blue*	*base*	*9*

5. When the learners have completed Task 1, hold a short class discussion on dependent and independent variables. Remind them that the dependent variable depends on (is affected by) the independent variable.
6. Next, get the learners to do Task 2 by completing columns 2 and 3 of the table.
   a. Remind learners to refer to Resource 13 showing a universal indicator colour chart.
   b. Discuss hydrochloric acid (stomach acid) which has been done as an example.
   c. Using the hydrochloric acid example: the pH is 1 (given). Reading from the colour chart, we can see that a pH of 1 is red on the chart. This has been written in column 2. The descriptor for pH 1 on the colour chart is strong acid. This has been written in column 3.
   d. Learners complete columns 2 and 3 of Table 2.
7. Model answer: Task 2

TASK 2

Table 2

Substance	***pH***	***Colour on universal indicator colour chart***	***Description***
Hydrochloric (stomach) acid	*1*	*red*	*strong acid*
Milk	*6*	*yellow-orange*	*weak acid*
Ammonia	*11*	*blue*	*base*
Sodium hydroxide (drain cleaner)	*14*	*purple*	*strong base*

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. On a universal colour chart, what colour indicates a strong acid?
b. On a universal colour chart, what colour indicates a weak acid?

Answers to the checkpoint questions are as follows:

a. Red
b. Orange or yellow-orange

8. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Acids and bases and pH value	127
Solutions for all	Acids and bases and pH value	137
Spot On	Acids and bases and pH value	75
Top Class	Acids, bases and pH value	106
Via Afrika	Acids, bases and pH value	93
Platinum	Acids, bases and pH value	99
Oxford Successful	Acids, bases and pH value	88
Pelican Natural Sciences	Acids, bases and pH value	149
Sasol Inzalo Bk A	Acids, bases and pH value	224

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?v=ckbsHM2igT0&t=28s (3min 10sec) [What is the pH scale?]
2. https://www.youtube.com/watch?time_continue=42&v=PdprNTwb4Ks (1min 59sec) [Universal indicator]

TOPIC OVERVIEW:

Reactions of acids with bases: Part I

Term 2, Weeks 6B – 6C

A. TOPIC OVERVIEW

Term 2, Weeks 6b – 6c

- This topic runs for half a week.
- It is presented over 2 lessons.
- This topic's position in the term is as follows:

LESSON	WEEK 1			WEEK 2			WEEK 3			WEEK 4			WEEK 5		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

LESSON	WEEK 6			WEEK 7			WEEK 8			WEEK 9			WEEK 10		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

B. SEQUENTIAL TABLE

GRADE 8	GRADE 9	GRADE 10 - 12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Acids, bases and neutrals • Reactants and products	• Neutralisation and pH	Grade 10 • Chemical reaction types Grade 11 • Neutral indicators for acids and bases • Acid-base theories and equations

C. SCIENTIFIC VOCABULARY

Ensure that you teach the following vocabulary at the appropriate place in the topic:

	TERM	EXPLANATION
1.	neutralisation reaction	Reaction that occurs when an acid and a base react together
2.	neutralisation	Chemical reaction in which an acid and a base react to produce a salt and water
3.	predict	State, before an investigation, what you think the results will be

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

Knowledge about the reaction of acids with bases can help us. Indigestion is often caused by extra stomach acid. We can get relief by using a base or alkali to neutralise the acid. When acid rain causes the soil to become too acidic, it can be neutralised by adding an alkali or base.

E. PERSONAL REFLECTION

Reflect on your teaching at the end of each topic:

Date completed:	
Lesson successes:	
Lesson challenges:	
Notes for future improvement:	

6 B

Term 2, Week 6, Lesson B
Lesson Title: Introducing acids, bases and pH
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Neutralisation and pH
CAPS Page Number	67

Lesson Objectives

By the end of the lesson, learners will be able to:

- describe the **neutralisation reaction**
- explain that a base reacts with an acid to make it less acidic/ neutral
- explain that an acid reacts with a base to make it less basic/ neutral
- explain that after an acid-base reaction, the resultant ph will vary according to the strength of the acid and base
- list two acids commonly used in the laboratory.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	
2. Observing	✓	7. Raising Questions		12. Recording Information	✓
3. Comparing		8. Predicting	✓	13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying	✓	10. Planning Investigations		15. Scientific Process	

TOPIC: Reaction of acids with bases

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 13: The pH scale.	
Bicarbonate of soda, vinegar, water, glass beaker, five x 1cm pieces of universal indicator paper, universal indicator colour chart, plastic teaspoon	Small yoghurt tub
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What is an acid?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

An acid is a substance that tastes sour and feels rough on the skin.

D ACCESSING INFORMATION

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

THE NEUTRALISATION REACTION

1. A neutral substance is neither an acid nor a base.
2. A neutral substance has a pH value of 7.
3. The **neutralisation reaction** is a chemical reaction in which an acid and a base react to produce a salt and water.
4. A base reacts with an acid to make it less acidic/ neutral.
5. An acid reacts with a base to make it less basic/ neutral.
6. When the correct amounts of an acid and a base are mixed, they neutralise each other.
7. In the laboratory we often use sulphuric acid (H_2SO_4) and hydrochloric acid (HCl).

2. Explain this to the learners as follows:
   a. There are many examples of the neutralisation reaction occurring in our everyday lives.
   b. If we add a base to an acid, the pH of the resulting solution will increase – that means the acid will become less acidic or neutral.

c. If we add an acid to a base, the pH of the resulting solution will decrease – that means the base will become less basic or neutral.

d. Sulphuric acid and hydrochloric acid are examples of acids we use in the laboratory.

3. Demonstrate a neutralisation reaction to the learners. Learners must observe the demonstration and record their findings. Their recording should include: names of products, name of reactant, and the approximate pH of the products and reactants at different stages of the demonstration.

4. Suggest to learners that they use a table to record their observations, but do not do the table layout for them as they need to start learning how to organise a table themselves.

   a. Place one teaspoon of bicarbonate of soda in the beaker or yoghurt tub.

   b. Add approximately 10 teaspoons of water to the bicarbonate of soda.

   c. Use the teaspoon to stir the solution until all the bicarbonate of soda has dissolved. Call this the test solution.

   d. Use the teaspoon to transfer one drop of the test solution to the first piece of universal indicator paper.

   e. Find the pH of the test by comparing the colour of the universal indicator paper with the colour guide. Remind learners to record this pH.

   f. Add 1 teaspoon of the vinegar to the test solution. Stir gently. Transfer another drop of the solution to a fresh strip of the universal indicator paper. Read the pH of the solution off the colour guide and get learners to record it in their results table.

   g. Repeat step f. until the pH of the test solution drops below 7.

5. Suggested table recording format:

Number of teaspoons of vinegar added'	**Colour of the universal indicator paper**	**pH of the test solution**

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. One way of treating a wasp sting is to put vinegar on the sting. Is the sting acidic or basic?

b. One way of treating a bee sting is to put a solution of bicarbonate of soda on the sting. Is the sting acidic or basic?

Answers to the checkpoint questions are as follows:

a. Basic

b. Acidic

E CONCEPTUAL DEVELOPMENT

1. Write and draw the following on the chalkboard (always try to do this before the lesson starts):

ACTIVITY

TABLE 1

Substance	**pH**	**Classify: acid or base?**
vinegar		
bicarbonate of soda solution		

TASK 1

1. Complete the table.

TASK 2

1. **Predict** what will happen when vinegar is added to the bicarbonate of soda solution.
2. Name two acids often used in the laboratory.

2. Explain Task 1 to the learners as follows:
   a. Columns 2 and 3 are blank.
   b. Use the notes you have written in your exercise, as well as the notes you took during the demonstration to complete columns 2 and 3.
3. Ask learners to share their answers to Task 1 with the class.
4. Fill the missing details in columns 2 and 3 of the table written on the chalkboard.
5. Model answer: Task 1

TASK 1

Substance	***pH***	***Classify: acid or base?***
vinegar	*2-4**	*acid*
bicarbonate of soda solution	*8-10**	*base*

**Varies according to strength of the substance.*

6. When the learners have completed Task 1, hold a short class discussion on the use of universal indicator paper to establish the pH of a substance. Be sure to discuss the process of matching the colour of the substance to the colour on the universal indicator colour chart.
7. Next, get the learners to do Task 2:
   a. Remind learners that scientists use the information they have to predict what might happen. Another word for predict is forecast.
   b. Leaners predict what will happen when vinegar is added to the bicarbonate of soda solution.

8. Model answer: Task 2

TASK 2

1. a. *The pH of the bicarbonate of soda solution will decrease.*
   b. *The bicarbonate of soda solution will start to neutralise.*
   c. *The bicarbonate of soda solution will become a weaker base.*

2. *Sulphuric acid, Hydrochloric acid*

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. What should be added to an acid to neutralise it?
b. What will happen to a substance with a pH of 12 if an acid is added to the substance?

Answers to the checkpoint questions are as follows:

a. A base
b. The pH of the substance will drop.

9. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Reactions of acids with bases	129
Solutions for all	Reactions of acids with bases	137
Spot On	Reactions of acids with bases, Part I	75
Top Class	Reactions of acids with bases, Part I, II, III	112
Via Afrika	Reactions of acids with bases, Part I	96
Platinum	Reactions of acids with bases	109
Oxford Successful	Reactions of acids with bases	92
Pelican Natural Sciences	Reactions of acids with bases, Part I	160
Sasol Inzalo Bk A	Reactions of acids with bases	242

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?v=zQowljL8e5E (5min 49sec) [pH value – Why is soil pH important to farmers]
2. https://www.youtube.com/watch?v=rznIgkRcZZE (4min 1sec) [Neutralization reaction - How to treat a bee sting]

6 C

Term 2, Week 6, Lesson C
Lesson Title: Investigating neutralisation
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Neutralisation and pH
CAPS Page Number	67

Lesson Objectives

By the end of the lesson, learners will be able to:

- describe the neutralisation reaction
- explain that when a base is added to an acid, the ph increases
- explain that when an acid is added to a base, the ph decreases
- explain that after an acid-base reaction, the resultant ph will vary according to the strength of the acid and base
- list water and a salt as the products of a neutralisation reaction.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	
2. Observing		7. Raising Questions		12. Recording Information	
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing	✓	14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	

TOPIC: Reaction of acids with bases

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 13: The pH scale.	
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What is a neutral substance?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

A substance that is neither an acid nor a base OR
A substance with a pH value of 7

D ACCESSING INFORMATION

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

THE NEUTRALISATION REACTION

1. A neutralisation reaction involves an acid and a base (or alkali).
2. When a base is added to an acid, the pH increases.
3. When an acid is added to a base, the pH decreases.
4. In order to form a neutral solution, the correct quantity and strength of an acid and base must be mixed together.
5. The products of a neutralisation reaction are a salt and water.
6. Sodium hydroxide is a base. The pH of sodium hydroxide is about 11.

