"One of the basic rules of the universe is that nothing is perfect. Perfection simply doesn't exist. Without imperfection, neither you nor I would exist."

-Stephen Hawking

NATURAL SCIENCES

LESSON PLAN
GRADE 9 TERM 4

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 and to help the DBE reach the NDP goals.

The NECT has successfully brought together groups of relevant people so that we can work collaboratively 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 embedding process.

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***

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 Systems in the human body Human Reproduction Circulatory and respiratory systems Digestive system	Compounds Chemical reactions Reactions of metals with oxygen Reactions of non-metals with oxygen Acids, bases and pH value Reactions of acids with bases Reactions of acids with metals	Forces Electric cells as energy systems Resistance Series and parallel circuits Safety with electricity Energy and the national electricity grid Cost of electrical power	The Earth as a system Mining of mineral resources Atmosphere Birth, life and death of stars
These lesson plans have been designed against the stipulated CAPS requirements with topics being allocated for the time prescribed by CAPS. (Remember that some slight changes have been incorporated to accommodate time for revision, tests and examinations).			

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 each – 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 checklist 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 checklist 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:
Earth as a System
Term 4, Weeks 1A – 1C

A. TOPIC OVERVIEW

Term 4, Weeks 1a – 1c

- This topic runs for 1 week.
- It is presented over 3 x 1 hour 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, 11 AND 12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• The solar system: The sun and planets; the Earth's position in the solar system. • Beyond the solar system: The Milky Way Galaxy, our nearest star; light years, light hours and minutes; beyond the Milky Way galaxy. • Looking into space; early viewing into space and the use of the telescopesy	• The lithoshere and the rock cycle. • Mining of mineral resources in South Africa. Extracting ores, refining minerals. • The atmosphere made up of the troposphere, stratoshere, mesosphere, therosphere. • The Greenhouse Effect. • Birth, life and death of the stars.	GRADE 10 • Matter and Classifiation • Periodic Table • Chemical bonding • Particles and substances • Chemical systems • Hydrospheres GRADE 11 • Lithosphere – Mining and energy resources Grade 12 • Chemical industry (fertilizer industry)

C. SCIENTIFIC VOCABULARY

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

	TERM	EXPLANATION
1.	spheres of the Earth	The Earth is a system with four main parts or spheres that interact to support life.
2.	lithosphere	The solid outer layer of theEarth. All mountains, rocks, soil and minerals are part of the lithosphere.
3.	hydrosphere	The water on, or surrounding the surface of the Earth: Oceans and rivers.
4.	atmosphere	The mixture of gases that surrounds the Earth such as oxygen, nitrogen, carbon dioxide and water vapour.
5.	biosphere	The part of the Earth's surface that consists of all living things and their interactions with the soil, air and water of the Earth.
6.	the Earth's concentric layers.	These are the crust, the mantle, and the outer and inner core.
7.	Earth's magnetic field	A region of space surrounding Earth in which the resulting magnetic force (pulling) can be detected. It is caused by the solid iron inner core of the Earth.

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

It is important for all people to know about the Earth as a complex system made up of four spheres (layers) because all life depends on the Earth's spheres. The atmosphere gives us air to breathe. The hydrosphere supplies us with water to drink. The lithosphere is the land we live on and where resources are mined. The biosphere supports animal and plant life, and provides sources of food.

By learning about the four layers of the Earth, people are given an opportunity to appreciate the age of the Earth. It is more than 5,000 million years old and is still in the process of changing.

Knowledge about the Earth and its resources may promote a deeper interest and a wider choice of possible careers such as geologists, miners, farmers and environmentalists.

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 4, Week 1, Lesson A
Lesson Title: The Earth as a system
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Spheres of the Earth
CAPS Page Number	78

Lesson Objectives

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

- explain the structure of the Earth
- recall at least two facts about each layer of the Earth

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

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing		Raising Questions		Recording Information	✓
Comparing		Predicting		Interpreting Information	✓
Measuring		Hypothesizing		Communicating	
Sorting & Classifying		Planning Investigations		Use information in a new way	

B POSSIBLE RESOURCES

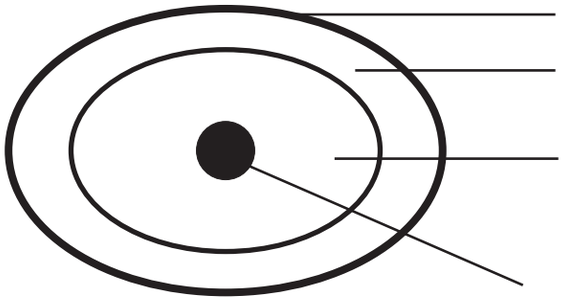
For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Make a model of the four layers of the Earth using four different colours of plastercine. Resource 1	Use four layers mealie meal (pap) to show the different layers of the Earth. Colour each layer with food colouring or natural dyes like tea.
Cut a sphere or ball in half to see the different layers which have been coloured in.	

C CLASSROOM MANAGEMENT

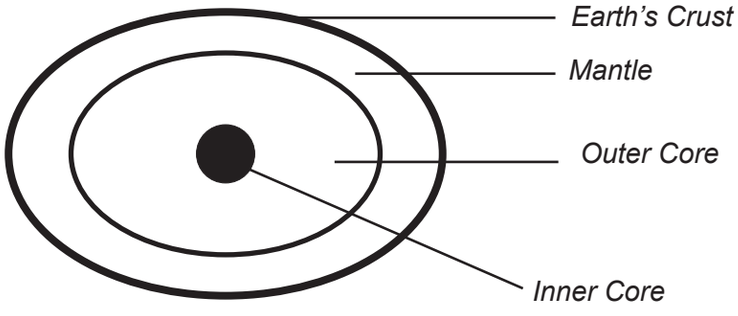
1. Make sure that you are ready and prepared.
2. Draw the following diagram onto the chalkboard before the lesson starts:

The concentric layers of the inside of the Earth



Draw and label this diagram in your workbook.
You learnt about this in Grade 7.

3. Learners should enter the classroom and label the diagram in their workbooks.
4. The teacher may write the following words on the board and learners must use them to label their diagram: Earth's crust, mantle, inner core, outer core.
5. Discuss the answer with the learners.
6. Write the model answer onto the chalkboard:



D ACCESSING INFORMATION

1. It will help to have a model . (The sphere of plastercine or mealie meal layers) to show the learners whilst explaining the following information to the learners:
   a. The Earth's crust is the thin, outer most layer of the Earth's surface. It is most made up of rock (the lithosphere) and it is where you will find all of the organisms that live on the planet (the biosphere).
   b. The average surface temperature of the crust is 15ºC.
   c. The mantle is the next inner layer of the Earth. It is the thickest layer.
   d. The mantle is made of silicate rock and can be 1 788 kilometers thick. (That's roughly the distance from Cape Town to Nelspruit).
   e. The outer core is liquid made up of mostly of iron and nickel. Temperatures in the outer core reaches 6000ºC.
   f. The inner core is responsible for the Earth's magnetic field.
   g. The inner core is solid and it is estimated that the temperature is 5400ºC and it is getting bigger as the outer core cools and becomes solid.
   h. Show the learners the diagram in Resource 1.
   i. All life is found on the Earth's surface because the temperature is suitable to support life, oxygen is available, water and sunlight are present and all organisms food sources are found on the Earth's surface.
2. Ask the learners to write the following information below their diagrams.
   You will need to add it to the diagram on the board for them to copy.

THE EARTH'S LAYERS

The Earth is made up of four layers:

1. The Earth's Crust
   - It is between 8-50 km thick.
   - The average temperature on its surface is 15°C.
   - Most life is found here.
2. The mantle
   - This is the thickest layer.
   - The outer layer is hard rock.
   - The inner layer, where it is hotter, is molten rock or magma.
3. The outer core
   - This is made of liquid rock called molten lava.
   - It is made up of iron and nickel.
   - It is very hot.
4. The inner core
   - Made up of iron, nickel and othe minerals.
   - It is almost as hot as the sun.

3. Give learners some time to copy the above information into their workbooks.

Checkpoint 1

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

a. Name the four layers of the Earth?
b. Which layer of the Earth supports life?
c. What is magma?

Answers to the checkpoint questions are as follows:

a. The layers of the Earth are the crust, mantle, outer core and inner core.
b. Life is found on the outer layer of the Earth called the crust.
c. Magma is molten or liqid rock found in the mantle.

E CONCEPTUAL DEVELOPMENT

1. Write the following questions onto the chalkboard:

1. Explain why life is only found on the Earth's crust. Give three reasons.
2. Which part of the Earth is responsible for the magnetic field around the Earth?
3. Imagine you are going on a journey to the centre of the Earth.
   a. What will be the biggest danger you will face as you travel towards the inner core?
   b. Identify three things which you will need to help you survive your journey to the centre of the Earth.

2. Explain this task to the learners as follows:
   a. They must answer the questions, seen above, into their notebooks.
   b. Answers must be given in full sentences.
3. Give learners some time to complete this task in their exercise books.
4. Write the model answer onto the chalkboard:

1. *Life exists on the outer Earth's crust because the average temperature is 15°, there is water, oxygen, food and heat and light from the sun. These are all essential to life.*
2. *The inner core creates the magnetic field.*
3. *a. The extreme heat will be the greatest danger to life*
   b. To survive this trip I will need a suit to rsist the high temperatures, oxygen, food and water.

Checkpoint 2

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

a. Where is all life found on Earth?

b. State 2 reasons why we find no life below the crust of the Earth.

Answers to the checkpoint questions are as follows:

a. Life exists on the crust of the Earth.

b. No life can exist below the Earth's crust as the temperature is too hig h and there is also a lack of food, water and oxygen.

5. 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
Viva Africa	Inside the Earth	171
Spot On	Internal structure of the Earth	144
Top Class	Layers of the Earth	202
Shuters	Earth as a system	196-200
Platinum	Earth as a system	201-205
Oxford	Earth as a system	168-170
Sasol Inzalo Bk B	The layers inside the Earth	224-225
Solutions for all	Earth and Beyond	251
Step-by-Step	Earth and Beyond	180 - 183

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.bbc.co.uk/schools/gcsebitesize/geography/natural_hazards/tectonic_plates_rev1.shtml [The Earth]
2. https://www.cliffsnotes.com/study-guides/geology/introduction-to-physical-geology/the-earths-structure [The Earth's structure]

1 B

Term 4, Week 1, Lesson B
Lesson Title: Introduction to the spheres of the Earth
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Spheres of the Earth
CAPS Page Number	78

Lesson Objectives

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

- identify the four spheres of the Earth's complex system
- identify how the spheres interact with each other
- discuss there is a disturbance in one of the systems how it can affect all the systems
- identify the four spheres and explain what they are

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
Glass of water	
A stone	
Pile of sand	
Balloon / plastic bag filled with air	
A grass plant – showing roots, stems and leaves.	

C CLASSROOM MANAGEMENT

1. Make sure that you are ready and prepared.
2. Have the following four items on the table in front of the class:
   a. A glass or transparent bottle of water.
   b. A pile of sand and a rock/stone.
   c. A plastic bag filled with air.
   d. A small branch with leaves or a plant showing roots, stems and leaves.
3. Write the following question onto the chalkboard before the lesson starts:

Name the four things that enable the Earth to support life.

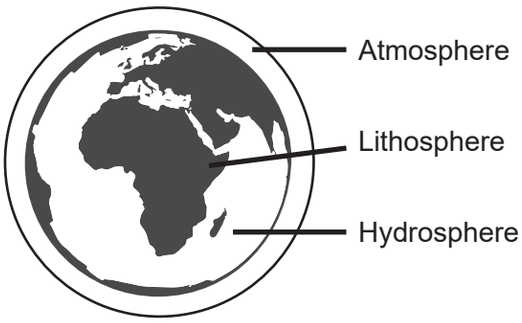
4. Learners should enter the classroom and answer the question in their workbooks.
5. Tell the learners to look at the display for clues to the answer the question.
6. Discuss the answer with the learners.
7. Write the model answer onto the chalkboard.

The Earth has water, air, land, and plants to support life.

D ACCESSING INFORMATION

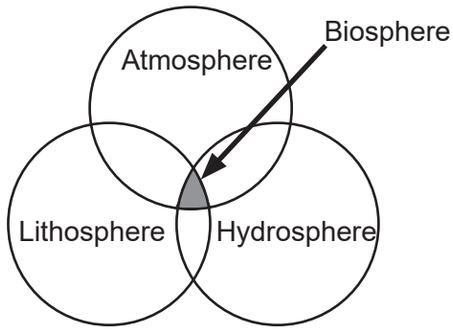
1. Draw and write the following onto the chalkboard (always try to do this before the lesson starts):

The four outer layers or spheres of the Earth's system



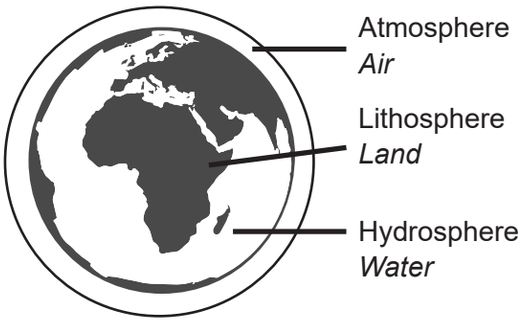
We find the biosphere in all three layers.

All the spheres of the Earth's system interact with each other



2. Explain this to the learners as follows:
   a. The Earth's system has four spheres: the biosphere - life, the hydrosphere – water, the atmosphere – air, and the lithosphere – land.
   b. Add the labels to your diagram on the board. Atmosphere – Air – oxygen, nitrogen, carbon dioxide and water vapour.
   c. Add the labels to your diagram on the board. Hydrosphere – Water– oceans, sea, rivers.
   d. Add the labels to your diagram on the board. Lithosphere – land, rocks soil.
   e. Add the labels to your diagram on the board. Biosphere – all living plants and animals and their interactions with rocks, soil, water and air.
3. Your diagram should look similar to the following diagram now:

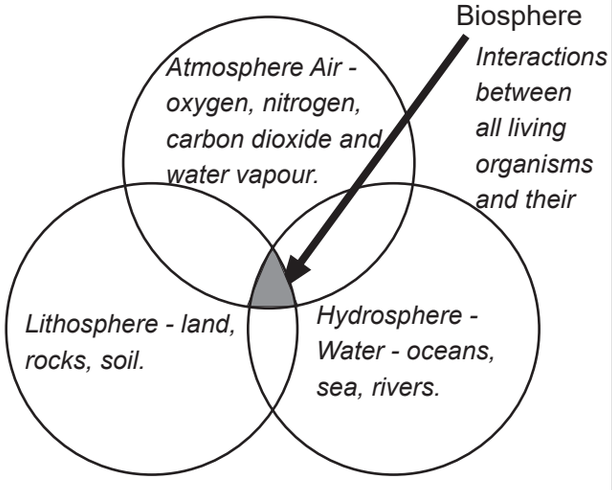
The four outer layers or spheres of the Earth's system



We find the biosphere in all three layers.

(Animals and plants)

All the spheres of the Earth's system interact with each other



4. Explain the following points to the learners.
    a. The **spheres of the Earth** are four connected systems which make up one complete system.
    b. Scientists use this classification system to study living and non-living matter.
    c. All four systems interact on, or near the surface of the Earth.
    d. The biosphere concerns all life on Earth. This includes all life from bacteria, to elephants, from algae to trees.
    e. All living things live in their own habitats.
    f. Two of the systems can interact at any time but all four are needed for life on earth.
    g. Some examples of interactions between the spheres:
        - The **lithosphere** and the **hydrosphere** interact when water erodes soil and carries it away in rivers.
        - The **atmosphere** interacts with the hydrosphere when water evaporates from oceans forming water vapour in the air.
    h. All life on Earth is found within a space of 5 kilometers above the ground and 19 kilometers below the ground.

Checkpoint 1

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

a. What are the four spheres of the Earth?
b. What is the biosphere?

Answers to the checkpoint questions are as follows:

a. The four spheres are the biosphere, lithosphere, atmosphere and the hydrosphere
b. The biosphere is part of the Earth's system where all living things on Earth are found. All living plants and animals and their interactions with rocks, soil, air and water.

E CONCEPTUAL DEVELOPMENT

1. Do the following activity with the learners:

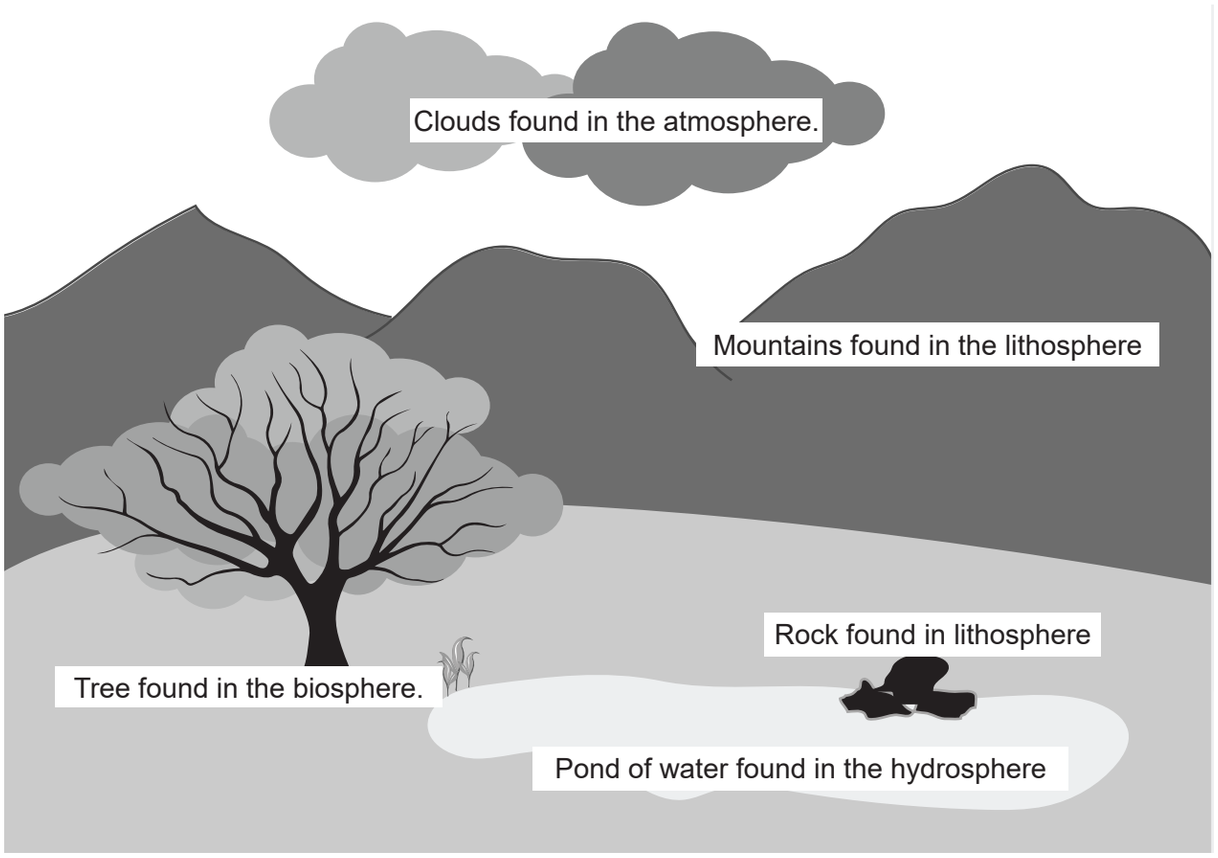
Explain this task to the learners as follows:

a. Look out of the closest window of the classroom.
b. Tell the learners to draw a diagram of what they can see. Their drawing should include something from the fours spheres of the Earth. They must do this in their workbooks.

2. Give learners some time to complete this task.

3. Draw and label the model answer onto the chalkboard:

The four spheres outside my classroom (The teacher should sketch the view outside of the classroom)



Checkpoint 2

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

a. Give 2 examples of living things which can be found in the biosphere.
b. Which sphere does soil belong to?
c. What do you think would happen if oil or a lot of soap was put into a river? Which spheres of the Earth's systems will be affected?

Answers to the checkpoint questions are as follows:

a. Any examples of life are acceptable, such as grass, trees, insects, people, etc.
b. Soil belongs to the lithosphere.
c. If a river is polluted by oil or soap it may cause the plants and animals living in the river to die. The river is part of the hydrosphere and the plants and animals are part of the biosphere. If a sphere is damaged then the Earth's system of life is damaged.

4. 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
Viva Africa	The Earth as a system	168-170
Spot On	The Earth as a system	144-145
Top Class	The Earth as a system	197-199
Shuters	Earth as a system	196-200
Platinum	Earth as a system	201-205
Oxford	Earth as a system	168-170
Sasol Inzalo Bk B	Spheres of the Earth	208-221
Solutions for all	Earth as a System	251
Step-by-Step	Earth as a System	180 - 183

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://study.com/academy/lesson/the-four-spheres-of-earth-geosphere-hydrosphere-biosphere-and-atmosphere.html [The spheres of the earth]
2. https://www.youtube.com/watch?v=VMxjzWHbyFM (4min) [Four spheres part 1]

1 C

Term 4, Week 1, Lesson C
Lesson Title: The Earth as a System
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The four spheres of the Earth
CAPS Page Number	78

Lesson Objectives

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

- describe the four spheres of the Earth
- identify the main components of each of the Earth's spheres
- explain how all four spheres interact on or near the surface of the Earth
- discuss why all four spheres are needed to support life on Earth

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
Computer	
Internet	
Projector	

C CLASSROOM MANAGEMENT

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

> Name the four Earth spheres.

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 four spheres of the Earth are the biosphere, hydrosphere, lithosphere and atmosphere.*

D ACCESSING INFORMATION

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

Biosphere	**Atmosphere**	**Hydrosphere**	**Lithosphere**
All life on Earth	The air around us	All water found on Earth	All rocks found on Earth
Examples of life:	Parts of the air:	Sources of water:	Examples:

2. During the introduction of the lesson ask the learners to name examples belonging to each sphere. As the lesson progresses add the following information:
3. Write the model answer on the chalkboard:

Biosphere	**Atmosphere**	**Hydrosphere**	**Lithosphere**
All life on Earth	The air around us	All water found on Earth	All rocks found on Earth
Life includes: All plants All animals Fungi Bacteria All other microorganisms	Parts of the air: Nitrogen Oxygen Carbon dioxide Water vapour Other gases including helium and hydrogen	Sources of water: Oceans Lakes Rivers The atmosphere (rain) Underground water	Examples: All rocks found in the crust and solid outer part of the mantle of the Earth. Mountains Soil

4. Explain this to the learners as follows:
   a. The **atmosphere** is the air around us. The air is made up of a mixture of different gases.
   b. The mixture includes nitrogen, oxygen, carbon dioxide, water vapor and other gases.

c. The **lithosphere** system is about all the rocks that are found on the Earth. This includes the ocean floor.

d. The **hydrosphere** contains all the water on the planet. This includes lakes, rivers, water in the atmosphere, oceans and in underground water.

e. All four systems interact on or near the surface of the Earth to support life.

f. All four spheres are needed for life on Earth.

Checkpoint 1

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

a. What is the lithosphere made up of?

b. Name the four main gases found in the atmosphere.

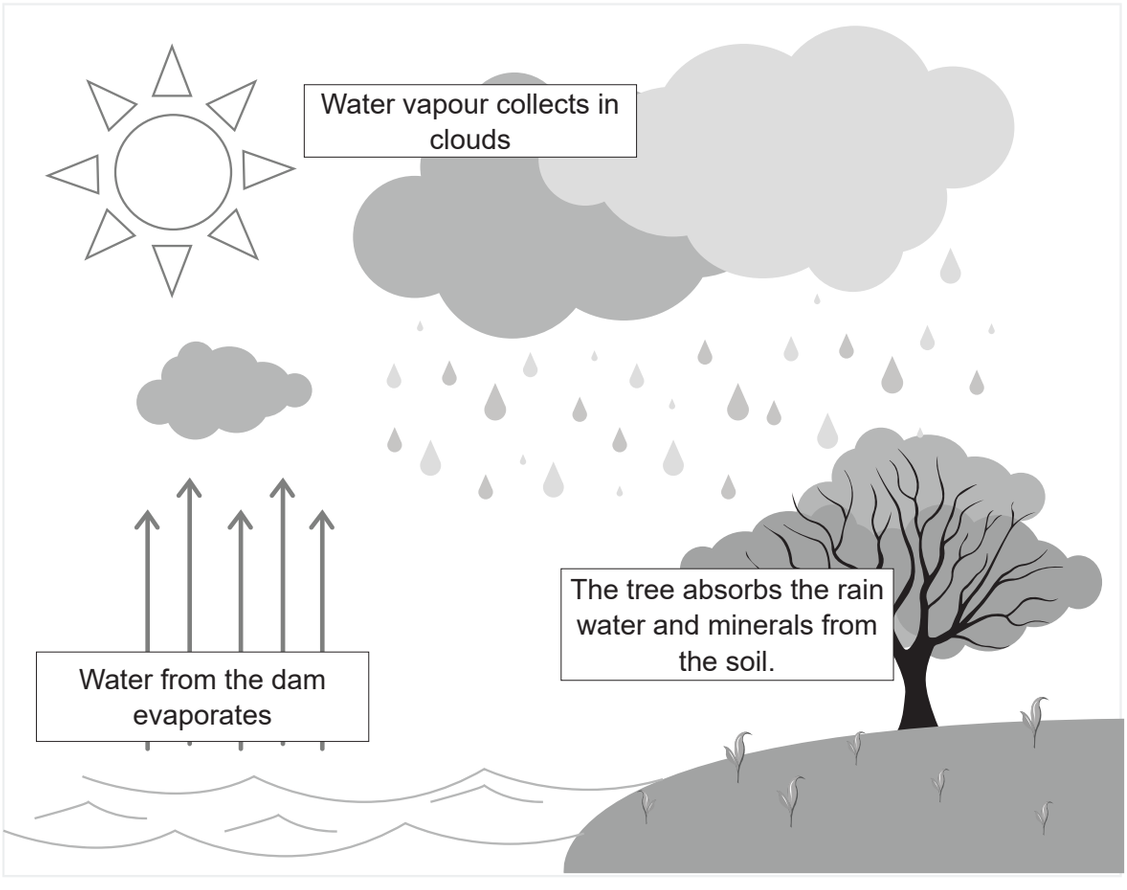
Answers to the checkpoint questions are as follows:

a. The Lithosphere includes all rocks found in the mantle and the Earth's crust.

b. Nitrogen, oxygen, water vapor and carbon dioxide are the four main gases in the atmosphere.

E CONCEPTUAL DEVELOPMENT

1. Draw the diagram seen below on the chalkboard.
2. Tell the learners to copy the diagram into their workbooks.



3. Explain the water cycle and the interaction of the Earth's spheres. Resource 2.
    a. The dam water is part of the hydrosphere.
    b. The water vapour in the air is part of the atmosphere.
    c. The tree is part of the biosphere.
    d. The tree absorbs water from the hydrosphere.
    e. The tree absorbs mineral salts from lithosphere.
4. Give learners some time to complete the above diagram into their workbooks.