2. Explain the following to the learners:
   a. In a neutralisation reaction an acid and a base are the reactants.
   b. In a neutralisation reaction a salt and water are the products.
   c. If we add a base to an acid, the pH of the resulting solution will increase – the original solution will become more neutral.
   d. If we add an acid to a base, the pH of the resulting solution will decrease – that means the original solution will become more neutral.

e. The products of an acid-base reaction (or neutralisation reaction) are a salt and water, for example:

hydrochloric acid + sodium hydroxide → sodium chloride + water

$HCl + NaOH \rightarrow NaCl + H_2O$

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. What is the colour of the universal indicator when a substance is neutral?

b. What are the reactants in a neutralisation reaction?

Answers to the checkpoint questions are as follows:

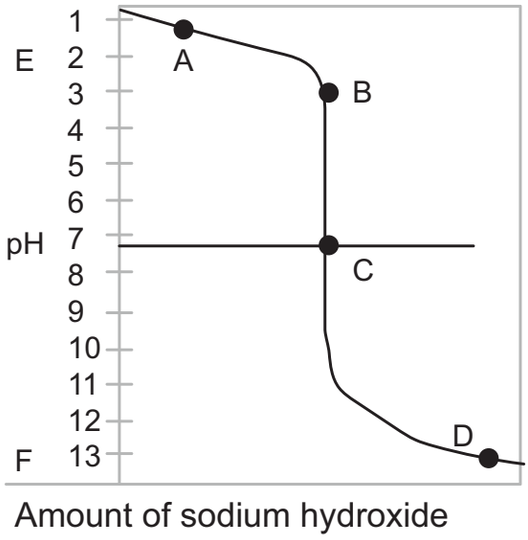
a. Green

b. Acid and base

E CONCEPTUAL DEVELOPMENT

1. Draw the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY



Amount of sodium hydroxide ⟶

Graph showing neutralisation and pH

TASK 1

1. Which line (E or F) represents a strong acid?
2. Which line (E or F) represents a strong base?

TASK 2

1. At which point (A, B, C or D) is the substance:
   a. exactly neutral
   b. most basic
   c. most acidic?
2. What evidence from the graph suggests that sodium hydroxide is a base?

3. Explain Task 1 to the learners as follows:
   a. The graph shows what happens to the pH of a substance when sodium hydroxide is added.
   b. Note that pH decreases from the bottom to the top of the *y*-axis (vertical axis).
   c. Note that the amount of sodium hydroxide increases from left to right on the *x*-axis (horizontal axis).
4. Ask learners to share their answers to Task 1 with the class.
5. Write the answers on the chalkboard.
6. Model answer: Task 1

TASK 1

1. E

2. F

7. When the learners have completed Task 1, hold a short class discussion on how to read a graph. Be sure to discuss the importance of finding out what information is provided on the x-axis and y-axis, and by the graph heading.
8. Next, get the learners to do Task 2:
   a. Using what they have learned, as well as their answers to Task 1, learners should state which positions on the line graph represent a strong acid and a strong base.
   b. Ask learners to find evidence on the graph.
9. Model answer: Task 2

TASK 2

1. C

D

A

2. As sodium hydroxide is added to the substance, the pH of the substance increases. This means that the sodium hydroxide becomes basic, which tells us that sodium hydroxide must be a base.

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. What is the name of the measure of whether a substance is an acid or a base?
b. What is the name of the laboratory acid with the formula H_2SO_4?

Answers to the checkpoint questions are as follows:

a. pH
b. Sulfuric acid

10. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Reactions of acids with bases	129
Solutions for all	Reactions of acids with bases	137
Spot On	Reactions of acids with bases, Part I	75
Top Class	Reactions of acids with bases, Part I, II, III	112
Via Afrika	Reactions of acids with bases, Part I	96
Platinum	Reactions of acids with bases	109
Oxford Successful	Reactions of acids with bases	92
Pelican Natural Sciences	Reactions of acids with bases, Part I	160
Sasol Inzalo Bk A	Reactions of acids with bases	242

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?v=LFQdD0e3L9I (6min 59sec) [Neutralization reaction of acids and bases]
2. https://www.youtube.com/watch?v=GRNslAaXu9k (2min 41sec) [Acids and bases activity using universal indicator solution]

TOPIC OVERVIEW:

Reactions of acids with bases: Part II

Term 2, Weeks 7A – 7C

A. TOPIC OVERVIEW

Term 2, Weeks 7a – 7c

- This topic runs for 1 week.
- It is presented over 3 lessons.
- This topic's position in the term is as follows:

LESSON	WEEK 1			WEEK 2			WEEK 3			WEEK 4			WEEK 5		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

LESSON	WEEK 6			WEEK 7			WEEK 8			WEEK 9			WEEK 10		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

B. SEQUENTIAL TABLE

GRADE 8	GRADE 9	GRADE 10 - 12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Acids, bases and neutrals • Reactants and products	• The general reaction of an acid with a metal oxide (base)	Grade 10 • Chemical reaction types Grade 11 • Neutral indicators for acids and bases • Acid-base theories and equations

C. SCIENTIFIC VOCABULARY

Ensure that you teach the following vocabulary at the appropriate place in the topic:

	TERM	EXPLANATION
1.	metal oxide	Compound formed when a metal reacts with oxygen
2.	salt	Compound made up of a metal and a non-metal.
3.	solution	Mixture in which one substance is dissolved in another
4.	habitat	Area or natural environment in which an organism normally lives
5.	metal hydroxide	Compound that can be formed when a metal oxide reacts with water
6.	hydroxide ion	A bond of an oxygen atom and a hydrogen atom

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

It is important to know that the reaction of an acid with metal oxides and metal hydroxides results in the formation of salts and water. An example of a salt that is formed is sodium chloride, which is the table salt we use to season our food.

E. PERSONAL REFLECTION

Reflect on your teaching at the end of each topic:

Date completed:	
Lesson successes:	
Lesson challenges:	
Notes for future improvement:	

7 A

Term 2, Week 7, Lesson A
Lesson Title: The general reaction of an acid with a metal oxide
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Neutralisation and pH
CAPS Page Number	67

Lesson Objectives

By the end of the lesson, learners will be able to:

- explain that non-metal oxides tend to be acidic (low ph)
- explain that metal oxides, metal hydroxides and metals tend to be bases (high ph)
- identify oxides as the product of the reaction of a metal and oxygen
- identify salt and water as the products of an acid with a metal oxide
- state the general equation for the reaction of an acid with a metal oxide
- balance chemical equations.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	
2. Observing	✓	7. Raising Questions		12. Recording Information	
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Poster: Periodic Table of the Elements	
Resource 13: The pH scale.	
Universal indicator, universal indicator colour chart, plastic teaspoon	
Magnesium oxide powder (from lesson 3C)	
Tap water, universal indicator, universal indicator colour chart, teaspoon, test tube, measuring jug/ cup	Small glass jar
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What is a metal oxide?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

Compound formed when a metal reacts with oxygen

D ACCESSING INFORMATION

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

THE NEUTRALISATION REACTION

1. A **metal oxide** is a compound formed when a metal reacts with oxygen.
2. When metal oxide reacts with an acid, the products that form are a salt and water.
3. A salt is a compound made up of a metal and a non-metal.
4. The general equation is:
   acid + metal oxide → salt + water

2. Explain and discuss the following with the learners:
    a. When a metal oxide reacts with an acid, the reactants are the metal oxide and the metal.
    b. A metal oxide is a compound formed when a metal reacts with oxygen.
    c. When a metal oxide reacts with an acid, the products are a salt and water.
    d. A salt is a compound made up of a metal and a non-metal.
    e. The type of salt formed will depend on the specific acid and metal oxide used in the reaction.
    f. The general equation for the reaction of a metal oxide with an acid is:

        acid + metal oxide → salt + water.
    g. Magnesium oxide (MgO) is an example of a salt. It is formed after the reaction of magnesium and oxygen.
    h. In a balanced equation, the number and type of atoms on each side of the reaction arrow must be the same.
3. Investigate whether magnesium oxide is an acid or a base when it is dissolved in water. Learners should observe the investigation and demonstration and record their observations.

    Demonstrate as follows:
        a. Dissolve one teaspoon of magnesium oxide powder in 125 ml water.
        b. Use the universal indicator to measure the pH of the magnesium oxide-water **solution**.

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. What are the products of the reaction of an acid and a metal oxide?
b. What is the general equation for the reaction of a metal oxide with an acid?

Answers to the checkpoint questions are as follows:

a. Salt and water
b. acid + metal oxide → salt + water

E CONCEPTUAL DEVELOPMENT

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

1. What colour did the universal indicator turn?
2. Is magnesium oxide an acid or a base?
3. Write a conclusion for the investigation.
4. This equation is balanced. Explain why.

   $MgO + H_2O \rightarrow Mg(OH)_2$

Product	**Metal reactant**	**Non-metal reactant**
Magnesium oxide		
Copper oxide		

TASK 1

1. Answer questions 1-3.

TASK 2

1. Complete the table.
2. Answer question 4.

2. Explain Task 1 to the learners as follows:
   a. To answer questions 1 and 2, refer to the notes you took during the investigation.
   b. To answer question 3: Write the conclusion by choosing the correct word to complete the sentence correctly:

      Metal oxides are acidic OR basic.
3. Ask learners to share their answers to Task 1 with the class.
4. Write the answers to questions 1-3 on the chalkboard.
5. Model answer: Task 1

TASK 1

1. *Blue*
2. *Base*
3. *Metal oxides are basic.*

6. When the learners have completed Task 1, hold a short class discussion on the use of universal indicator paper to establish the pH of a substance. In this investigation the magnesium oxide-water solution turned the universal indicator blue. This shows (indicates) that the magnesium oxide is a base.

7. Next, ask the learners to do Task 2:
    a. Remind learners that in a balanced equation, the number and type of atoms on the left-hand side of the reaction arrow is the same as the number and type of atoms on the right-hand side of the reaction arrow. Learners should start by identifying the elements in the equation and should then check that the number and type of atoms of each element is the same on both sides of the equation.
    b. Remind learners that they can get information about whether an element is a metal or a non-metal from the Periodic Table of Elements. They should start by identifying the two reactants and should then use the Periodic Table of Elements to establish which reactant is the metal and which reactant is the non-metal.
8. Model answer: Task 2

TASK 2

Product	***Metal reactant***	***Non-metal reactant***
Magnesium oxide	*magnesium*	*oxygen*
Copper oxide	*copper*	*oxygen*

2. The equation is balanced because:

1. There is one Mg atom on the left-hand side and one Mg atom on the right-hand side of the reaction arrow.

2. There are two O atoms on the left-hand side and two O atoms on the right-hand side of the reaction arrow.

3. There are two H atoms on the left-hand side and two H atoms on the right-hand side of the reaction arrow.

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. Do metal oxides form acidic or basic solutions when dissolved in water?
b. How would you neutralise a metal oxide?