Checkpoint 2

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

a. Why is the lithosphere important to us?
b. Describe how trees interact with the lithosphere and the hydrosphere.

Answers to the checkpoint questions are as follows:

a. The lithosphere is important to us as soil allows plants to grow. Plants are a source of food. We find many valuable minerals such gold, copper in the ground. Mining is a source of wealth.
b. Trees are part of the biosphere. The roots of the tree grow into the lithosphere. The roots hold the soil. The roots absorb mineral salts from the soil. The roots absorb water from the hydrosphere. The tree absorbs carbon dioxide from the atmosphere. The tree also releases oxygen into the atmosphere.

5. 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
Viva Africa	Earth as a System	168-170
Spot On	Earth as a System	144-147
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Step-by-Step	Earth as a System	180 - 183

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://study.com/academy/lesson/the-four-spheres-of-earth-geosphere-hydrosphere-biosphere-and-atmosphere.html [The earth's spheres]
2. A song about the spheres of the Earth. https://www.youtube.com/watch?v=o1PzX_Mq7ug (1.36min) [The earth's four main spheres]

TOPIC OVERVIEW:
The Lithosphere
Term 4, Weeks 2A – 3C

A. TOPIC OVERVIEW

Term 4, Weeks 2a – 3c

- This topic runs for 2 weeks.
- It is presented over 6 x 1 hour 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, 11 and 12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Elements • Compounds • Particle model of the state of matter • Density • The solar system • The sun and Earth's position	• The lithosphere • Igneous rocks • Sedimentary rocks • Metamorphic rocks • The rock cycle	Grade 10 • States of matter • Periodic table • Atoms, elements and compounds • Chemical systems • The hydrosphere GRADE 11 • Lithosphere • Chemical Industry - Fertilizers and Mining

C. SCIENTIFIC VOCABULARY

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

	TERM	EXPLANATION
1.	density	Mass per unit volume. This means that the density of any solid, liquid or gas can be found by dividing its mass in kilograms by its volume in cubic metres. Usually gases are less dense than liquids and liquids are less dense than solids. When one compares 1cm^3 of carbon dioxide, and a 1cm^3 block of iron, the carbon dioxide will feel less 'heavy' in your hand – this is because particles in a gas are far apart compared to that of the block of iron where the particles are packed very closely together.
2.	the lithosphere	A layer of the Earth's surface made up of the crust and the solid part of the mantle.
3.	geological time	This is the time scale geologists and other scientists use to measure periods in the Earth's history. Geological time usually spans over millions of years.
4.	igneous rocks	These rocks are formed when volcanic lava cools. Igneous rocks are hard wearing, and usually have crystals. Pumice and granite are two types of igneous rock.
5.	sedimentary rocks	Rocks are formed from the sediment of weathered rocks. They form over millions of years and are soft and found in areas that used to be covered by seas. Sandstone and shale are two types of sedimentary rock.
6.	metamorphic rocks	These rocks are made inside the Earth's crust when either sedimentary or igneous rocks are heated and put under pressure. Marble and slate are two types of metamorphic rocks. They are hard wearing, have crystals and are resistant to weathering.
7.	rock cycle	The natural process of how rocks are made, worn away and remade. This is a very slow process and happens over millions of years.
8.	fossils	Dead plants and animals which have been trapped in layers of sediment are called fossils. Over time an imprint of the skeleton of the plant or animal is made in the rock.
9.	elements	A material that consists of only one type of atom. E.g. oxygen.
10.	compounds	A material that consists of only two or more different elements chemically bonded together. E.g. Water – hydrogen and oxygen bonded together.
11.	minerals	Minerals are substances which are made up of elements or compounds that occur naturally in the Earth's crust. E.g. copper and gold

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

If learners are encouraged to become more aware of the world around them and all the resources that the lithosphere provides, they may become more appreciative of their environment. Recognising the marvel of the rock cycle or realising the age of the various types of rocks, they may become motivated to follow a career in mining or environmental studies. South Africa has a wealth of resources in its lithosphere. These resources need to be carefully monitored to ensure a satisfactory future for all South Africans.

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 4, Week 2, Lesson A
Lesson Title: The structure of the lithosphere
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The structure of the lithosphere
CAPS Page Number	78

Lesson Objectives

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

- identify the location of lithosphere in the Earth's structure.
- explain that the lithosphere is made up of the outer most layer of the mantle and the Earth's crust.
- list different minerals in the Earth's crust such as gold, silver, copper and hematite (iron oxide).
- compare the differences between the two terms: elements and 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
Projector	Chalkboard
Board	Resources booklet
Computer with an internet connection	
Magazines with pictures of farms, natural food, jewellery, electrical appliances to show mineral resources.	

C CLASSROOM MANAGEMENT

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

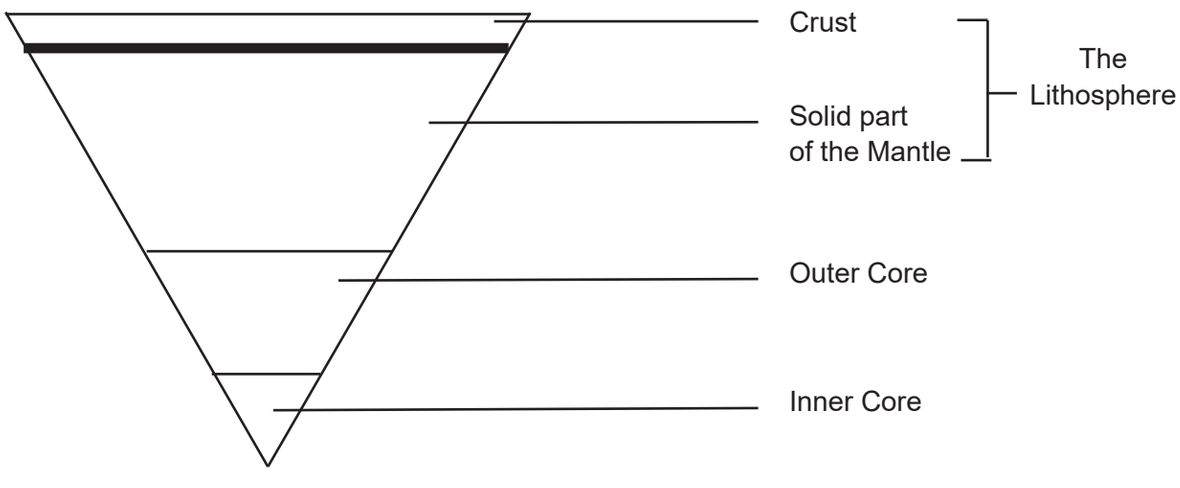
> 1. What are the four concentric layers of the Earth?
> 2. What two parts of the Earth's layers make up the lithosphere?

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.

> *1. The four concentric layers of the Earth are the inner core, the outer core, the mantle, and the crust.*
> *2. The lithosphere is made up of the crust and the rocky layer of the mantle.*

D ACCESSING INFORMATION

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



2. Remind the learners of the structure of the Earth – revision from lesson 1a. You can ask them to add the lithosphere label to the diagram they drew in their notebooks in lesson 1a.
3. Explain the following information to the learners as follows:
    a. The **lithosphere** is made up of rocks, and stones, pebbles, sand and soil.
    b. There are 3 700 known **minerals** in the lithosphere.
    c. Minerals are made up of a combination of **elements** and **compounds**.
    d. Elements are made up of only one type of atom.
    e. Compounds are made up of two or more elements bonded together.
    f. Over time (**geological time**) new rocks are formed as others wear out. For example: New rocks are formed when volcanoes erupt. Rocks break down into soils and smaller stones when they get battered by the weather.
    g. Humans mine into the Earth's crust and take out rocks, like limestone and sandstone, for construction.
    h. Humans also mine the Earth's crust for minerals such as diamonds, gold, platinum and other valuable minerals.
    i. South Africa has large reserves of many valuable minerals like diamonds and gold, which are sold on the international market.
    j. Mining creates employment for many people in this country.

Checkpoint 1

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

a. Why is the lithosphere important?
b. What is the rock cycle?

Answers to the checkpoint questions are as follows:

a. The lithosphere is important because it is where most life is found. It supplies us with soil to grow food and minerals that can be mined. These minerals are valuable. Many people find work on or in the lithosphere such as miners and farmers.
b. The rock cycle is a slow natural process where rocks are formed, break down and reform.

E CONCEPTUAL DEVELOPMENT

1. Write the following onto the chalkboard.

1. The lithosphere is made up of two of the layers of the Earth:
   a. The solid, rocky part of the mantle
   b. The crust
2. The lithosphere is made up of rocks, pebbles, stones and soil found on the Earth's surface, as well as the sea floor.
3. The rock cycle is a natural and continuous process, where rocks are formed, broken down and reformed.
4. The Earth's crust contains many types of rocks, as well as elements and compounds, which make up valuable minerals.
5. Some examples of valuable mineral which are mined in South Africa are coal, gold, diamonds, copper, iron, lead, titanium, uranium, chrome, platinum, antimony, vanadium and zinc.
6. Humans have dug these minerals out of the ground for hundreds of years and used them for building materials, manufacturing of various items such as weapons, jewellery, electrical wiring and vehicles.
7. South Africa has world leading sized deposits of gold, diamonds, platinum, iron and coal.
8. The mining industry employs over 1 million people and brings huge wealth to the country in the form of foreign exchange.

2. Tell the learners to write the following questions down in their workbooks.

THE LITHOSPHERE

1. Describe the lithosphere and explain what is found in the lithosphere.
2. Describe the rock cycle.

3. Tell the learners to answer the questions in their workbooks.
4. Write the model answers on the chalkboard:

1. *The lithosphere is made up of the outer Earth's crust and the outer part of the solid mantle. Elements and compounds are found in the lithosphere. Elements and compounds make up different minerals. Minerals can help plants to grow. Other minerals can be mined.*
2. *The rock cycle is a natural process that takes place over a long time. This is the process where rocks are formed, broken down and reformed.*

Checkpoint 2

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

a. Name 3 valuable minerals found in South Africa's lithosphere.

b. How does the lithosphere help South Africa's economy?

Answers to the checkpoint questions are as follows:

a. South Africa has many valuable minerals such as coal, gold, diamonds, copper, iron, lead, titanium, uranium, chrome, platinum, antimony, vanadium and zinc.

b. The lithosphere has many valuable minerals in it, which can be mined. Mines provide jobs and the minerals bring in foreign exchange. Soil is also part of our lithosphere. Farming requires good soil for plants to grow. Many of these crops provide people with food all over the world. Mountains are part of the lithosphere. People from all over the world come to see our mountains such as Table Mountain in Cape Town and the Drakensburg in Kwa-Zulu Natal. Tourism boosts South Africa's economy by providing jobs.

5. 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
Viva Africa	Lithosphere	171-173
Spot On	The Lithosphere	148- 150
Top Class	Lithosphere	201-204
Shuters	The Lithosphere	201-203
Oxford	The Lithosphere	171-173
Platinum	The Lithosphere	207-211
Sasol Inzalo Bk B	The Lithosphere	222-249
Solutions for all	The Lithosphere	262 - 275
Step-by-Step	The Lithosphere	184 - 193

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=NAHY6965o08&index=6&list=PLjm4OZf8Iyp8UL9IrCaKhMOXCWeTzQ80u (6min) [Documentary: Layers of the Earth]
2. https://www.nationalgeographic.org/encyclopedia/lithosphere/ [The lithosphere]
3. http://www.softschools.com/facts/geology/lithosphere_facts/2542/ [Facts about the lithosphere]
4. https://www.youtube.com/watch?v=rd_d43jHTUs (3.26min) [Lithosphere song]
5. https://www.youtube.com/watch?v=6v2L2UGZJAM&list=PLjm4OZf8Iyp8UL9IrCaKhMOXCWeTzQ80u&index=4 (17min) [Nature scenery showing various forms of the lithosphere]

2 B

Term 4, Week 2, Lesson B
Lesson Title: Igneous rocks
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Igneous rocks
CAPS Page Number	78

Lesson Objectives

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

- recall that igneous rocks are formed from volcanic lava.
- list examples of igneous rocks such as granite, pumice and obsidian.
- explain that different igneous rocks form because the volcanic lava cools at different rates which cause them to have a differing mineral content.

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
Samples of igneous rocks	Chalkboard
Rock cycle poster	Resources booklet
Projector Resource 3 and 4	Examples of different rocks and stones found on the school ground or surrounding area.
Examples of the three different types of rocks.	Igneaus, metamorphic and sedimentary
Computer with an internet connection	

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 many different types of rocks do we find in the lithosphere?

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.

> *There are only three different types of rocks found in the lithosphere. They are igneous rocks, sedimentary rocks and metamorphic rocks.*

D ACCESSING INFORMATION

1. Show the learners the diagram of how igneous rocks are formed using Resources 3 and 4.
2. Explain this to the learners as follows:
   a. **Igneous** rock is formed when magma from a volcano cools after the magma escapes from a volcano and cools on the Earth's surface.
   b. Igneous rock can also cool underground.
   c. The speed at which the magma cools will determine what size crystals are found in the igneous rock.
   d. If the magma cools slowly then the crystals will be large like granite. This is called intrusive igneous rock
   e. If the magma cools quickly then the crystals will be small or will have gas holes in them and rocks like pumice will form. This is called extrusive igneous rock.
   f. Basalt is the most common igneous rock in the solar system. It is even found on Mars.
   g. The very top of the Drakensburg Mountains are covered in a layer of basalt.
   h. Millions of years ago igneous rocks used to be the only type of rocks found on Earth.

3. Show the learners the pictures of igneous rock on Resource 4.
4. Write the following information on the chalkboard:

IGNEOUS ROCKS

1. Igneous rock is formed when magma from a volcano cools.
2. Cooling can happen either when magma escapes from a volcano and cools on the Earth's surface or when the lava cools underground.
3. The speed at which lava cools will determine what size crystals are found in the rock.
4. If magma cools slowly underground, the crystals will be large like in granite. This is called intrusive igneous rock.
5. If the magma cools quickly above ground, the crystals will be small like in basalt. The magma could also have holes in it where gas has escaped and rocks like pumice will form. These are called extrusive igneous rocks.
6. Another example of an extrusive igneous rock is obsidian. It is sometimes called volcanic glass.

5. Read through this information with the learners.
6. Tell the learners to copy the above information into their workbooks.
7. Give learners some time to copy the information on the chalkboard into their workbooks.

Checkpoint 1

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

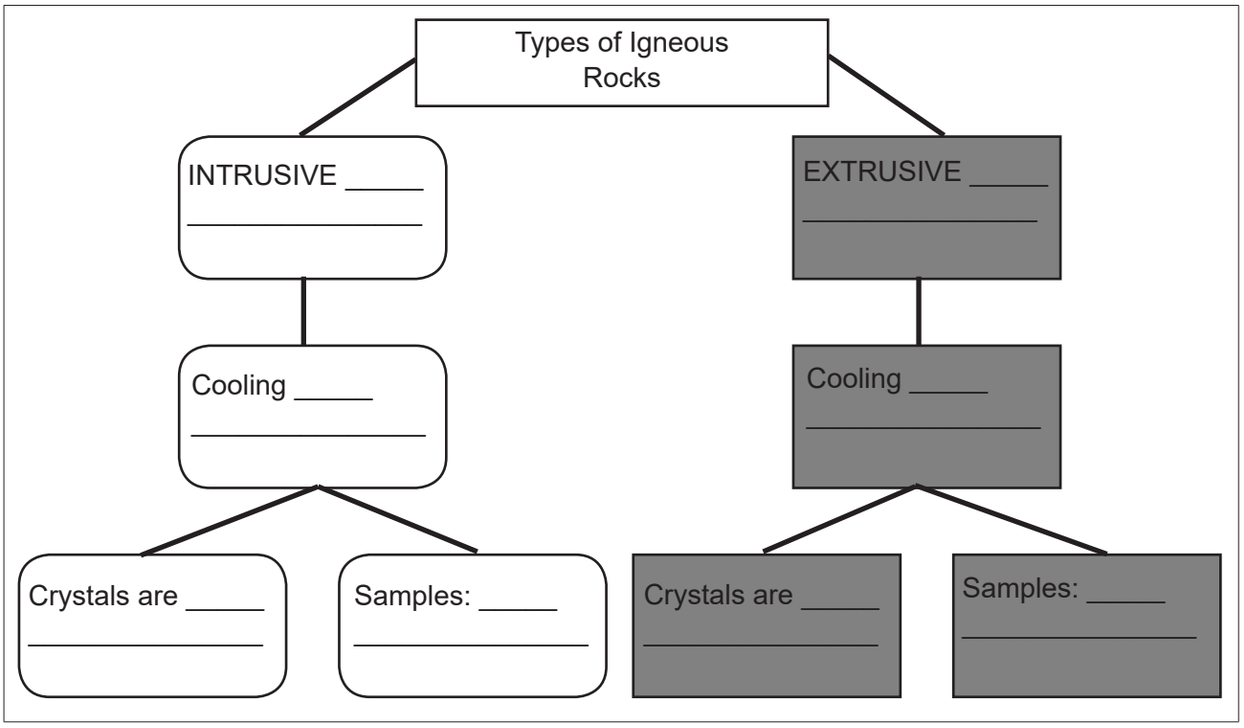
a. What is an igneous rock made from?
b. What is the difference between intrusive and extrusive igneous rocks?

Answers to the checkpoint questions are as follows:

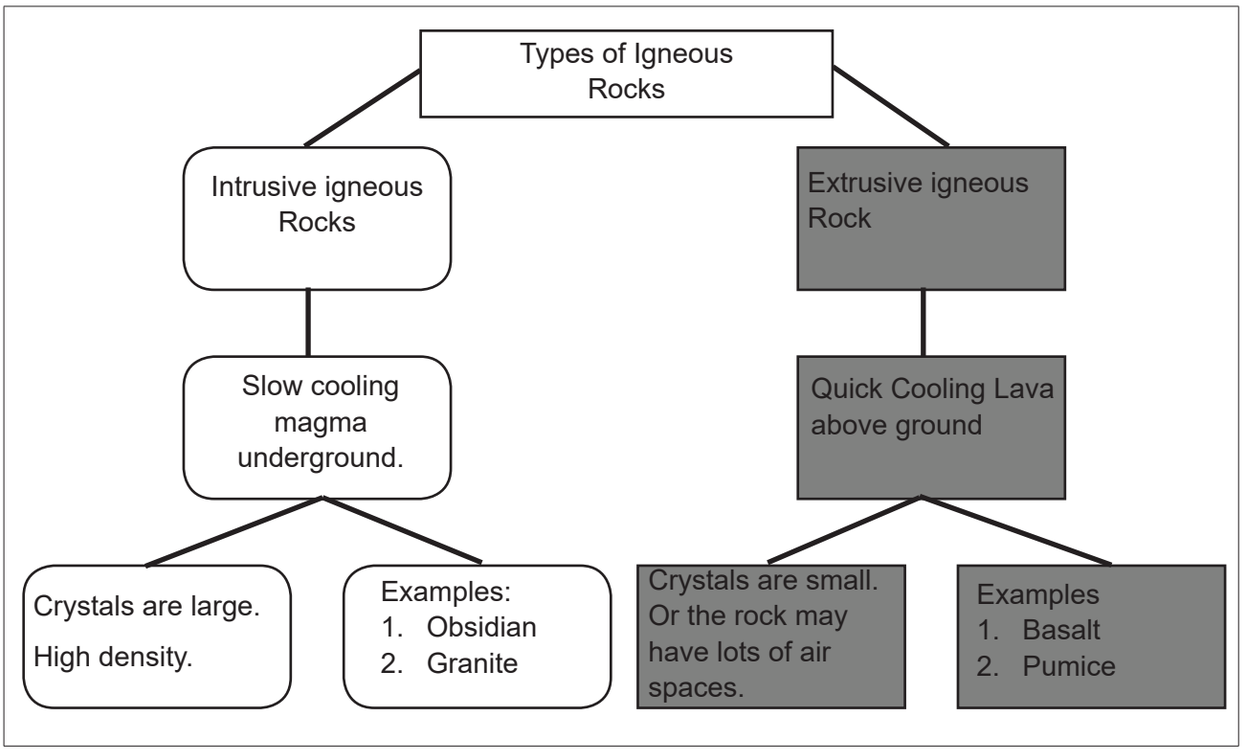
a. Igneous rock is made from either slow cooling or fast cooling magma.
b. The difference between intrusive and extrusive igneous rocks is the size of the crystals which form when the magma cools.

E CONCEPTUAL DEVELOPMENT

1. Show the learners the examples or pictures of igneous rocks. (See the Resource 4).
2. Draw the following graphic organizer onto the chalkboard:



3. Explain this task to the learners as follows:
   a. They must draw the graphic organizer seen above to record the differences between intrusive and extrusive igneous rock in their workbooks.
   b. They must fill in the boxes with the correct information, using the notes they have just written.
4. Give learners some time to complete this task in their exercise books.
5. Write the model answer on the chalkboard:



6. If it is possible show them the video: https://www.youtube.com/watch?v=jtUMMZKHGqQ (1min) [igneous rock]

Checkpoint 2

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

a. What causes the crystal size to differ in igneous rocks?
b. Give 3 examples of an igneous rock.

Answers to the checkpoint questions are as follows:

a. The rate at which the magma cools determines the size of the crystals in igneous rocks.
b. Examples of igneous rock are: basalt, pumice, granite and obsidian.

7. 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
Viva Africa	Igneous Rock	174-176
Spot On	The rock cycle	151
Top Class	The rock cycle	204
Shuters	The rock cycle	204-210
Oxford	Igneous Rocks	174-175
Platinum	The Rock Cycle	212-213
Sasol Inzalo Bk B	Types of rocks	222-249
Solutions for all	The Lithosphere	262 - 275
Step-by-Step	The Lithosphere	184 - 193

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=jtUMMZKHGqQ (1min) [igneous rocks]

2 C

Term 4, Week 2, Lesson C
Lesson Title: Sedimentary rocks
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Sedimentary rocks – formation and structure
CAPS Page Number	79

Lesson Objectives

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

- explain that rocks on the Earth's surface are weathered by heat, cold, wind and water
- compare the processes of weathering and erosion
- discuss how sedimentary rocks are formed from weathered pieces of metamorphic and igneous rock
- list a few characteristics of sedimentary rocks

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
Samples of sedimentary rocks	Chalkboard
Hydrochloric acid or sulphuric acid	Resources booklet
Limestone chips	Resource 5 and 6
Beaker	
Projector	
Board	
Computer with an internet connection	

C CLASSROOM MANAGEMENT

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

> List 2 examples of an igneous rock and state how they are formed.

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.

> Granite, obsidian, pumice and basalt are examples of igneous rocks. These rocks are formed when magma from a volcano cools either quickly above ground or slowly underground.

D ACCESSING INFORMATION

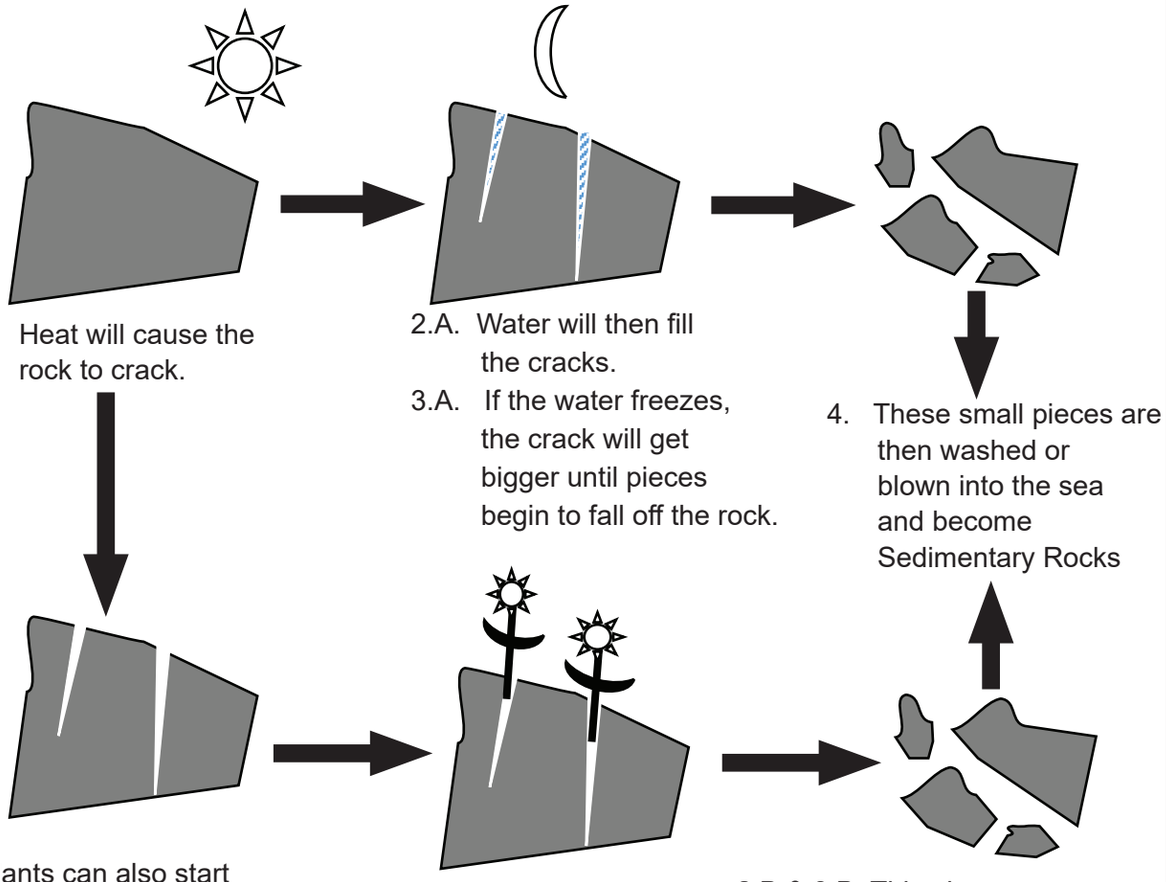
1. Explain the following to the learners:
   a. Rocks on the Earth's surface are constantly being affected by heat, cold, wind, water, plants and animal movement over them.
   b. Weathering and erosion cause rocks to break down into smaller pieces.
   c. Weathering is the process of breaking down rocks by wind, rain, ice and snow.
   d. Erosion occurs when the broken off smaller pieces of rock are carried away by water or wind.
   e. There are two types of weathering: chemical weathering and physical weathering.
   f. Chemical weathering is when water reacts chemically with the rocks. This usually happens to limestone and marble. People use limestone and marble to make sculptures and grave stones. If you have been into a graveyard you may have seen a gravestone where you can't read the writing anymore – this is probably because of chemical weathering.
   g. Show the learners the diagram on chemical weathering– Resource 5.