Answers to the checkpoint questions are as follows:

a. Basic
b. By adding an acid

9. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Reactions of acids with bases	129
Solutions for all	Reactions of acids with bases	137
Spot On	Reactions of acids with bases, Part I	75
Top Class	Reactions of acids with bases, Part I, II, III	112
Via Afrika	Reactions of acids with bases, Part I	96
Platinum	Reactions of acids with bases	109
Oxford Successful	Reactions of acids with bases	92
Pelican Natural Sciences	Reactions of acids with bases, Part I	160
Sasol Inzalo Bk A	Reactions of acids with bases	242

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?v=qaBUHS5dJhQ (2min 3sec) [Magnesium Oxide and water]

7 B

Term 2, Week 7, Lesson B
Lesson Title: Applications of reactions of acids with bases
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Applications
CAPS Page Number	68

Lesson Objectives

By the end of the lesson, learners will be able to:

- explain the formation of acid rain
- explain the use of limestone to reduce soil acidity.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues	✓	11. Doing Investigations	
2. Observing		7. Raising Questions	✓	12. Recording Information	
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	✓
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	

TOPIC: Reaction of acids with bases

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 14: Photograph of a building corroded by acid rain.	
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What is corrosion?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

Damage of material due to a chemical reaction.

D ACCESSING INFORMATION

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACID RAIN

1. Acid rain is a weak acid that sometimes forms in the atmosphere.
2. Acid rain is formed when non-metals such as carbon and sulfur react with oxygen to form sulfur dioxide and carbon dioxide, which dissolve in rain water.
3. Formula for formation of sulfurous acid:

   $SO_2 + H_2O \rightarrow H_2SO_3$
4. Formula for formation of carbonic acid:

   $CO_2 + H_2O \rightarrow H_2CO_3$
5. Acid rain can corrode buildings, structures such as bridges, historical landmarks and statues.
6. Acid rain changes the pH of the soil – this affects agriculture and forestry.
7. Acid rain causes rivers and ground water to become acidic.
8. Acid rain threatens the habitat of some species.

TOPIC: Reaction of acids with bases

USE OF LIMESTONE TO MAKE SOIL LESS ACIDIC

1. Some crops grow well in an alkaline (basic) soil.
2. An alkaline soil prevents the growth of some harmful bacteria.
3. Crushed limestone ($CaCO_3$) is added to soil to make it less acidic.

2. Explain and discuss the following with the learners:
   a. Acid rain is formed as a result of chemical reactions.
   b. Acid rain is formed when non-metals such as carbon and sulfur (and many others) react with oxygen to form sulfur dioxide and carbon dioxide, which dissolve in rain water.
   c. Human activities such as the burning of fossil fuels cause air pollution. This contributes towards the formation of acid rain.
   d. Although acid rain is a weak acid, it has negative effects.
   e. Acid rain alters the pH of soil and water.
   f. Acid rain has a negative effect on animal and plant **habitats**.
   g. Acid rain corrodes human-made structures such as buildings, bridges, monuments and statues.
   h. Farmers try to neutralise acidic soils by adding crushed limestone ($CaCO_3$) to the soil. They need to do this to improve the quality of the soil.

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. What is acid rain?
b. Does $CaCO_3$ have a high pH or a low pH?

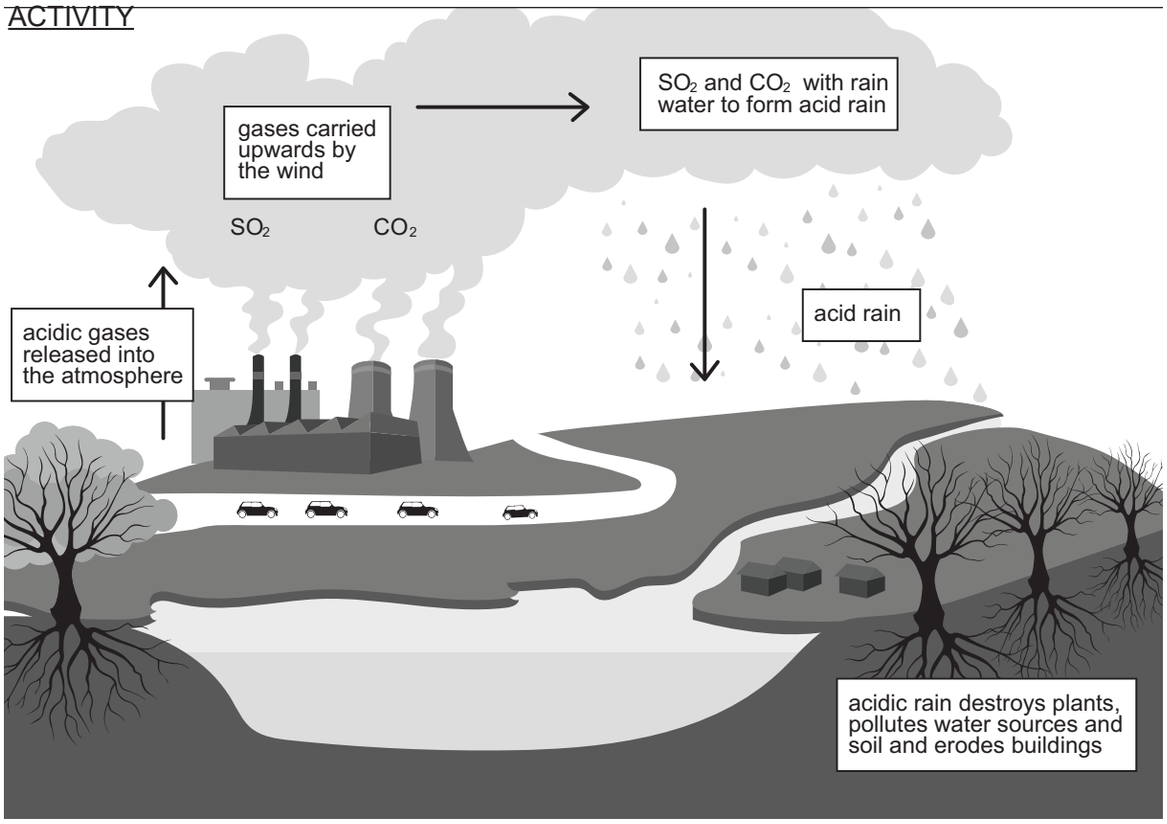
Answers to the checkpoint questions are as follows:

a. Weak acid that sometimes forms in the atmosphere
b. High (It is basic and may be used to reduce the acidity of soils.)

E CONCEPTUAL DEVELOPMENT

1. Write and draw the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY



1. Which two gases contribute to the formation of acid rain?
2. Name two human activities that cause an increase in the gases listed in question 1.
3. Write the equations for how the gases listed in question 1 react with water to form an acid.
4. What are the names of these acids?
5. List two environmental impacts of acid rain.
6. What property of acids causes them to 'eat away' at buildings?

TASK 1

1. Answer questions 1-3.

TASK 2

1. Answer questions 4-6.

2. Explain this Task 1 to the learners as follows:
    a. The diagram on the chalkboard shows how acid rain forms and how it can affect the environment.
    b. To answer question 1: Look at the examples of gases released into the atmosphere.
    c. To answer question 2: Trace the gases in the clouds back to their source on the Earth's surface.
    d. To answer question 3: Look back at your notes on acid rain.
3. Ask learners to share their answers to Task 1 with the class.
4. Write the answers to questions 1-3 on the chalkboard.
5. Model answer: Task 1

TASK 1

1. *SO_2 and CO_2 (sulfur dioxide and carbon dioxide)*
2. *Burning fossil fuels in factories and vehicle engines*
3. *$SO_2 + H_2O \rightarrow H_2SO_3$*
   $CO_2 + H_2O \rightarrow H_2CO_3$

6. When the learners have completed Task 1, hold a short class discussion on formation of acid rain and the negative impact of acid rain on the environment.
7. Next, ask the learners to do Task 2:
    a. To answer question 4: Remind learners to refer to their notes on the formation of acid rain.
    b. To answer question 5: Learners should refer to the diagram on the chalkboard.
8. Model answer: Task 2

TASK 2

1. *Carbonic acid and sulphuric acid.*
2. *Rivers become acidic, soils become acidic, plant and animal habitats are damaged, and human structures are corroded.*
3. *Acids are corrosive.*

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. What substance do farmers often add to soils to make the soil less acidic?
b. What is the name of the chemical process in which an acid is added to a base in order to reduce the pH?

Answers to the checkpoint questions are as follows:

a. Crushed limestone ($CaCO_3$)
b. Neutralisation

9. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Reactions of acids with bases	129
Solutions for all	Reactions of acids with bases	137
Spot On	Reactions of acids with bases, Part II and Part III	83
Top Class	Reactions of acids with bases, Part I, II, III	112
Via Afrika	Reactions of acids with bases, Part II	99
Platinum	Reactions of acids with bases	109
Oxford Successful	Reactions of acids with bases	92
Pelican Natural Sciences	Reactions of acids with bases, Part II	171
Sasol Inzalo Bk A	Reactions of acids with bases	242

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?v=3gjZqfmMN1k (3min 36sec) [How does the acid rain form?]
2. https://www.youtube.com/watch?v=VILCk2CpUCw (4min 39sec) [Reducing acid rain or its effects]

7 C

Term 2, Week 7, Lesson C
Lesson Title: The general reaction of an acid with a metal hydroxide
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Applications
CAPS Page Number	68

Lesson Objectives

By the end of the lesson, learners will be able to:

- list the products of the reaction of an acid with a metal hydroxide (base)
- state that hydroxides are formed when metals react with water
- list the general reaction of an acid with a metal hydroxide.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	✓
2. Observing	✓	7. Raising Questions		12. Recording Information	✓
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	✓

TOPIC: Reaction of acids with bases

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 15: Flashcards for the general reaction of an acid with a metal hydroxide.	
Prestik or similar	
Dilute sodium hydroxide, dilute hydrochloric acid, water, universal indicator, universal indicator colour chart, two beakers, one test tube, test tube rack (if available), Bunsen burner, evaporating dish, measuring cylinder, teaspoon, dropper (if available – otherwise use a teaspoon), safety goggles, gloves, laboratory coat	Four glass jars, spirit burner, heat resistant saucer/ plate, measuring jug, old shirt
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What is a metal hydroxide?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

Compound that can be formed when a metal oxide reacts with water

D ACCESSING INFORMATION

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

THE GENERAL REACTION OF AN ACID WITH A METAL HYDROXIDE (BASE)

1. A metal hydroxide forms when a metal reacts with water.
2. Hydroxide is a hydrogen atom and an oxygen atom bonded together.
3. The reactants in the acid-metal hydroxide reaction are the acid and the metal hydroxide.
4. The products in the acid-metal hydroxide reaction are a salt and water.

TOPIC: Reaction of acids with bases

THE GENERAL REACTION OF AN ACID WITH A METAL HYDROXIDE (BASE)

1. A metal hydroxide forms when a metal reacts with water.
2. Hydroxide is a hydrogen atom and an oxygen atom bonded together.
3. The reactants in the acid-metal hydroxide reaction are the acid and the metal hydroxide.
4. The products in the acid-metal hydroxide reaction are a salt and water.
5. Metal hydroxides can neutralise acids (make them less acidic).
6. The general word equation is always:
7. acid + metal hydroxide → salt + water

   An example of an equation for the formation of table salt is:

   word equation:

   hydrochloric acid + sodium hydroxide → sodium chloride + water

   balanced chemical equation:

   $HCl + NaOH \rightarrow NaCl + H_2O$

2. Explain the following to the learners:
   a. When metals react with water, they tend to form **metal hydroxides**.
   b. A **hydroxide ion** is the bond of an oxygen atom and a hydrogen atom. The hydroxide ion carries a negative charge and has the chemical formula OH. The negatively charged ion is able to bond with metals which are usually positive.
   c. An alkaline is a base that can dissolve in water.
   d. Metal hydroxides are bases. When metal hydroxides dissolve in water they form alkaline solutions with a pH greater than 7.
   e. A neutral solution has a pH of 7 and is indicated by the colour green when using the universal indicator.
   f. Use the flashcards as you discuss the general reaction of an acid with a metal hydroxide.
3. The flashcard display could look something like this:

metal hydroxide	acid	→	salt	water

4. Demonstrate the neutralisation of sodium hydroxide and hydrochloric acid. Learners must observe the demonstration and record their observations.

   Notes: Take special care when you dilute hydrochloric acid. Acids react strongly with water. An acid must be added slowly to water and not water to an acid to dilute it. Hydrochloric acid and sodium hydroxide are both highly corrosive.

Demonstrate as follows:

a. Place dilute sodium hydroxide in a beaker.
b. Place dilute hydrochloric acid in a beaker.
c. Place about 10 ml (two teaspoons) of sodium hydroxide in a test tube. Use a dropper to add a drop of universal indicator. Learners must record the colour of this solution.
d. Place about 10 ml (two teaspoons) of hydrochloric acid in a test tube. Use a dropper to add a drop of universal indicator. Learners must record the colour of this solution.
e. Use a teaspoon or dropper. Slowly add hydrochloric acid to the sodium hydroxide. Swirl the test tube after every few drops.
f. When the indicator turns light blue, add the acid very slowly. Stop when the indicator turns green.

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. What will happen to an acid when a metal hydroxide is added?
b. What is the common name for sodium chloride?

Answers to the checkpoint questions are as follows:

a. The acid will become less acidic/ weaken.
b. Table salt

E CONCEPTUAL DEVELOPMENT

1. Write the following onto the chalkboard:

ACTIVITY

2. Is the sodium hydroxide solution acidic or basic? Give a reason for your answer.
3. Is the hydrochloric acid acidic or basic? Give a reason for your answer.
4. Explain the meaning of the green colour of the universal indicator after hydrochloric acid is added to the sodium hydroxide.
5. What do we call the process in which an acid and a base are mixed until the universal indicator turns green?

TASK 1

1. Answer questions 1 and 2.

TASK 2

1. Answer questions 3 and 4.

2. Explain Task 1 to the learners as follows:
    a. Learners should refer to the notes they wrote in their exercise books as well as the record of their observations.
    b. Remind learners that the function of a universal indicator is to indicate the pH of a substance and that this is done through the colour of the solution once the indicator has been added.
    c. Remind learners that they need to compare the colour of the solution (after the indicator has been added) with the universal indicator colour chart.
    d. To answer question 3: look back at your notes on acid rain.
3. Ask learners to share their answers to Task 1 with the class.
4. Write the answers to questions 1 and 2 on the chalkboard.
5. Model answer: Task 1

TASK 1

1. *Basic. The universal indicator turned blue, indicating a base.*
2. *Acidic. The universal indicator turned red indicating an acid. The name of the substance indicates that it is an acid.*

6. When the learners have completed Task 1, hold a short class discussion on the use of universal indicator to indicate pH.
7. Next, ask the learners to do Task 2:
    a. Remind learners that the addition of an acid (hydrochloric acid) to a base (sodium hydroxide) will have a neutralising effect. This means that the pH of the base will drop and get closer to 7, and the pH of the acid will rise and get closer to 7.
    b. To answer question 5: Learners should refer to the diagram on the chalkboard.
8. Model answer: Task 2

TASK 2

1. *The green colour indicates a neutral substance/ a substance with a pH of 7.*
2. *Neutralisation*

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. True or false: When the pH of an acid drops, the acid gets stronger?
b. What are the products of an acid-metal hydroxide reaction?

Answers to the checkpoint questions are as follows:

a. True
b. Hydroxide salt and water/ salt and water

9. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Reactions of acids with bases	129
Solutions for all	Reactions of acids with bases	137
Spot On	Reactions of acids with bases, Part II and Part III	83
Top Class	Reactions of acids with bases, Part I, II, III	112
Via Afrika	Reactions of acids with bases, Part II	99
Platinum	Reactions of acids with bases	109
Oxford Successful	Reactions of acids with bases	92
Pelican Natural Sciences	Reactions of acids with bases, Part II	171
Sasol Inzalo Bk A	Reactions of acids with bases	242

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?v=TS-I9KrUjB0 (55sec) [Acid-base reaction]

TOPIC OVERVIEW:

Reactions of acids with bases: Part III

Term 2, Weeks 8A – 8C

A. TOPIC OVERVIEW

Term 2, Weeks 8a – 8c

- This topic runs for 1 week.
- It is presented over 3 lessons.
- This topic's position in the term is as follows:

LESSON	WEEK 1			WEEK 2			WEEK 3			WEEK 4			WEEK 5		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

LESSON	WEEK 6			WEEK 7			WEEK 8			WEEK 9			WEEK 10		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

B. SEQUENTIAL TABLE

GRADE 8	GRADE 9	GRADE 10 - 12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Acids, bases and neutrals • Reactants and products	• The general reaction of an acid with a metal carbonate	Grade 10 • Chemical reaction types Grade 11 • Neutral indicators for acids and bases • Acid-base theories and equations

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

Metallic substances and acids are all around us. We use many applications of acid-base reactions in our everyday lives. Examples include the use of bicarbonate of soda in baking, the use of antacids to neutralise stomach acidity, the use of acids or bases to neutralise and relieve insect stings, the management of the pH of swimming pool water and soils.

E. PERSONAL REFLECTION

Reflect on your teaching at the end of each topic:

Date completed:	
Lesson successes:	
Lesson challenges:	
Notes for future improvement:	

8 A

Term 2, Week 8, Lesson A
Lesson Title: The general reaction of an acid with a metal carbonate
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The general reaction of an acid with a metal carbonate (base)
CAPS Page Number	69

Lesson Objectives

By the end of the lesson, learners will be able to:

- explain that metal carbonates are bases
- describe a carbonate ion
- list the products of an acid-metal carbonate reaction
- list the reactants in an acid-metal carbonate reaction
- build a model of a calcium carbonate molecule
- give the general reaction of an acid with a metal carbonate.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	
2. Observing	✓	7. Raising Questions	✓	12. Recording Information	✓
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Poster: Periodic Table of the Elements	
Resource 13: The pH scale.	
Modelling clay or plasticine (two colours)	Paper Mache (two colours)
Calcium carbonate powder	Dust from old blackboard chalk (most 'modern' chalk is made from calcium sulphate)
Dilute hydrochloric acid, water, small beaker, teaspoon, dropper, universal indicator paper, universal indicator colour chart	Small glass jar
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What is the chemical formula for carbon dioxide gas?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

CO_2.

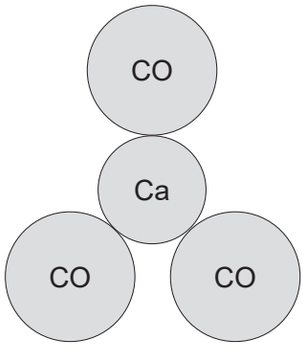
D ACCESSING INFORMATION

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

THE NEUTRALISATION REACTION

1. A **metal carbonate** is a compound consisting of a metal and a carbonate.
2. $CaCO_3$ is an example of a metal carbonate.
3. A **carbonate ion** is formed when a carbon atom and three oxygen atoms bond together.
4. An alkali is a base that can dissolve in water.
5. Metal carbonates are bases (they have a pH greater than 7).
6. The products of an acid-metal carbonate reaction are salt, water and carbon dioxide.
7. The reactants in an acid-metal carbonate reaction are a metal carbonate and an acid.
8. The word equation for the general reaction of an acid with a metal carbonate is:
9. metal carbonate + acid → salt + water + carbon dioxide

2. Explain the following to the learners:
   a. A metal carbonate is a compound consisting of a metal and a carbonate.
   b. $CaCO_3$ is an example of a metal carbonate. Calcium is the metal and CO_3
   c. is the carbonate.
   d. A carbonate ion is formed when a carbon atom and three oxygen atoms bond together.
   e. Metal carbonates are bases (they have a pH greater than 7).
   f. The word equation for the general reaction of an acid with a metal carbonate is:
   g. metal carbonate + acid → salt + water + carbon dioxide
   h. The metal carbonate and the acid are the reactants.
   i. The salt, water and carbon dioxide are the products of an acid-metal carbonate reaction.
   j. Use the modelling clay or plasticine. Get learners to work in groups to make a model of a calcium carbonate molecule.
3. The model should look something like this:



Calcium carbonate ($CaCO_3$) molecule

4. Demonstrate the neutralisation of metal carbonate. Learners should observe the investigation and record their observations.

   Safety precaution: Concentrated hydrochloric acid is highly corrosive. Handle it with care and do not allow learners to dilute it.

Demonstrate as follows:

   a. Place half a teaspoon of calcium carbonate powder in the beaker.
   b. Add a few drops of water and swirl the beaker.
      Learners should record what they observe. Hint: Is it a mixture or a solution?
   c. Add a drop of universal indicator solution.
   d. Learners should record the colour of the mixture once the universal indicator has been added.
   e. Use the dropper to add the hydrochloric acid to the mixture. Swirl the beaker after every few drops.
   f. When the indicator becomes light blue, add the acid one drop at a time. Stop when the indicator turns green.