2. If it is possible, at this point, you can show the learners how hydrochloric or sulphuric acid reacts with limestone chips. Do the following activity with the learners:

   a. Put some limestone chips in a beaker and add some acid.
   b. Look at the mixture. The mixture should bubble and fizz.
   c. Explain that the acid is eroding the limestone.
   d. Carbon dioxide gas is given off and eventually the acid will have eroded all the chips away. (This should be revision from acid base reactions from Term 2)

3. Physical weathering is when a rock is broken down by wind, rain, ice or animals and plants.
4. Draw and label the following onto the chalkboard (always try to do this before the lesson starts):

WEATHERING AND EROSION OF IGNEOUS ROCKS TO FORM SEDIMENTARY ROCKS



5. Explain this to the learners as follows:
   a. Weathering by water and temperature: A rock will be heated up by the sun and will begin to form small cracks. Water will collect in these cracks. When the temperature drops the water will freeze in those cracks and the crack will get bigger. This will happen repeatedly and eventually the rock will break into smaller pieces.

b. Weathering by plants: A rock will be heated up by the sun and will begin to form small cracks. Water, dust and seeds will collect in the cracks. As the plant grows the crack will get bigger until eventually pieces of the rock will fall off.

c. The rivers carry the eroded particles to their flood plains. As the flow of water slows down it deposits particles of rock in layers of sediment.

d. Over time more sediment is covered by more layers.

e. The pressure of many layers turns the lower layers into sedimentary rocks, such as sandstone.

6. Show the learners the diagrams of physical weathering in Resource 6.

Checkpoint 1

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

a. Name the two types of weathering.

b. What is the difference between weathering and erosion?

Answers to the checkpoint questions are as follows:

a. There is chemical and physical weathering of rocks.

b. Weathering is the breaking down of rocks whereas erosion is the carrying away of the broken pieces of rocks.

7. Learners need to write a paragraph on how sedimentary rocks are formed by the process of weathering and erosion using the diagram drawn the board.

8. The learners must write the paragraph in their workbooks.

9. The teacher may write the following paragraph with missing words if the class struggles to write the paragraph alone:

THE FORMATION OF SEDIMENTARY ROCKS

_____are formed over a very long period of time. Exposed rocks above the _____ are weathered and eroded over time. The rocks can be _____or broken down by heat, cold, wind, water, plants and animal movement over them. _____ causes the rocks to break down into smaller pieces. These smaller pieces or particles are then carried away or _____by _____. When the _____and _____slow down, the particles are laid down as _____. Sediments are covered by _____over time. The _____ of the many layers turns the lower layers into _____, such as _____.

10. Give learners some time to copy and complete the above information into their books.

11. Write the model answer on the chalkboard:

THE FORMATION OF SEDIMENTARY ROCKS

Sedimentary rocks are formed over a very long period of time. Exposed rocks above the Earth's surface are weathered and eroded over time. The rocks can be weathered or broken down by heat, cold, wind, water, plants and animal movement over them. Weathering causes the rocks to break down into smaller pieces. These smaller pieces or particles are carried away or eroded by wind and water. When the water and wind slow down, the particles are laid down as sediments. Sediments are covered by many more layers over time. The pressure of the many layers turns the lower layers into sedimentary rock, such as sandstone and shale.

12. If it is possible show the learners the following video: https://www.youtube.com/watch?v=AD7sqlOIgl4 (10 mins) [chemical and physical weathering]

Checkpoint 2

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

a. Explain the differences between chemical and physical weathering.
b. Fossils are frequently found in sedimentary rocks rather than in igneous rocks. Why do you think is so?

Answers to the checkpoint questions are as follows:

a. Chemical weathering occurs when rain water as an acid, reacts with the chemicals found in the rock. Physical weathering occurs when wind, ice, animals, plants and water breaks the rock into smaller pieces.
b. Long ago animals and plants died and were buried in the layers of sediment. The pressure of new layers prevented complete decomposition and the plant or animal body got preserved in the sedimentary rock. Whereas, if an animal or a plant came into contact with the cooling magma the extreme heat would burn the body of living organism to ash.

13. 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
Viva Africa	Types of Rock	174-177
Spot On	The rock cycle	151 -155
Top Class	The rock cycle	205
Shuters	The rock cycle	204-210
Oxford	Sedimentary rocks	176-177
Platinum	Sedimentary Rock forms	214-215
Sasol Inzalo Bk B	Types of Rocks	222-249
Solutions for all	The Lithosphere	262 - 275
Step-by-Step	The Lithosphere	184 - 193

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=AD7sqlOIgl4 (10 mins) [Chemical and physical weathering]

3 A

Term 4, Week 3, Lesson A
Lesson Title: The Lithosphere
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Sedimentary rocks – formation and identification
CAPS Page Number	78/79

Lesson Objectives

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

- explain how rocks on the Earth's surface are weathered by heat, cold, wind and water
- outline how sedimentary rock is made when erosion transports small rock particles to flood plains or the sea floor
- list characteristics of the appearance of sedimentary rocks

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
Half a loaf of white bread	Chalkboard
Half a loaf of brown bread	Resources booklet
Water	Resource 7
Projector	Resource 9
Board	Resource 10
Computer with an internet connection	

C CLASSROOM MANAGEMENT

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

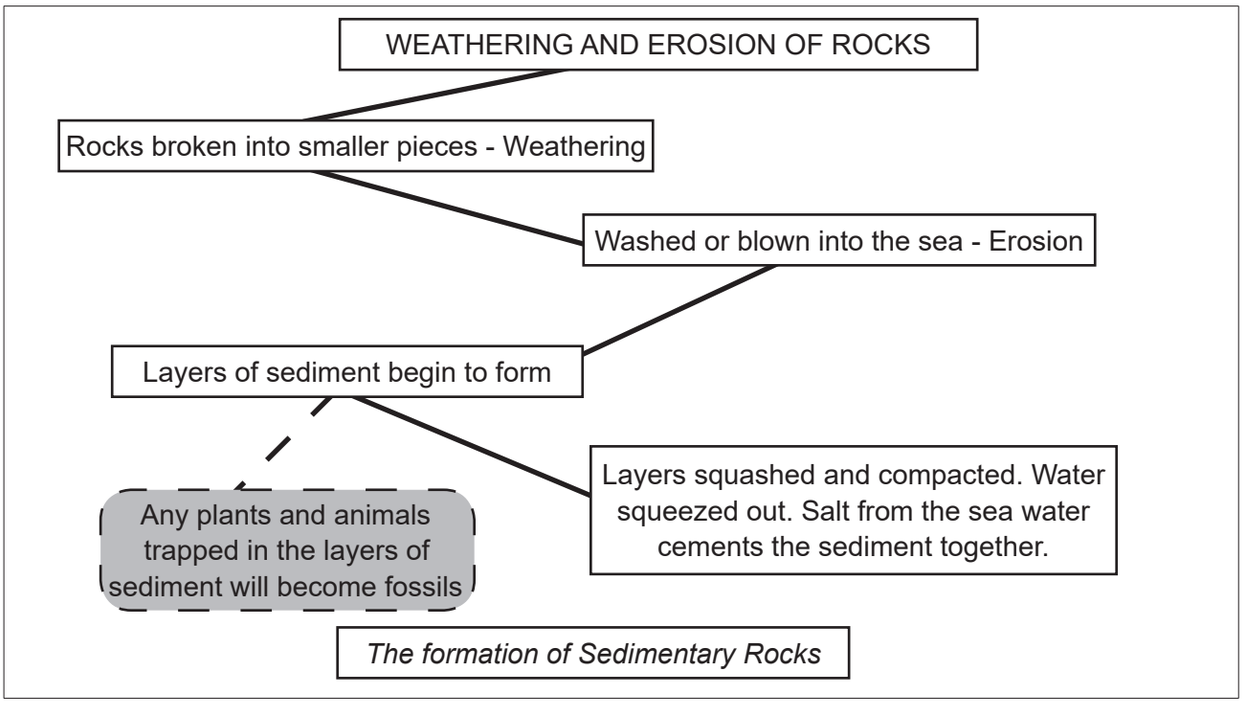
Name two processes required in the formation of sedimentary rock.

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.

Weathering and erosion are two processes required to form sedimentary rocks.

D ACCESSING INFORMATION

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



2. Explain this to the learners as follows:
   a. **Sedimentary rocks** are made from eroded pieces of igneous or metamorphic rocks.
   b. Rocks on the Earth's surface are constantly being exposed to heat, cold, wind, water and animal movement over them. This is called weathering.
   c. This causes the rocks to break down into smaller pieces. These little pieces are then blown or washed into the sea. This is called erosion.
   d. Once at the bottom of the ocean, these little pieces are buried in layers by other pieces and eventually they will be squashed or compacted together, all the water is squeezed out and the sediment becomes cemented together. This forms sedimentary rocks.
   e. Show the learners the diagrams of sedimentation – Resource 7.
   f. If a fish, animal or plant is in one of these layers, **a fossil** will form.
   g. All sedimentary rocks on the Earth's surface were made this way. The Drakensburg Mountains are mostly made from sedimentary rocks which mean that they were made under a sea, which dried up many years ago.
   h. Show the learners Resource 8 which demonstrates the process off sedimentation and cementation; and Resource 9 which shows the Drakensberg Mountains.
   i. Sandstone, mudstone, limestone, dolomite, shale and coal are all sedimentary rocks.
   j. Show the learners Resource 10 - The formation of Sedimentary Rock; and Resource 11 - Examples of Sedimentary Rock.
   k. Coal, oil, gas and fossil fuels are all found between sedimentary rocks. These are dead plants and animals which died millions of years ago and were trapped in between sedimentary layers.
   l. Sedimentary rocks are quite easy to identify because they have grains and layers.
   m. Sedimentary rocks are quite soft and erode easily.
3. Ask learners, to draw the flow diagram on the chalkboard into their workbooks.
4. Give learners some time to copy this information into their work books.

Checkpoint 1

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

a. What are sedimentary rocks made from?
b. How do fossils form in sedimentary rocks?

Answers to the checkpoint questions are as follows:

a. Broken pieces of igneous and metamorphic rocks.
b. Plants and animals get trapped at the layers of sediment layers.

E CONCEPTUAL DEVELOPMENT

1. Do the following demonstration in front of the class.

> 1. Bring two loaves of different types of bread to class. (Brown and white bread)
> 2. Slice the two loaves into slices.
> 3. Wet the slices slightly.
> 4. Take one slice of white bread and place it on a flat surface.
> 5. Add a brown slice to the pile.
> 6. Continue to do this three or four times, each time you should change the type of bread so you get different coloured layers
> 7. Gently but firmly squash out the water from the pile of bread.
> 8. Continue adding slices until they are finished, making sure to squash the water out every couple of layers.

2. Ask the learners to explain what this demonstration represents.
3. Discuss how this demonstration matches the flow diagram done earlier in this lesson.
4. Write the following onto the chalkboard:

> MORE ABOUT THE FORMATION OF SEDIMENTARY ROCKS
>
> 1. After rock particles have been weathered and eroded into the sea, these little pieces are buried in layers by more layers.
> 2. Eventually the layers or particles are squashed or compacted together, all the water is squeezed out.
> 3. The salt from the sea water cements the layers of sediment together. This forms sedimentary rocks.
> 4. If a dead fish, animals or plants are in one of these layers, a fossil will form.
> 5. Coal, oil and gas are all fossil fuels. These fuels are all found between sedimentary rocks – these plants and animals died millions of years ago and were trapped in between sedimentary layers.
> 6. Examples of sedimentary rocks are sandstone, shale and limestone.
> 7. Sedimentary rocks are quite easy to identify because they have grains or lines and layers in them.
> 8. Sedimentary rocks are quite soft and erode easily.

5. Read over the above information with the learners.

Checkpoint 2

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

a. What does compaction mean?

b. What cements the sediment together to form sedimentary rocks?

Answers to the checkpoint questions are as follows:

a. Compaction means squashed or packed closely together.

b. The sea salt cements the sediment layers together to form sedimentary rock.

6. 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
Viva Africa	Types of Rock	174-177
Spot On	The rock cycle	151 -155
Top Class	The rock cycle	205
Shuters	The rock cycle	204-210
Oxford	Sedimentary rocks	176-177
Platinum	Sedimentary Rock forms	214-215
Sasol Inzalo Bk B	Types of Rocks	222-249
Solutions for all	The Earth as a system	262 - 275
Step-by-Step	Lithosphere	184 - 193

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=AD7sqlOIgl4 (10mins) [Chemical and physical weathering]
2. https://www.youtube.com/watch?v=04a_32NuYqs(2mins) [Formation of sedimentary rock under the sea]

3 B

Term 4, Week 3, Lesson B
Lesson Title: Metamorphic rocks
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Metamorphic Rocks
CAPS Page Number	79

Lesson Objectives

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

- identify metamorphic rocks
- explain how metamorphic rocks are formed
- describe the process of the rock cycle

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
Samples of metamorphic rocks	Chalkboard
Projector	Resources booklet
Board	
Computer with an internet connection	

C CLASSROOM MANAGEMENT

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

> Briefly explain how sedimentary rocks are formed.

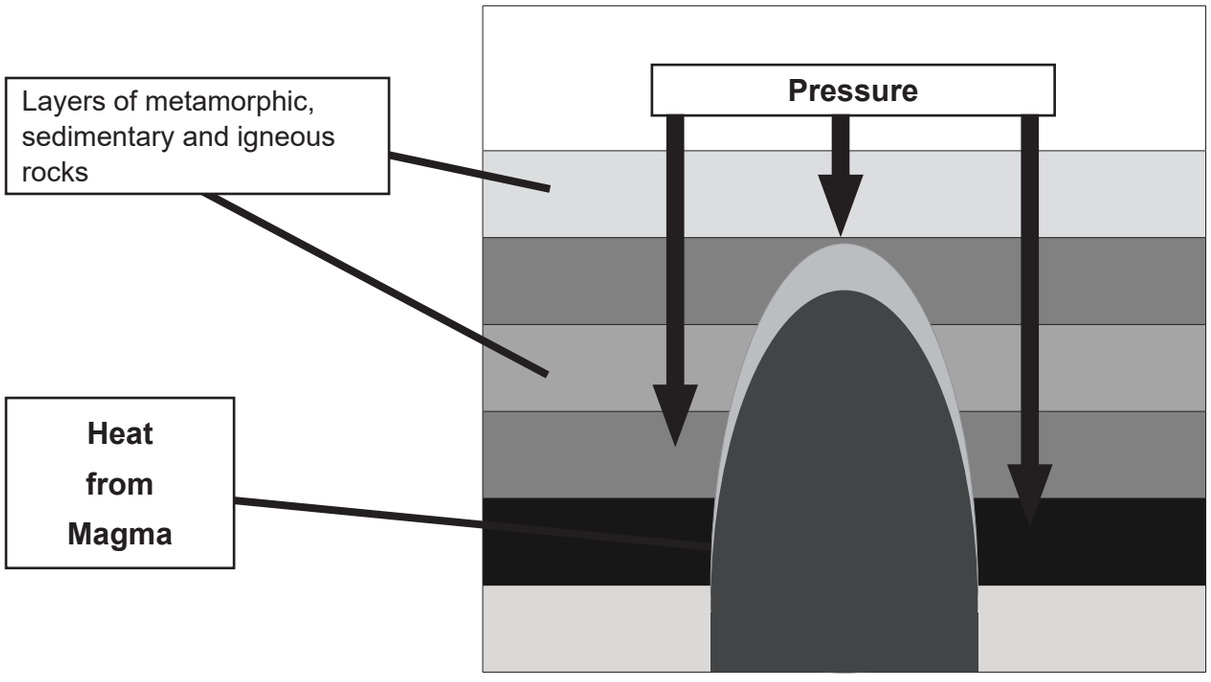
3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

> *Sedimentary rocks are formed by the processes of weathering, erosion, sedimentation and compaction.*

D ACCESSING INFORMATION

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

How Metamorphic Rocks Are Formed



2. Explain this to the learners as follows:
    a. Metamorphic rocks are formed when sedimentary or igneous rocks are buried under the Earth's surface and become heated by magma.
    b. The heat and pressure causes the sedimentary and igneous rocks to change in chemical structure.
    c. During this process, the crystals in the rock all line up causing the softer sedimentary rocks to become hard.
    d. Metamorphic rocks are hard wearing and because of the crystal structure can be split into sheets.
    e. Some examples of sedimentary rock becoming metamorphic rock are:
        - Limestone changing into marble.
        - Shale changing into slate.
        - Sandstone into quartzite
3. If possible show the learners the video https://www.youtube.com/watch?v=UrimDbTUalg (2mins) [Identification of metamorphic rocks]
4. Ask learners to draw diagram from chalboard into their workbooks.
5. Give learners some time to copy this diagram into their workbooks.

Checkpoint 1

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

a. Briefly explain how metamorphic rocks are formed.
b. Give 2 examples of a metamorphic rock and what they are used for.

Answers to the checkpoint questions are as follows:

a. Igneous and sedimentary rocks are buried below the ground. These rocks are put under pressure and heated. This heat and pressure changes the chemical structure of the rocks and they become harder, metamorphic rocks.
b. Examples of metamorphic rock are: Slate – used as roof tiles or floor covering. Marble – buildings.

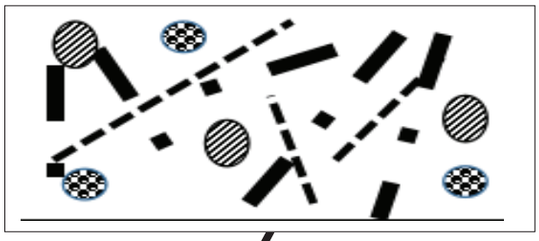
E CONCEPTUAL DEVELOPMENT

1. Write the following flow chart onto the chalkboard.

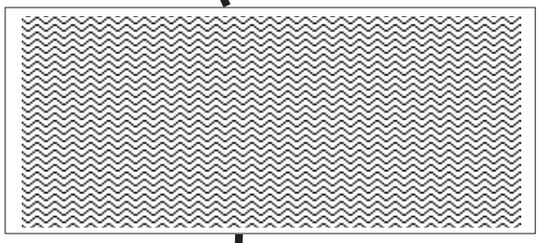
METAMORPHIC ROCKS

1. Metamorphic rocks are formed when sedimentary or igneous rocks are buried under the Earth's surface.
2. The heat and pressure causes these rocks to melt and change in chemical structure and form new rocks.
3. Examples of this change in rocks are: limestone changing into marble, shale changing into slate, sandstone into quartzite.
4. During this process, the crystals in the rock all line up.
5. Metamorphic rocks are hard wearing and because of the crystal structure, can be split into sheets.
6. Slate and marble are often split into sheets. Slate is used to tile roofs and marble is used in buildings as a construction material.

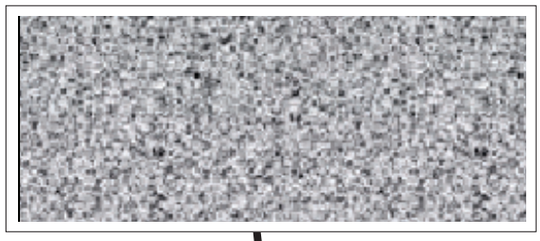
How sedimentary rocks get reformed into metamorphic rocks



Crystals and or other pieces of stone in igneous or sedimentary rocks are heated up which causes the minerals to change structure and form metamorphic rocks.



Under heat and pressure, the minerals line up. Metamorphic rocks can be identified by their bands of minerals.



Granite turns into marble

2. Tell the learners to write the above information from the chalkboard into their workbooks.
3. Give learners some time to complete this task in their exercise books.

Checkpoint 2

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

a. What features do metamorphic rocks have which would allow you to identify them?
b. What is needed to reform sedimentary and igneous rock into metamorphic rocks?

Answers to the checkpoint questions are as follows:

a. Metamorphic rocks have wavy or straight stripes of different colours in the rock. Many metamorphic rocks look as if they are two rocks mixed together.
b. Heat and pressure is needed to form metamorphic rocks.

4. 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
Viva Africa	Types of Rock	174-177
Spot On	The lithosphere and the rock cycle	150 -155
Top Class	The Lithosphere	205 -209
Shuters	The Lithosphere	204-210
Oxford	The Lithosphere	178-181
Platinum	The Lithosphere	216-217
Solutions for all	The Lithosphere	262 - 275
Step-by-Step	The Lithosphere	184 - 193

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=UrimDbTUalg (2mins) [Identification of metamorphic rocks]

3 C

Term 4, Week 3, Lesson C
Lesson Title: Lithosphere
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The rock cycle
CAPS Page Number	78

Lesson Objectives

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

- know that the Earth is the third planet from the Sun
- give reasons why the Earth is the only planet that is known to support life

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

SCIENCE PROCESS SKILLS					
Accessing & recalling Information	✓	Identifying problems & issues		Doing Investigations	
Observing		Raising Questions		Recording Information	
Comparing		Predicting		Interpreting Information	✓
Measuring		Hypothesizing	✓	Communicating	✓
Sorting & Classifying		Planning Investigations		Use information in a new way	

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Samples of rocks	Chalkboard
Poster of the rock cycle	Resources booklet
Projector	Resource 10
Board	Resource 11
Computer with an internet connection	

C CLASSROOM MANAGEMENT

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

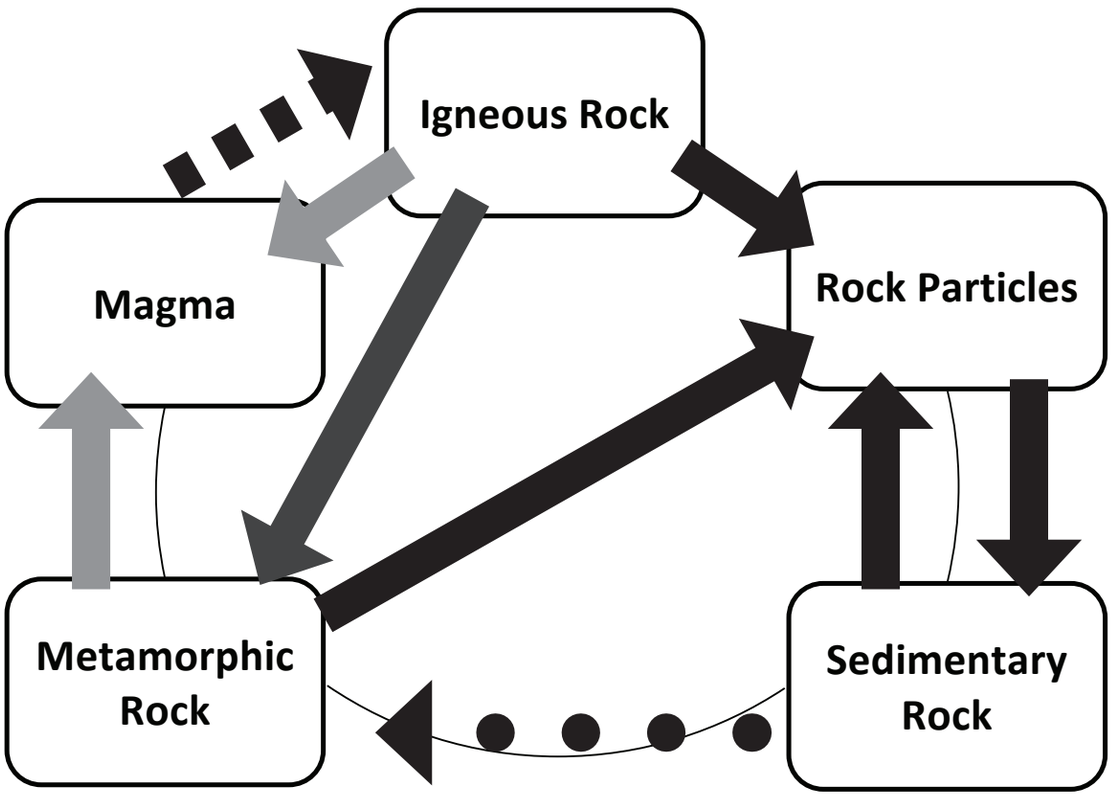
> Name the three types of rocks found in the lithosphere.

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.

> *Igneous, sedimentary and metamorphic rocks are found in the lithosphere.*

D ACCESSING INFORMATION

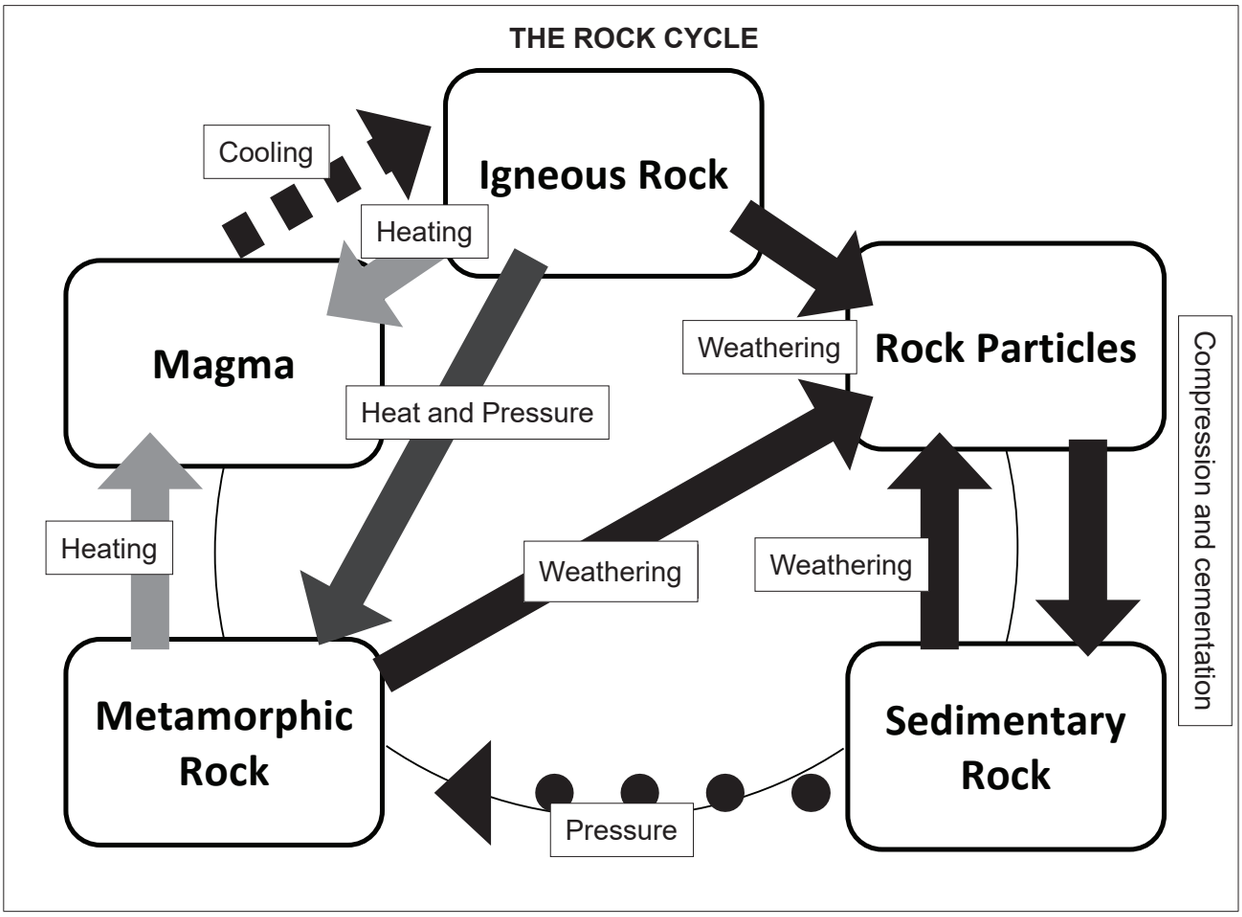
THE ROCK CYCLE



2. Ask the learners to put the following nine labels into the correct spaces on the arrows to explain the rock cycle.

Weathering	Weathering	Weathering	Compression and cementation
Cooling	Heating	Heating	Heat and Pressure	Pressure

3. Complete the answers on the flowchart for the model example on the chalkboard:



4. Explain this to the learners as follows:
5. The rock cycle is a continuous natural process of rocks breaking down and being reformed.
6. There are 3 types of rocks found on the surface of the Earth: sedimentary, igneous and metamorphic:
   - Sedimentary rocks
   - Metamorphic rocks
   - Igneous rocks
7. If it is possible, show the learners the following video: https://www.youtube.com/watch?v=EGK1KkLjdQY (4 mins) [The rock cycle]
8. Ask learners to copy the diagram from the chalkboard into to their workbooks.
9. Give learners some time to copy this information into their workbooks.