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. What are the reactants in the reaction of an acid and a metal carbonate?
b. What are the products of the reaction of an acid and a metal carbonate?

Answers to the checkpoint questions are as follows:

a. Metal carbonate and an acid
b. Salt, water and carbon dioxide

E CONCEPTUAL DEVELOPMENT

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

1. Was the calcium carbonate mixture acidic or basic? Give a reason for your answer.
2. Is calcium carbonate an alkali or a base? Give a reason for your answer.
3. Explain the meaning of the green colour of the indicator.
4. Write a word equation and a balanced symbol equation for the reaction of calcium carbonate and hydrochloric acid.

TASK 1

1. Answer questions 1-3.

TASK 2

1. Answer question 4.

2. Explain Task 1 to the learners as follows:
   a. Remind learners to refer both to the notes they wrote in their exercise books and also those that they took during the investigation.
   b. Remind learners that an alkali is actually a type of base. An alkali is a base that can dissolve in water.
   c. Remind learners that the colour on the universal indicator colour chart indicates the pH of the substance. Blue to purple colours are basic and orange to red colours are acidic.
3. Ask learners to share their answers to Task 1 with the class.
4. Write the answers on the chalkboard.
5. Model answer: Task 1

TASK 1

1. *Basic. The colour on the indicator chart was blue.*
2. *Base. The calcium carbonate did not dissolve in the water. It formed a mixture, not a solution.*
3. *The green colour indicates that neutralisation has occurred.*

6. When the learners have completed Task 1, hold a short class discussion on the reaction of an acid with a metal carbonate. Also discuss the neutralisation process which occurred: the addition of the acid to the base decreased the pH of the base until it reached 7 (green on the colour indicator chart).
7. Next, get the learners to do Task 2:
   a. Remind learners that in a balanced equation, the number and type of atoms on the left-hand side of the reaction arrow are the same as the number and type of atoms on the right-hand side of the reaction arrow. Learners should start by identifying the elements in the equation and should then check that the number and type of atoms of each element are the same on both sides of the equation.
   b. Tell learners that the formula for calcium carbonate is $CaCO_3$ and the chemical formula for hydrochloric acid is HCl. The chemical formula for calcium chloride, which is a salt, is $CaCl_2$.
8. Write the answers on the chalkboard.
9. Model answer: Task 2

TASK 2

4. *calcium carbonate + hydrochloric acid → calcium chloride + water + carbon dioxide*

   $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. What has to be added to a base to neutralise it?
b. How would you neutralise a metal carbonate?

Answers to the checkpoint questions are as follows:

a. Acid
b. By adding an acid

10. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Reactions of acids with metals	133
Solutions for all	Reactions of acids with metals	160
Spot On	Reactions of acids with bases, Part II and III	83
Top Class	Reactions of acids with metals	125
Via Afrika	Reactions of acids with metals	106
Platinum	Reactions of acids with bases	109
Oxford Successful	Reactions of acids with metals	102
Pelican Natural Sciences	Reactions of acids with metals	190
Sasol Inzalo Bk A	Reactions of acids with metals	277

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?v=CreO-rVrxT0 (1min 2sec) [Metal carbonates react with acids to produce salt and carbon dioxide]

8 B

Term 2, Week 8, Lesson B
Lesson Title: Reaction of an acid with a metal carbonate
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The general reaction of an acid with a metal carbonate (base)
CAPS Page Number	69

Lesson Objectives

By the end of the lesson, learners will be able to:

- explain that metal carbonates are bases
- list the products of an acid-metal carbonate reaction
- list the reactants in an acid-metal carbonate reaction
- build a model of a carbon dioxide molecule
- state one way of testing for carbon dioxide gas
- balance a chemical equation.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	✓
2. Observing	✓	7. Raising Questions		12. Recording Information	✓
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	✓

TOPIC: Reaction of acids with bases

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Poster: Periodic Table of the Elements	
Resource 13: The pH scale. Page 19	
Modelling clay or plasticine (two colours)	Papier Mache (two colours)
Calcium carbonate powder	Dust from old blackboard chalk (most 'modern' chalk is made from calcium sulphate)
Dilute hydrochloric acid, water, one small beaker, teaspoon, one test tube, test tube stopper with delivery tube, clear limewater	One small glass jar
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

How do we test for the presence of carbon dioxide gas?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

CO_2 turns clear lime water milky.

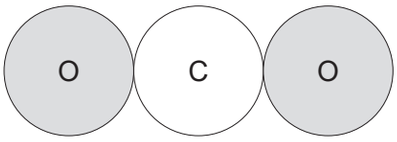
D ACCESSING INFORMATION

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

<u>THE REACTION BETWEEN A CARBONATE AND AN ACID RELEASES CARBON DIOXIDE GAS</u>

1. Carbon dioxide gas is a product of the reaction between a metal carbonate and an acid.
2. Limewater is a solution of calcium hydroxide and water.
3. Calcium carbonate is a base.
4. Hydrochloric acid is an acid.
5. Carbon dioxide turns clear limewater milky.

2. Explain the following to the learners:
   a. Carbon dioxide gas is a product of the reaction between a metal carbonate and an acid.
   b. Carbon dioxide gas consists of one carbon atom and two oxygen atoms.
   c. The chemical formula for carbon dioxide is CO_2.
   d. We can test for the presence of carbon dioxide by using clear lime water. CO_2 turns clear limewater milky.
   e. In order to test whether a gas is carbon dioxide, you need to trap it. This is done using a stopper with a delivery tube.
   f. Use the modelling clay or plasticine. Get learners to work in groups to make a model of a carbon dioxide molecule.
3. The model should look something like this:



Carbon dioxide (CO_2) molecule

4. Demonstrate that the reaction between a carbonate and an acid releases carbon dioxide gas. Learners should observe the investigation and record their observations.

   Safety precaution: Concentrated hydrochloric acid is highly corrosive. Handle it with care and do not allow learners to dilute it.

   Demonstrate as follows:
   a. Half fill the beaker with clear limewater. Place the beaker next to the test tube. Check that the delivery tube is long enough to reach from the test tube to the beaker.
   b. Put one-quarter of a teaspoon of calcium carbonate powder in one of the test tubes.
   c. Carefully add hydrochloric acid to the test tube with the calcium carbonate powder in it. The test tube should be about one-third full.
   d. Work as fast as you can to close the test tube with the stopper and insert the delivery tube to below the level of the clear limewater in the beaker.
   e. Observe the limewater carefully.

      Learners should record the colour of the limewater when CO_2 is bubbled into the limewater.

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:
   a. What colour change will occur when CO2 is bubbled through clear limewater?
   b. What does the word dioxide tell us?

Answers to the checkpoint questions are as follows:
   a. Limewater will turn milky (white)
   b. That there are two oxygen atoms

E CONCEPTUAL DEVELOPMENT

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

1. $NaCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$
2. $CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H2O + CO_2$
3. $NaCO_3 + H_2SO_4 \rightarrow Na_2SO_4 + H_2O + CO_2$
4. $CaCO_3 + HCl \rightarrow CaCl_2 + H_2O + CO_2$

TASK 1

1. Balance the equations, if necessary.

TASK 2

1. Write word equations for each equation.

2. Explain Task 1 to the learners as follows:
   a. Remind learners that in a balanced equation, the number and type of atoms on the left-hand side of the reaction arrow are the same as the number and type of atoms on the right-hand side of the reaction arrow. Learners should start by identifying the elements in the equation and should then check that the number and type of atoms of each element are the same on both sides of the equation.
   b. Remind learners that some of the equations might already be balanced – they need to check this.
   c. Remind learners to write the balanced equations in symbol form.
3. Ask learners to share their answers to Task 1 with the class.
4. Write the answers on the chalkboard.
5. Model answer: Task 1

TASK 1

1. *$NaCO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$*
2. *Balanced*
3. *Balanced*
4. *$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$*

6. When the learners have completed Task 1, hold a short class discussion on balancing equations. Encourage learners to work through the equation methodically in order to establish whether there are the same number and type of atoms on each side of the reaction arrow.

7. Next, get the learners to do Task 2:
   a. Remind learners that they must write the word equation, not the symbol equation.
   b. Remind learners of the word equation for the general reaction of an acid with a metal carbonate:

      metal carbonate + acid → salt + water + carbon dioxide
8. Write the answers on the chalkboard.
9. Model answer: Task 2

TASK 2

1. *sodium carbonate + hydrochloric acid → sodium chloride + water + carbon dioxide*
2. *calcium carbonate + sulphuric acid → calcium sulfate + water + carbon dioxide*
3. *sodium carbonate + sulphuric acid → sodium sulfate + water + carbon dioxide*
4. *calcium carbonate + hydrochloric acid → calcium chloride + water + carbon dioxide*

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. True or false? Water and carbon dioxide are always products of the reaction of an acid with a metal carbonate.
b. What gas is produced when hydrochloric acid reacts with calcium carbonate?

Answers to the checkpoint questions are as follows:

a. True
b. Carbon dioxide

10. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Reactions of acids with metals	133
Solutions for all	Reactions of acids with metals	160
Spot On	Reactions of acids with bases, Part II and III	83
Top Class	Reactions of acids with metals	125
Via Afrika	Reactions of acids with metals	106
Platinum	Reactions of acids with bases	109
Oxford Successful	Reactions of acids with metals	102
Pelican Natural Sciences	Reactions of acids with metals	190
Sasol Inzalo Bk A	Reactions of acids with metals	277

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?v=QR6GsydYUSI (1min 16sec) [Limewater test for carbon dioxide]

8 C

Term 2, Week 8, Lesson C
Lesson Title: Reaction of an acid with a metal
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The general reaction of an acid with a metal
CAPS Page Number	68

Lesson Objectives

By the end of the lesson, learners will be able to:

- list the products of an acid-metal reaction
- list the reactants in an acid-metal reaction
- give the general reaction of an acid with a metal
- build a model of a hydrogen molecule
- balance a chemical equation
- describe a simple test for the presence of hydrogen gas.