Checkpoint 1

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

a. What is the rock cycle?
b. Name the three types of rocks found on the Earth's surface.

Answers to the checkpoint questions are as follows:

a. The rock cycle is the formation, breakdown and reformation of the three types of rocks.
b. Igneous, sedimentary and metamorphic rocks.

E CONCEPTUAL DEVELOPMENT

1. If you have different rock samples, show them to the learners.
2. Write the following onto the chalkboard:

THE ROCK CYCLE

There are 3 types of rocks found on the surface of the Earth: sedimentary, igneous and metamorphic.

a. **Sedimentary rocks** are formed when igneous and metamorphic rocks are eroded by either physical or chemical weathering. This takes a very long time. (Remind the learners that they learnt about this in Grade 5.)

b. **Metamorphic rocks** are formed when sedimentary and igneous rocks are buried under the Earth's crust and heated up by the Earth's core and put under pressure. This makes the rocks melt and form new rocks.

c. **Igneous rocks** are formed when sedimentary and metamorphic rocks are melted into magma which then comes out of a volcano and cools either below or above ground.

The process of new rocks being formed, broken down and reformed is called the rock cycle.

3. Tell the learners to copy the above notes from the chalkboard into their workbooks.
4. Give learners some time to complete this task in their workbooks.

Checkpoint 2

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

a. Explain how igneous rocks are formed.
b. Explain how metamorphic rocks are formed.

Answers to the checkpoint questions are as follows:

a. Igneous rocks are formed when magma comes out of a volcano and then cools above or below ground.
b. Metamorphic rocks are made from igneous or sedimentary rocks which are buried under the Earth's crust. There the rocks are heated under great pressure until they melt and are then reformed into harder metamorphic rocks.

5. 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
Viva Africa	Types of Rock	174-177
Spot On	The rock cycle	151 -155
Top Class	The Lithosphere	206 -208
Shuters	The Lithosphere	204-210
Oxford	The Lithosphere	174-175, 180-181
Platinum	The Lithosphere	217
Solutions for all	The Lithosphere	262 - 275
Step-by-Step	The Lithosphere	184 - 193
Sasol Inzalo Bk B	The Lithosphere	222-249

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.universetoday.com/75803/how-does-the-sun-produce-energy [How the Sun produces energy]

TOPIC OVERVIEW:

Mining of mineral resources

Term 4, Weeks 4A – 5C

A. TOPIC OVERVIEW

Term 4, Weeks 4a – 5c

- This topic runs for 2 weeks.
- It is presented over 6 x 1 hour 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, 11 and 12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Matter and materials: elements; compounds; particle model of the state of matter; density • The solar system: The sun and Earth's position.	• Extracting ores • Refining materials • Mining in South Africa	GRADE 10 • Matter and Materials • States of matter • Periodic table • Atoms, elements and compounds • Chemical systems • Hydrosphere GRADE 11 • Lithosphere GRADE 12 • Chemical Industry - fertilizers and mining

C. SCIENTIFIC VOCABULARY

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

	TERM	EXPLANATION
1.	ore	Rock with a large amount of valuable minerals. Kimberlite is an ore in which diamonds are found.
2.	minerals	Minerals are naturally occurring solids with a crystalline structure. They have a fixed chemical structure. Hematite is a mineral otherwise known as iron oxide.
3.	alluvial	Describes materials deposited by rivers. Usually panning and sluicing is used to extract gold and diamonds found in rivers.
4.	cyanide	Poisonous compound (CN) used in the extraction of gold from gold ore.
5.	coke	A type of carbon made from charcoal and used to extract iron from iron oxide.
6.	pig iron	Once iron has been through the smelting process with coke (a type of carbon) we call it pig iron.
7.	smelting	A process where metal is removed from its ore by melting. This is usually done in a blast furnace.
8.	alloy	A mixture of metals. Brass, steel and bronze are all alloys.
9.	acid rain	Atmospheric pollutants combine with water vapour resulting in the rain becoming acidic. Acid rain can damage the environment.

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

Learners should be given the opportunity to become more aware of the South Africa's mineral resources and the mining process. This may help them develop a broader view of their country and the opportunities it offers. With the exposure to the wide variety of mining occurring in South Africa, they may become motivated to follow a career in mining or engineering. South Africa's wealth is largely based on mining. Learners should be encouraged to see the importance on good mining practices and develop an appreciation of the role that mines play in our lives.

E. PERSONAL REFLECTION

Reflect on your teaching at the end of each topic:

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

4 A

Term 4, Week 4, Lesson A
Lesson Title: Mining of Mineral Resources
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Extracting Ore
CAPS Page Number	80

Lesson Objectives

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

- name a number of the useful minerals found in South Africa's lithosphere
- recall the two main methods of extraction and refining of minerals from ore
- name the location of different mines in South Africa
- compare traditional and modern-day mining

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
Projector	Chalkboard
Board	Resources booklet
Computer with an internet connection	Resource 12 - 19

C CLASSROOM MANAGEMENT

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

> Name at least 4 valuable minerals that are mined in South Africa.

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.

> *There are a wide variety of valuable minerals that are mined in South Africa: Gold, diamonds, platinum, coal, iron, phosphate, copper, zinc, manganese, chrome and tin are some of the main mineral deposits found in South Africa.*

D ACCESSING INFORMATION

1. Write the following information on the chalkboard:

> EXTRACTING ORE IN SOUTH AFRICA
>
> 1. People have been mining valuable minerals from the lithosphere for thousands of years.
> 2. Rocks that contain a large amount of minerals are called ore.
> 3. There are two common ways of extracting the minerals from the lithosphere: surface mining and underground mining.
>   a. Surface mining occurs when minerals are removed from the surface of the Earth.
>   - The ground is excavated and the exposed minerals are removed by drilling or blasting.
>   - The rock with the valuable mineral is taken to the treatment plant.
>   - Strip farming, open pit mining and quarrying are all types of surface mining.
>   b. Underground mining occurs when deep holes and tunnels are dug into the ground.
>   - Tunnels, called shafts, can go to great depths into the Earth.
>   - The ore is extracted using heavy machinery and transported to the extraction plant.

4. There are different ways to remove the minerals from the ore:
   - Iron oxide is heated in a blast furnace with **coke** (a type of carbon). This is how '**pig iron'** is produced.
   - Gold ore is ground up into powder and treated with sodium **cyanide**. This dissolves the gold. Zinc and Sulfuric acid is then added to form sludge. This sludge is melted into gold bars.
   - Diamond ore is crushed and then sorted. X-ray fluorescence and hand sorting then collects the diamonds. Grease belts can be used. Diamonds stick to the grease belt better than the other minerals in the ore.

2. Read through the information on the chalkboard with the learners.
3. Show them the map of mines in South Africa: Resource 12.
4. Tell the learner the following points while they are looking at the map showing the main mining areas in South Africa: Resource 12.
   a. Minerals are naturally occurring elements or compounds found in the Earth's crust. South Africa is rich in mineral wealth.
   b. South Africa has/had huge deposits of gold, platinum, copper, iron and diamonds, manganese, chrome and tin.
   c. Most of the valuable mineral deposits are found in Gauteng, the Northern Cape, Limpopo and Mpumalanga.
5. Show the learners the pictures of the different types of mines from the Resource 12 and the map of the deposits found in South Africa.
6. Tell the learner the following points:
   - Mining is a process whereby ore is removed from the ground.
   - Mining has been happening in South Africa for hundreds of years.
   - There is archeological evidence showing people mined for gold and iron in KwaZulu Natal and at Mapungubwe many hundreds of years ago.
   - Mining used to be done by hand and was very labor intensive.
   - Modern mining uses lots of big machinery. However, it is still very labor intensive. Show them the pictures of mines in Resource 13 - 16.

Checkpoint 1

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

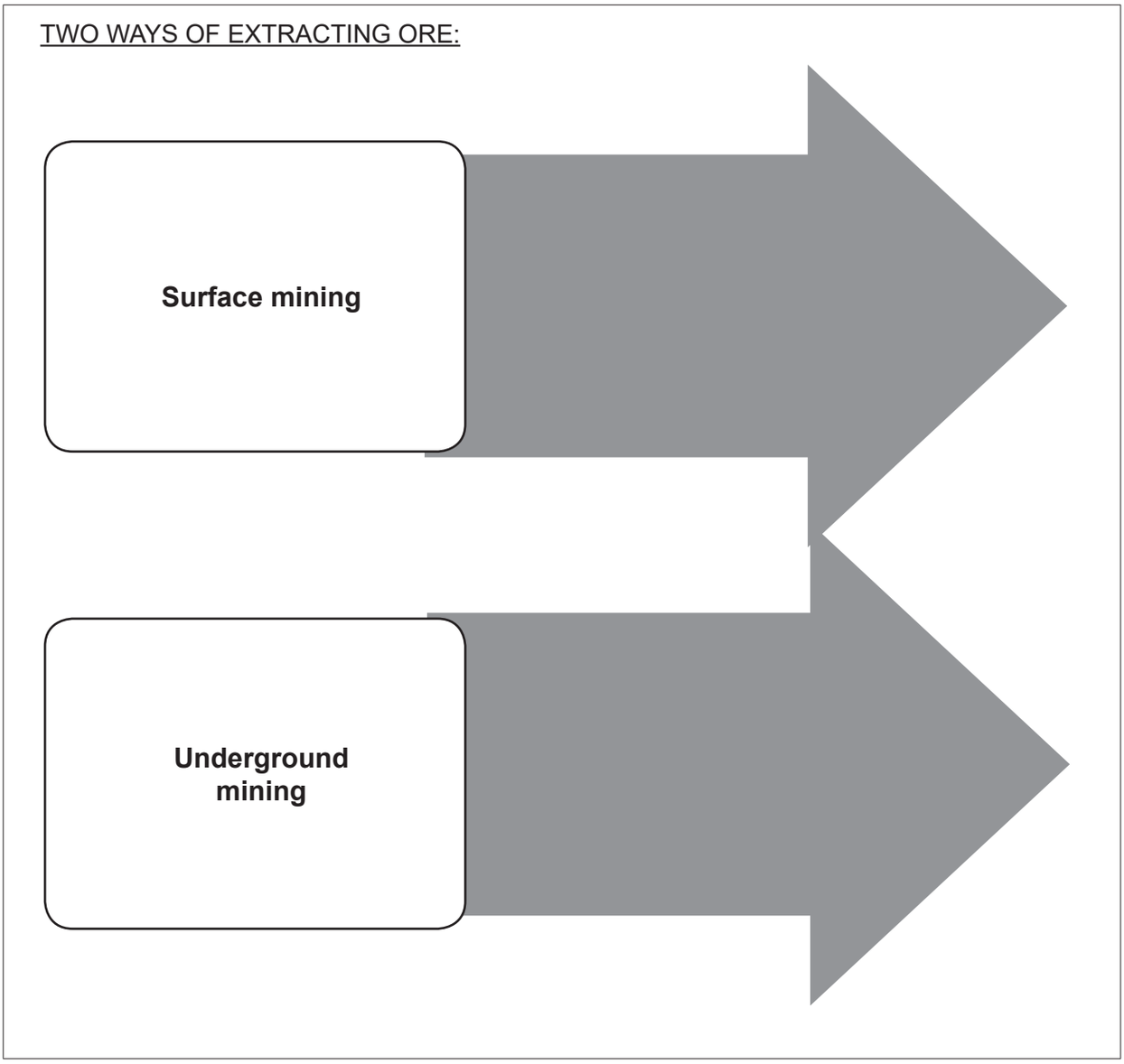
a. Where are most of the mines in South Africa today?
b. Outline one main difference between traditional mining and modern mining.