Specific Aims	1. DOING SCIENCE	✓
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	✓
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	

SCIENCE PROCESS SKILLS

1. Accessing & recalling Information	✓	6. Identifying problems & issues		11. Doing Investigations	✓
2. Observing	✓	7. Raising Questions		12. Recording Information	✓
3. Comparing		8. Predicting		13. Interpreting Information	✓
4. Measuring		9. Hypothesizing		14. Communicating	
5. Sorting & Classifying		10. Planning Investigations		15. Scientific Process	✓

TOPIC: Reaction of acids with bases

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Poster: Periodic Table of the Elements	
Resource 13: The pH scale.	
Modelling clay or plasticine	Paper Mache
Magnesium	
Dilute hydrochloric acid, water, one small beaker, teaspoon, one test tube with a stopper, wooden splint, matches, watch/ stopwatch/ cell phone, teaspoon	One small glass jar
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Write the following question onto the chalkboard before the lesson starts:

What gas is released when an acid reacts with a metal carbonate?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

Carbon dioxide

D ACCESSING INFORMATION

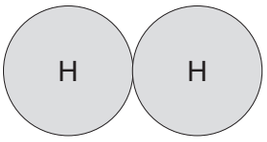
1. Write the following onto the chalkboard (always try to do this before the lesson starts):

THE REACTION OF AN ACID WITH A METAL

1. Salt and hydrogen gas are the two products of the reaction between a metal and an acid.
2. The general equation of the reaction of an acid with a metal is:
   acid + metal → salt + hydrogen gas

2. Explain and discuss the following with the learners:
   a. When an acid reacts with a metal, the products formed are a salt and hydrogen gas.
   b. The type of salt formed will depend on the specific acid and metal used in the reaction.
   c. When an acid reacts with a metal, the reactants are the acid and the metal.

2. Explain and discuss the following with the learners:
   a. When an acid reacts with a metal, the products formed are a salt and hydrogen gas.
   b. The type of salt formed will depend on the specific acid and metal used in the reaction.
   c. When an acid reacts with a metal, the reactants are the acid and the metal.
   d. The general equation of the reaction of an acid with a metal is:
   e. acid + metal $\rightarrow$ salt + hydrogen gas
   f. Hydrogen gas makes a popping sound in the presence of a flame.
   g. Use the modelling clay or plasticine. Get learners to work in groups to make a model of a hydrogen molecule.
3. The model should look something like this:



Hydrogen (H_2) molecule

4. Demonstrate the reaction of acids with metals. Learners should observe the investigation and record their observations.

   Safety precaution: Concentrated hydrochloric acid is highly corrosive. Handle it with care and do not allow learners to dilute it. Take care when working with magnesium as it is flammable.

   Demonstrate as follows:

   a. Place 20 ml (four teaspoons) hydrochloric acid into a test tube.
   b. Place some magnesium into the acid. Place a stopper in the test tube.
   c. Light the wooden splint.

      Allow the reaction to run for about one minute. Open the stopper and place the lit wooden splint in the test tube (do not submerge the flint in the solution). Part of learners 'observation' here is to listen carefully.

      A popping sound will be heard.

Checkpoint 1

Ask the learners the following questions to check their understanding at this point:

a. What gas is released when an acid reacts with a metal?
b. What acid was used in the investigation?

Answers to the checkpoint questions are as follows:

a. Hydrogen
b. Hydrochloric acid

E CONCEPTUAL DEVELOPMENT

1. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

1. What did you observe when the magnesium was added to the hydrochloric acid?
2. What did you observe when the hydrogen gas was brought near the flame?
3. Name the gas that was produced in the reaction. How do you know this?
4. Write a word equation for the reaction.
5. Write a balanced chemical equation for the reaction.

TASK 1

1. Answer questions 1-3.

TASK 2

1. Answer questions 4 and 5.

2. Explain Task 1 to the learners as follows:
   a. Remind learners to refer to the notes they have written in their exercise books, as well as their observation records.
   b. Revise the general equation of the reaction of an acid with a metal:
      acid + metal → salt + hydrogen gas
   c. Help learners to identify the reactants and products in the investigation.
3. Ask learners to share their answers to Task 1 with the class.
4. Write the answers on the chalkboard.
5. Model answer: Task 1

TASK 1

1. *Bubbles*
   A popping sound
   Hydrogen. Hydrogen gas makes a popping sound in the presence of a flame.

6. When the learners have completed Task 1, hold a short class discussion in which you
7. revise the reaction of metals with acids.
   a. Next, get the learners to do Task 2:
   b. Remind learners that in a balanced equation, the number and type of atoms on the left-hand side of the reaction arrow are the same as the number and type of atoms on the right-hand side of the reaction arrow. Learners should start by identifying the elements in the equation and should then check that the number and type of atoms of each element are the same on both sides of the equation.
8. Remind learners to write the balanced equations in symbol form.

9. Write the answers on the chalkboard.
10. Model answer: Task 2

TASK 2

1. *hydrochloric acid + magnesium → magnesium chloride + hydrogen*
2. *$2HCl + Mg \rightarrow MgCl_2 + H_2$*

Checkpoint 2

Ask the learners the following questions to check their understanding at this point:

a. True or false? Carbon dioxide gas makes a popping sound in the presence of a flame.
b. What are the products of an acid - metal reaction?

Answers to the checkpoint questions are as follows:

a. False
b. Salt and hydrogen gas

11. Ask the learners if they have any questions and provide answers and explanations.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

If you need additional information or activities on this topic, you can find these in your textbook on the following pages:

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Reactions of acids with metals	133
Solutions for all	Reactions of acids with metals	160
Spot On	Reactions of acids with bases, Part II and III	83
Top Class	Reactions of acids with metals	125
Via Afrika	Reactions of acids with metals	106
Platinum	Reactions of acids with bases	109
Oxford Successful	Reactions of acids with metals	102
Pelican Natural Sciences	Reactions of acids with metals	190
Sasol Inzalo Bk A	Reactions of acids with metals	277

G ADDITIONAL ACTIVITIES/ READING

In addition, further reading, listening or viewing activities related to this sub-topic are available through the following web links:

1. https://www.youtube.com/watch?v=9hBCLoWwcWo (1min 49sec) [Metals react with acids to produce salt and hydrogen]

NATURAL SCIENCES
ASSESSMENT
GRADE 9 TERM 2

GRADE 9 ASSESSMENT

- This section presents the CAPS assessment requirements for this grade for this term.
- See your prescribed textbooks for examples of the required assessments.
- An example of a practical task and an exam have been included. See your textbook and departmental resources for policy compliant tests.

CAPS Assessment

Assessment is a continuous planned process that involves identifying, gathering, interpreting and diagnosing information about the performance of learners.

Assessment involves generating and collecting evidence of learner achievement and progress, and using this information to understand and provide assistance to the learner during the process of teaching and learning.

Assessment should be both *formal* and *informal*:

a. ***Informal Assessment*** involves regular checking of learners' class work and practical tasks; asking questions; discussions; informal classroom interactions; and giving constructive feedback. Informal assessment marks do not need to be recorded, but the teacher can make notes for future reference.

b. ***Formal Assessment*** provides teachers with a systematic way of evaluating how well learners are progressing. Formal Assessment consists of selected assessment tasks. These tasks are stipulated by CAPS and the marks need to be recorded. These tasks are done throughout the year, and include practical / investigations, project, tests and examinations.

   i. ***Tests and Examinations***

   The weighting of the marks should reflect the time allocated to each section in the curriculum content. Tests and exams should consist of a range of questions that cover different cognitive levels: recall; understanding; application; evaluation; analysis; and synthesis. CAPS aligned tests and examinations, with accompanying memoranda, are provided with these lesson plans.

   ii. ***Practical / investigation tasks***

   Practical / investigation tasks give learners the opportunity to demonstrate knowledge, skills and understanding. They form part of the activities included in these lesson plans. Each term, one practical / investigation task has been selected for assessment. A rubric is provided to conduct the assessment.

   iii. ***Poject***

   Projects give learners the opportunity to demonstrate knowledge, skills, understanding and application. The project can be given in any term but must be recorded for term 4 assessment.

A minimum mark allocation is prescribed in CAPS for, practical / investigation, projects, tests and examinations for each grade. These are summarised, by grade, in the table below:

Grade 8							
Programme of Formal Assessment							
	Term 1		**Term 2**		**Term 3**		**Term 4**
Form of Assessment	Practical task/ Investigation	Test	Practical task/ Investigation	Examination	Project	Test	Examination
Tools of Assessment	Rubric/memo/ checklist	Memo	Rubric/memo/ checklist	Memo	Rubric/memo/ checklist	Memo	Memo
Minimum Marks	**20**	**70**	**20**	**100**	**30**	**70**	**100**
Maximum Time Allocation	Dependent on nature of the task and context	90 minutes	Dependent on nature of the task and context	120 minutes	Dependent on nature of the task and context	90 minutes	120 minutes
Content and skills focus	Term 1	Term 1	Term 1	Terms 1 & 2	Any content for the year	Term 3	Terms 3 & 4
No. of Tasks	**2**		**2**		**2**		**1**

PRACTICAL TASK - INTRODUCTION

NS
GRADE 9
PRACTICAL TASK
TERM 2

20 MARKS

Time allocation: 60 minutes

NOTE TO THE TEACHER

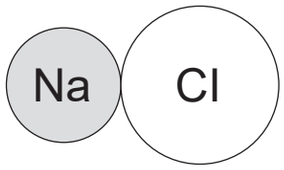
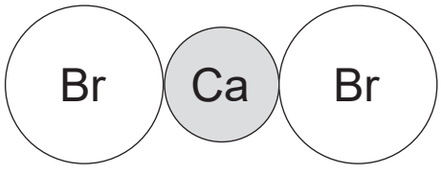
1. This practical activity will be completed as part of Section E of lesson 1C.
2. This practical will take place during the lesson after the teaching component in Section D, “Accessing Information”.
3. The first 20 minutes will be used to teach section D and prepare learners for the practical task.
4. The next 40 minutes will be used to complete the practical activity as outlined in Section E.
5. The instructions and content of the practical task should be written on the chalkboard for the learners.
6. This task will be done in groups of 6.
7. The learners will need access to the poster for Term 2: “The Periodic Table of the Elements” for this activity.
8. Each group will need the following in order to complete the practical:
    - clay/ plasticine/ dough/ (preferably in a variety of colours)
    - matches/ toothpicks/ straws/ small thin lengths of stick
    - tinfoil (optional)
    - paper scraps for labels
    - tape for sticking
    - prestik (optional)
    - round seeds and/or beads in different colours (optional)
    - pens or markers
9. Ensure that you have all the materials ready and prepared for the learners before the lesson begins.
10. The memorandum for assessing the practical task is provided.
11. The learners should complete the drawings with a sharp pencil and the written answers should be completed in pen.

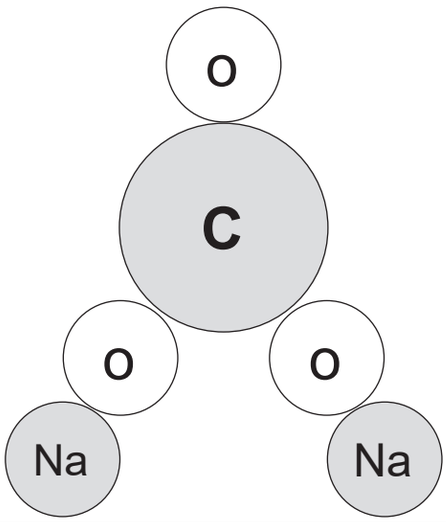
PRACTICAL – MEMORANDUM

NS
GRADE 9
PRACTICAL TASK
TERM 2

20 MARKS

(see Section E of Lesson 1C for instructions and questions)

Topic	Task	Expected answer/outcome	Marks
	1		
Compounds	1.1	sodium chlorine	1
Compounds	1.2	Sodium Chloride	1
Compounds	1.3	1 : 1	1
Compounds	1.4		1
Compounds	1.5	A suitable 3-D model as per the diagram has been made	1
Compounds	1.6	The labels are correct as per the diagram	1
	2		
Compounds	2.1	calcium bromine	1
Compounds	2.2	Calcium bromide	1
Compounds	2.3	1 : 2	1
Compounds	2.4		1
Compounds	2.5	A suitable 3-D model as per the diagram has been made	2
Compounds	2.6	The labels are correct as per the diagram	1
	3		
Compounds	3.1	sodium carbon oxygen	1

Compounds	3.2	Sodium carbonate	1
Compounds	3.3	2 : 1 : 3	1
Compounds	3.4		1
Compounds	3.5	A suitable 3-D model as per the diagram has been made	2
Compounds	3.6	The labels are correct as per the diagram	1
		TOTAL	**20**

GRADE 9 ASSESSMENT

TERM EXAM

NS
GRADE 9
EXAM
TERM 2

100 MARKS
120 MINUTES

NOTE TO THE TEACHER:

If possible, photocopy this test for each learner. If this is not possible, write the test on the chalkboard.

INSTRUCTIONS TO THE LEARNERS

1. Answer all questions in blue or black ink.
2. Read each question carefully before answering it.
3. Pay attention to the mark allocations.
4. Plan your time carefully.
5. Write your answers in the spaces provided.
6. Write neatly.

Practice Question

Read the question and circle the letter that shows the correct answer.

1.1 Which one of these happens when humans put food into their mouths?

A. absorption
B. ingestion
C. digestion
D. excretion

You have answered correctly if you have circled (B)

GRADE 9 ASSESSMENT

NS
GRADE 9
TERM 2
EXAM

100 MARKS

PART 1: Life and Living

Question 1: Multiple choice [3]

Read each question and circle the letter that shows the correct answer.

1.1 Which one of these is NOT an animal cell?

A. Red blood cell.
B. White blood cell.
C. Palisade cell.
D. Sperm cell.

1.2 Which of these statements is FALSE?

A. Plants are producers because they make their own food.
B. The process of making their own food is called photosynthesis.
C. Photosynthesis takes place in the nucleus.
D. Some plants can store the food they make underground.

1.3 Which of these statements is TRUE?

A. Arteries are blood vessels that transport blood away from the heart.
B. Veins are blood vessels that transport blood away from the heart..
C. Capillaries carry sperm cells.
D. The oesophagus carries air to the lungs.

Question 2: Match the columns **[4]**

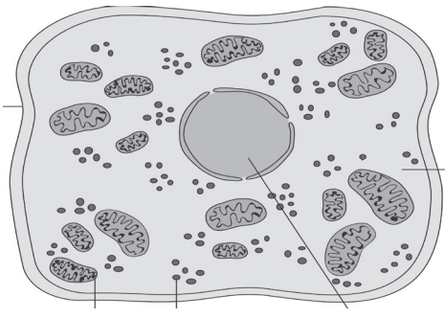
Instructions:

- Match the sentences in COLUMN A with the words in COLUMN B.
- Draw a line to join the sentence in COLUMN A with the correct word in COLUMN B. Do this as shown in the example below.

COLUMN A		COLUMN B
example	Waste matter from ingested food.	A. Uterus
2.1.	Tube which carries the female egg to the uterus.	B. Oviduct
2.2.	Bag made of skin that holds testes outside the body.	C. Cholesterol
2.3.	Hollow cavity inside a female in which the baby develops during pregnancy.	D. Scrotum
2.4.	Fatty substance found in animal-based foods.	E. Faeces

Question 3 **[8]**

Look at the diagram of the cell below:



(Note to teacher: Copy this picture or use Term 1 Resource 1 with the labels covered.)

3.1. Is this cell a plant or animal cell? _____

3.2. Give two reasons from what you can see in the diagram to explain your answer.

_____

_____

3.3. What part of the cell is labelled A?

_____

3.4. What function does part A have in the cell?

_____

_____

3.5. What part of the cell is labelled B?

_____

3.6. What function does part B have in the cell?

_____

3.7. What part of the cell is labelled C?

_____

3.8. What function does part C have in the cell?

_____

Question 4 **[5]**

The statements below all refer to the plant cell.

Write the word that is being described in the sentence.

Only write the answer.

4.1. The jelly-like liquid in cells where reactions take place.

_____

4.2. Structure that is green in colour which uses energy from the Sun to produce food.

_____

4.3. Structure that controls all the activities of the cell.

_____

4.4. Large bubble pumped full of water to make the cell firm.

_____

4.5. Thin layer on outside that makes the plant cell strong and firm.

_____

Question 5 **[10]**

Using what you have learnt and the words in the box below, explain what you understand about the processes of the digestive system, from ingestion to egestion.

Ingestion, molecules, bloodstream, oesophagus, intestines, stomach, digestion, nutrients, gastric juices, liver, egestion, faeces, anus, waste, muscles, saliva, chewing, absorption, mouth, teeth, peristalsis, enzymes, rectum

Question 6 **[10]**

"The Respiratory System functions to supply oxygen to the body and remove carbon dioxide."

6.1. Explain what happens during breathing. (2)

6.2. Which gasses are exchanged and where does this take place? (2)

6.3. Define respiration: (2)

6.4. Write down a word equation for respiration: (2)

6.5. Name two products of respiration? (2)

6.6. Explain where the glucose that is needed for respiration comes from in the blood stream.

_____

6.7. Explain what you understand by diffusion of gases and how this helps in respiration.

_____

_____

_____

6.8. Where in the cells does respiration take place?

_____

Question 7 **[6]**

Read the following statement:

"Puberty is the time of your life when the sexual organs mature for reproduction."

7.1. These changes are caused by hormones. Which gland is responsible for releasing these hormones?

_____

7.2. Where is this gland located?

_____

7.3. What is the function of hormones in the body?

_____

7.4. Which hormone is released from the testes in males?

_____

7.5. Which hormone is released from the ovaries in females?

_____

7.6. Explain the difference between the menstrual cycle and menstruation.

_____

Question 8 **[4]**

State whether the following statements are True or False:

8.1. Condoms can be used more than once. _____

8.2. Condoms prevent pregnancy every time. _____

8.3. Condoms may help prevent the spread of STDs._____

8.4. During pregnancy it is safe to drink alcohol. _____

8.5. Pregnant girls who use drugs may be affecting their unborn baby._____

8.6. 40 weeks is considered a full-term pregnancy._____

8.7. Fertilization of the female egg happens during first 5 days of a regular menstrual cycle._____

8.8. The urethra can carry semen and urine at the same time. _____

TOTAL: [46]

PART 2: Matter and Materials

Question 9: Multiple choice **[4]**

Read each question and circle the letter that shows the correct answer.

9.1 Which one of these is NOT an element on the Periodic Table?

A. CO_2
B. Xe
C. O
D. Ar

9.2 Which of these statements is TRUE?

A. An element is the basic unit of a chemical element.
B. An element is made up of atoms of the same kind.
C. A pure substance consists of many different elements, chemically bonded together.
D. Compounds not pure substances.

9.3 Which of these statements is FALSE?

A. An element is a pure substance that cannot be broken down any further.
B. The elements are classified into two group; metals and non-metals.
C. Copper and oxygen are examples of elements.
D. All the elements are listed on the Periodic Table.

9.4 What is the ratio of the elements Calcium and Bromine in Calcium Bromide ($CaBr_2$)

A. 1 : 1
B. 2 : 1
C. 1 : 2
D. 2 : 2

Question 10: Match the columns **[4]**

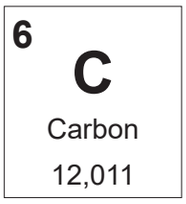
Instructions:

- Match the sentences in COLUMN A with the words in COLUMN B.
- Draw a line to join the sentence in COLUMN A with the correct word in COLUMN B. Do this as shown in the example below.

COLUMN A		COLUMN B
example	Basic unit of a chemical element.	A. Electron
10.1	Neutral sub-atomic particle.	B. Neutron
10.2	Negatively charged sub-atomic particle.	C. Particle
10.3	Positively charged sub-atomic particle.	D. Proton
10.4	Minute portion of matter.	E. Atom

Question 11 **[4]**

Look at the following element at it appears on the Periodic Table:



11.1. What is the name of this element? _____

11.2. What is the symbol for this element? _____

11.3. What does the number “12,011” refer to? _____

11.4. What does the number”6” refer to? _____

11.5. What does this number tell us about the nucleus of the carbon atom?

_____

11.6. Is Carbon an element or a compound?

_____

11.7. Explain your answer, giving two reasons.

_____

_____

Question 12 **[3]**

Complete the following sentences using the words in the box below:

oxygen, sodium, hydrogen, water, two, chemically bonded, three, chlorine

"Many compounds are named according to their elements."

12.1. If the compound name ends in "ide" (example: Copper oxide) there are _____ elements in the compound.

12.2. If the compound ends in "ate" (example: Calcium carbonate) there are _____ elements in the compound, one of which is _____.

12.3. The common name for H_2O is: _____.

12.4. The formula for ammonia (NH_3) tell us there is one nitrogen atom and three _____ atoms in Ammonia.

12.5. Compounds are made of elements that are _____.

12.6. The common name for the compound NaCl is table salt. What elements are found in table salt? _____

Question 13 **[3]**

Write the word that is being described in the sentence.

Only write the answer.

13.1. A process that occurs when two or more substances react to form new substances.
_____

13.2. The substances that react in a chemical reaction.
_____

13.3. Substances that are made as a result of a chemical reaction.
_____

13.4. The law that explains that atoms are not lost or gained during a chemical reaction.
_____

13.5. Molecule composed of only two atoms.
_____

13.6. Process where a metal is damaged or weakened by a chemical reaction.
_____

Question 14 **[3]**

State whether the following sentences are True or False:

14.1. Not all chemical equations must be balanced. _____

14.2. In a balanced equation, the total number and type of atoms in the reactants are the same as in the products. _____

14.3. You can change the composition of a molecule or atom in order to balance an equation. _____

14.4. You can change the number of molecules or atoms to balance an equation. _____

14.5. $4Fe + 3O_2 \rightarrow 2Fe_2O_2$ is a balanced equation. _____

Question 15 **[3]**

Complete and balance the following reactions:

15.1. $H_2P + O_2 \rightarrow$ _____

15.2. $HCl + Mg \rightarrow$ _____

15.3. $S + O_2 \rightarrow$ _____

Question 16 **[6]**

" Some metals react when exposed to oxygen."

16.1. When a substance reacts with oxygen, the reaction is called_____.

16.2. Some metals burn in the presence of oxygen. This process is called _____.

16.3. When a metal is burned in air, the metal reacts with the oxygen in the air and a _____ is formed.

16.4. Complete the following table:

Reactants	Metal oxide formed
	Sodium oxide
Calcium and oxygen	

16.5. Write the reaction equation (using chemical symbols) for the oxidation of calcium and oxygen: _____

Question 17 **[5]**

" Rusting is the slow chemical reaction of iron metal with oxygen and water."

17.1. Explain what happens, chemically, when iron reacts with water and oxygen.

_____

_____

17.2. What is the chemical symbol for iron oxide? _____

17.3. Name two ways to prevent rusting of metal or iron objects.

_____

Question 18 **[7]**

Define the following:

18.1. pH measure:_____

18.2. An acid:_____

18.3. A base: _____

18.4. What is the pH value of a neutral substance?_____

18.5. What happens to the pH level when you add an acid to a base?

_____

_____

When sulfur dioxide combines with moisture in the air it forms an acid.

18.6. What do we commonly call this acid?_____

18.7. List three effects this acid has on the environment.

_____

_____

_____

Question 19 **[4]**

Draw a model of each of the following molecules:

19.1 sulphur trioxide molecule

19.2 carbon dioxide molecule

Question 20 **[4]**

Complete the following table:

Chemical symbol on Periodic Table	Name
N	
	Sodium
Fe	
Mg	

TOTAL: [100]

TERM 2 EXAM – MEMORANDUM
NS **GRADE 9** **MEMORANDUM** **TERM 2** **100 MARKS**

Caps Topic	Questions	Expected answer(s)	Marks
PART 1: Life and the Living			
	1		
Cells as basic units of life	1.1	C✓	1
Cells as basic units of life	1.2	C✓	1
Systems in the human body	1.3	B✓	1
	2		
Human reproduction	2.1	B✓	1
Human reproduction	2.2	D✓	1
Human reproduction	2.3	A✓	1
Human reproduction	2.4	C✓	1
	3		
Cells as basic units of life	3.1	Animal cell✓	1
Cells as basic units of life	3.2	Answers will vary✓	1
Cells as basic units of life	3.3	Nucleus✓	1
Cells as basic units of life	3.4	Controls all activities inside the cell✓	1
Cells as basic units of life	3.5	Cytoplasm✓	1
Cells as basic units of life	3.6	Where all reactions in the cell take place✓	1
Cells as basic units of life	3.7	Mitochondria✓	1
Cells as basic units of life	3.8	Creates energy for the cell/ respiration✓	1

	4		
Cells as basic units of life	4.1	cytoplasm✓	1
Cells as basic units of life	4.2	chloroplast✓	1
Cells as basic units of life	4.3	nucleus✓	1
Cells as basic units of life	4.4	vacuole✓	1
Cells as basic units of life	4.5	cell wall✓	1
	5		
Digestive system	5	(Any 10) • When you eat you put food in you mouth. This is called ingestion. ✓ • Saliva in the mouth helps break the food down chemically. ✓ • The teeth break up the food and the tongue assists in swallowing, ✓ • This is mechanical digestion. ✓ • The food then moves down the oesophagus • to the stomach. ✓ • The liver assists in digestion by producing liquid to break down fats. ✓ • The oesophagus moves the food by process of peristalsis. ✓ • In the stomach the food is broken down by enzymes ✓ • and hydrochloric acid. ✓ • This chemical digestion makes the food easier to absorb. ✓ • Digestion is necessary so that the nutrients can be absorbed by the bloodstream. ✓ • The food then moves into the small intestine ✓ • and then the large intestine. ✓ • Nutrients are absorbed by the body in the intestines. ✓ • These nutrients are needed for respiration. ✓ • Waste (or faeces) is stored in the rectum. ✓ • Egestion occurs when waste is pushed out of the rectum. ✓	10

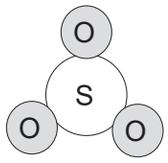
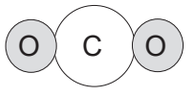
	6		
Circulatory and respiratory systems	6.1	During breathing air is taken in through the mouth and nose (inhalation) into the lungs and then air is breathed out of the nose and mouth (exhalation).✓✓	1
Circulatory and respiratory systems	6.2	Oxygen and carbon dioxide are exchanged. This takes place in the alveoli which are in the lungs.✓✓	1
Circulatory and respiratory systems	6.3	Respiration is when oxygen✓ is used to change sugars into energy✓	1
Circulatory and respiratory systems	6.4	oxygen + glucose → energy + carbon dioxide + water✓✓	1
Circulatory and respiratory systems	6.5	Carbon dioxide✓ Water✓	1
Circulatory and respiratory systems	6.6	Digested food	1
Circulatory and respiratory systems	6.7	6 steps correctly ordered • Diffusion is the movement of gases from a high concentration to a low concentration. ✓ • Oxygen moves from the alveoli into the blood capillary because of diffusion. ✓ • The concentration of oxygen is high in the alveoli because the person has just inhaled. ✓ • The oxygen will move into the blood capillary where there is now a low concentration of oxygen but a high concentration of carbon dioxide. ✓ • The carbon dioxide will move in the opposite direction. ✓ • The carbon dioxide will move from the blood capillaries to the alveoli where there is now a low concentration of carbon dioxide. ✓ • The carbon dioxide will now be exhaled. ✓	6 x ½ = 3
Circulatory and respiratory systems	6.8	In the mitochondria of the cells ✓	1

	7		
Human reproduction	7.1	Pituitary gland✓	1
Human reproduction	7.2	The brain✓	1
Human reproduction	7.3	Hormones are chemical substances that are released that affect the activity of another part of the body.✓	1
Human reproduction	7.4	They become extinct✓	1
Human reproduction	7.5	Testosterone✓	1
Human reproduction	7.6	Menstrual cycle: a 28-day cycle to prepare the uterus for a possible pregnancy. ✓ Menstruation: Breakdown of the uterus during the menstrual cycle, known as the “period”. ✓	1
	8		
	8.1	False ✓	½
	8.2	False ✓	½
	8.3	True ✓	½
	8.4	False ✓	½
	8.5	True ✓	½
	8.6	True ✓	½
	8.8	False ✓	½
	8.9	False ✓	½

GRADE 9 ASSESSMENT

Caps Topic	Questions	Expected answer(s)	Marks
PART 2 : Matter and Materials			
	9		
Compounds	9.1	A✓	1
Compounds	9.2	B✓	1
Compounds	9.3	B✓	1
Compounds	9.4	C✓	1
	10		
Compounds	10.1	B✓	1
Compounds	10.2	A✓	1
Compounds	10.3	D✓	1
Compounds	10.4	C✓	1
	11		
Compounds	11.1	Carbon✓	½
Compounds	11.2	C✓	½
Compounds	11.3	Atomic mass✓	½
Compounds	11.4	Atomic number ✓	½
Compounds	11.5	This number tells us how many protons are in the nucleus ✓	½
Compounds	11.6	Element ✓	½
Compounds	11.7	An element is made up of atoms of the same kind. ✓ Carbon is not bonded to any other element ✓	1
	12		
Compounds	12.1	two✓	½
Compounds	12.2	both answers must be correct for the half mark three oxygen✓	½
Compounds	12.3	water✓	½
Compounds	12.4	hydrogen✓	½
Compounds	12.5	chemically bonded✓	½
Compounds	12.6	both answers must be correct for the half mark sodium chlorine✓	½

	13		
Chemical reactions	13.1	chemical reaction ✓	½
Chemical reactions	13.2	reactants ✓	½
Chemical reactions	13.3	products ✓	½
Chemical reactions	13.4	Law of Conservation of Matter ✓	½
Chemical reactions	13.5	diatomic molecule ✓	½
Chemical reactions	13.6	corrosion ✓	½
	14		
Chemical reactions	14.1	False ✓	½
Chemical reactions	14.2	True ✓	½
Chemical reactions	14.3	False ✓	½
Chemical reactions	14.4	True ✓	½
Chemical reactions	14.5	True ✓	1
	15		
Chemical reactions	15.1	$H_2P + O_2 \rightarrow P + H_2O$ ✓	1
Chemical reactions	15.2	$HCl + Mg \rightarrow MgCl + H_2$ ✓	1
Chemical reactions	15.3	$S + O_2 \rightarrow SO_2$ ✓	1
	16		
Reaction of metals with oxygen	16.1	oxidation ✓	1
Reaction of metals with oxygen	16.2	combustion ✓	1
Reaction of metals with oxygen	16.3	metal oxide ✓	1
Reaction of metals with oxygen	16.4	**Reactant** / **Metal oxide** sodium and oxygen ✓ / sodium oxide ✓ calcium and oxygen ✓ / calcium oxide ✓	2
Reaction of metals with oxygen	16.5	Cu + O →CuO ✓	1
	17		
Reaction of metals with oxygen	17.1	When iron reacts with water and oxygen it forms iron hydroxide. When the iron hydroxide dries out the water evaporates, and iron oxide is formed. ✓ Iron oxide corrodes the metal in the form of rust. ✓	2

Reaction of metals with oxygen	17.2	Fe_2O_3 ✓	1
Reaction of metals with oxygen	17.3	Electroplating ✓ Painting ✓	2
	18		
Acids, bases and pH value	18.1	pH is a measure of how acidic or basic a substance is. ✓	½
Acids, bases and pH value	18.2	An acid is a substance with a pH value between 0 and 7. ✓	½
Acids, bases and pH value	18.3	A base is a substance with a pH value between 7 and 14. ✓	½
Acids, bases and pH value	18.4	7 ✓	½
Reaction of acids with bases	18.5	The pH decreases ✓	1
Reaction of acids with bases	18.6	Acid rain ✓	1
Reaction of acids with bases	18.7	Damages buildings/statues/ bridges/ man-made structures✓ Makes water / soil acidic✓ Kills fish / plants ✓	3
	19		
Compounds	19.1		2
Compounds	19.2		2
	20		
Compounds		<table><tr><td>Symbol</td><td>Name</td></tr><tr><td>N</td><td>Nitrogen</td></tr><tr><td>Na</td><td>Sodium</td></tr><tr><td>Fe</td><td>Iron</td></tr><tr><td>Mg</td><td>Magnesium</td></tr></table>	4
			TOTAL 100