Answers to the checkpoint questions are as follows:

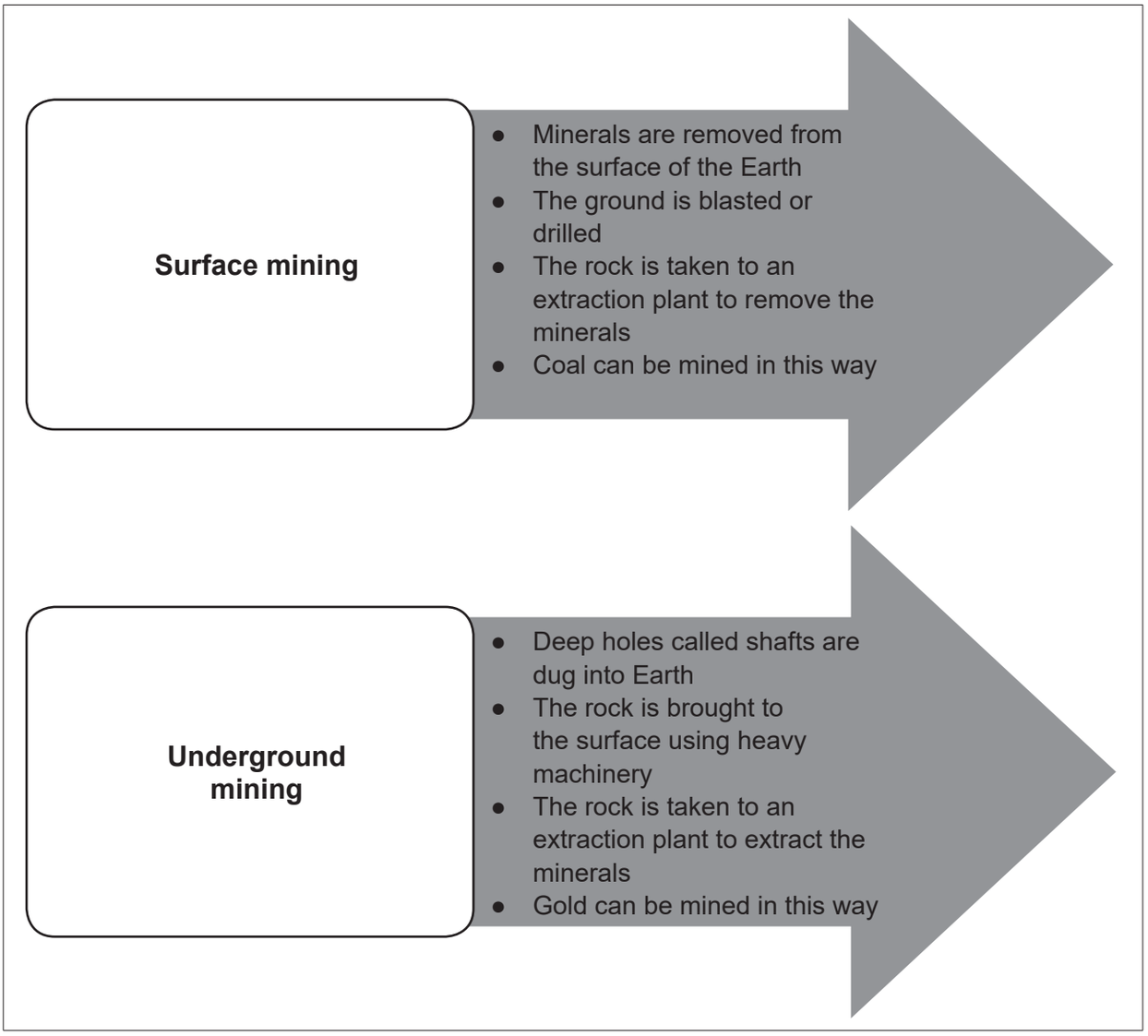
a. Gauteng, Limpopo, Mpumalanga and Limpopo are where most mines are found in South Africa.
b. Traditional mining was done by hand, whereas modern mining uses machinery.

E CONCEPTUAL DEVELOPMENT

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



2. Tell the learners to draw the above diagram into their workbooks.
3. Tell the learners that they should look at the information that they have already learnt about extracting ore and fill the following in on the arrows:
   a. How the ore is mined
   b. How the ore is treated after it is extracted
   c. An example of a mineral that is mined in this way
4. Refer to Resources 13 - 16.
5. Give learners some time to complete this activity in their workbooks.
6. Write the model answer on the chalkboard:



Checkpoint 2

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

a. What is the difference between ore and minerals?
b. Which are the two ways of extracting ore from the Earth?

Answers to the checkpoint questions are as follows:

a. A mineral is a solid pure substance which has a definite chemical structure and ore is a rock which has a concentration of minerals.
b. Surface mining and underground mining.

6. 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
Viva Africa	Mining of mineral resources	178-181
Spot On	Mining of mineral resources	157- 161
Top Class	Mining of mineral resources	211-219
Shuters	The Lithosphere	211-227
Oxford	The Lithosphere	182-191
Platinum	Extracting ores	219-232
Sasol Inzalo Bk B	The Lithosphere	250-281
Solutions for all	The Lithosphere	277-280
Step-by-Step	The Lithosphere	194 - 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?v=liFGHW4ZxrM (2.55min) [In a South African Gold Mine]
2. https://www.youtube.com/watch?v=1NlyaDAtGwI (5.22min) [Gold Ore, Silver Ore and Platinum Group Metals Ore Explained]
3. https://www.youtube.com/watch?v=mGtTes28gTU (3.59min) [10 Minerals More Valuable Than Gold]
4. https://www.youtube.com/watch?v=szD1bnKkWOo (44.09 min) [Gold Mining How Gold is mined, refined and formed. A Documentary Film]

4 B

Term 4, Week 4, Lesson B
Lesson Title: Mining of mineral resources
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Refining minerals
CAPS Page Number	80

Lesson Objectives

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

- name the two basic ways of refining materials
- describe the two methods of refining materials

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
Projector	Chalkboard
Board	Resources booklet
Computer with an internet connection	

C CLASSROOM MANAGEMENT

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

Why do people remove ore from the Earth's crust?

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.

People remove ore from the Earth's crust for the valuable minerals.

D ACCESSING INFORMATION

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

ORE AND MINERALS

1. Minerals are naturally occurring elements or compounds found in the Earth's crust.
2. These minerals are found in rock called ore. Ore is dug out of the Earth's crust by mining.
3. Some of these minerals can be used in their natural state like gold, diamonds and potash, but others like iron and copper need further processing. Some minerals require physical and chemical processes to extract materials from the ore.
4. The extraction of iron and copper from ore has been happening for thousands of years.
5. There are archaeological sites in KwaZulu Natal and Limpopo that show this.

2. Explain to the learners that:
   a. There are two types of mines:
      - Surface mining or open cast mining which involves digging an enormous hole in the surface of the Earth; and
      - Sub-surface mining, which involves digging deep tunnels under the surface of the earth to reach the ore. Show the learners the pictures on Resource 17.
   b. Once the ore is removed, it needs to be processed so the minerals can be removed.

c. Show the learners the pictures of processing on Resource 18 - 21.

d. Physical processing involves crushing and milling the rocks which have been dug out of the ground. Ore is put into machines which crush the rocks into smaller pieces and then put into mills which then make the rocks even smaller.

e. The rocks are then put into a floatation tank so the dense ore sinks to the bottom. They can also use huge magnets to remove the ore if it is magnetic. Hematite is magnetic because it is made of iron.

f. The ore is then put into a smelter or furnace to melt the metals inside the ore.

g. Other ores have different chemicals added to them to separate the minerals and the ore.

h. Some ore does not need to be physically separated, and can be used as it is, like coal.

i. Potash is a compound containing potassium. Potash is used to make fertilisers which help farmers to grow crops. It does not need processing once it has been removed from the ground.

3. Get the learners to write the information on the chalkboard into their workbooks.
4. Give them enough time to complete the task.

Checkpoint 1

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

a. What are the two types of mines?

b. What is physical processing?

Answers to the checkpoint questions are as follows:

a. Surface and sub-surface.

b. When the ore and rocks are broken into smaller pieces.

E CONCEPTUAL DEVELOPMENT

1. Draw and label the diagram below onto the chalkboard:

A FLOW DIAGRAM TO ILLUSTRATE THE PROCESS OF MINING.

EXPLORATION
The finding of high quality ore.

This process is usually carried out by _____.

DRILLING AND BLASTING

There are two types of mines:
Underground mines–

Open cast mines

PHYSICAL SEPARATION
The ore is _____from the rocks by _____ and milling and floatation and smelting.

The rocks are brought to the surface and then put through a crusher to make them _____.

They are then put in a tank of water and the _____ ore will sink to the bottom of the tank. This is called floatation.

The ore is then put into a smelter and _____ to temperatures around 1500ºC. This melts the metal and removes it's from the ore.

CHEMICAL PROCESSING
Refining the metals by cleaning

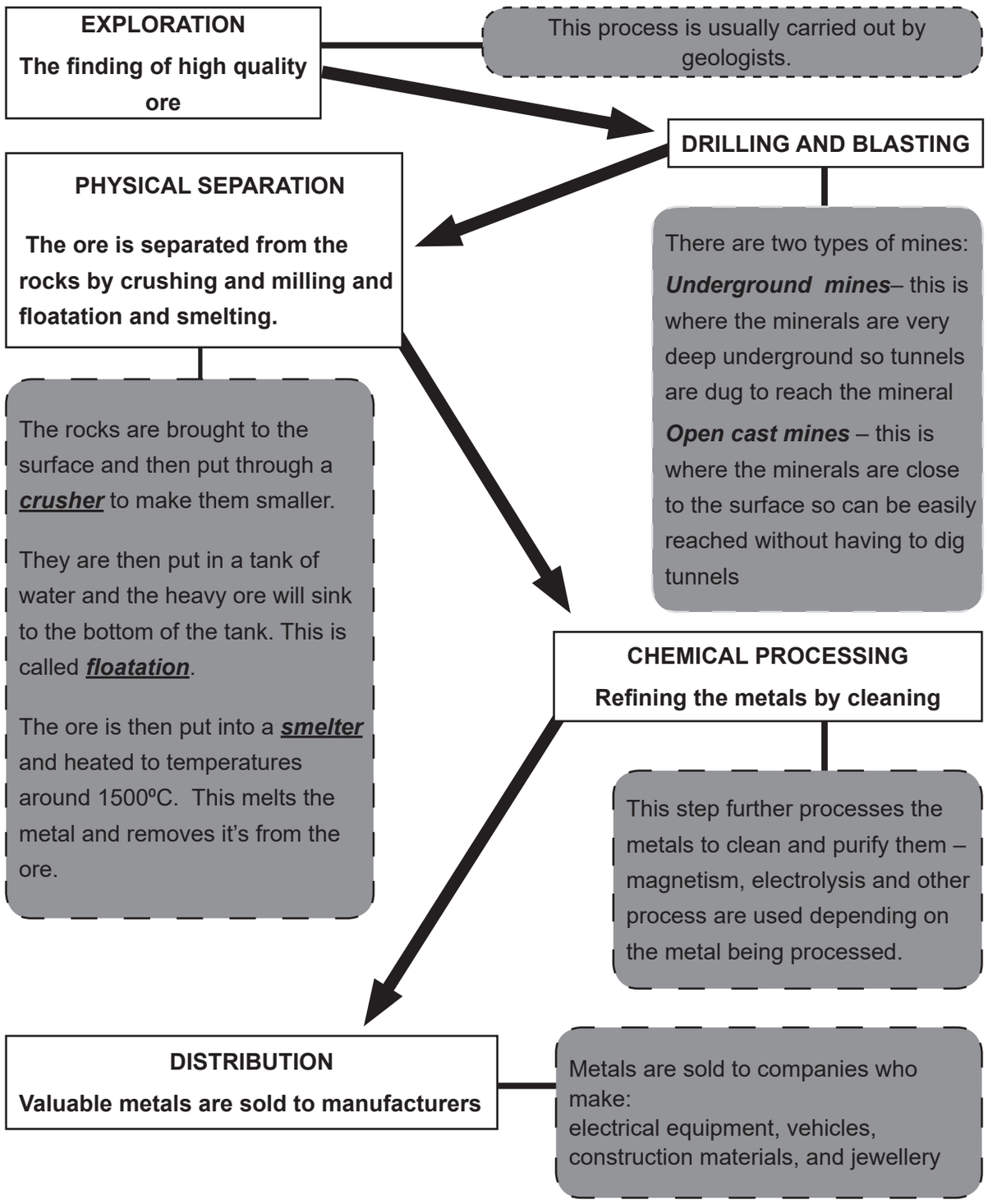
This step further processes the metals to _____ and _____ them – magnetism, electrolysis and other process are used depending on the metal being processed.

DISTRIBUTION
Valuable metals are sold to _____

Metals are sold to companies who make:
electrical equipment, vehicles, construction materials, and jewellery.

2. Tell the learners to draw the above flow chart into their workbooks.
3. Tell the learners to fill in the missing details.
4. Write the model answer onto the chalkboard:

A FLOW DIAGRAM TO ILLUSTRATE THE PROCESS OF MINING.



5. Give learners some time to check their answer against the model answer on the chalkboard.
6. Discuss these with the learners.

Checkpoint 2

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

a. Why do they put mined ore in crushers and mills?

b. Which ore do they use an electromagnet to separate?

Answers to the checkpoint questions are as follows:

a. To make the rock smaller.

b. Hematite.

7. 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
Viva Africa	Mining of mineral resources	178-181
Spot On	Mining of mineral resources	157- 161
Top Class	Mining of mineral resources	211-219
Shuters	The Lithosphere	211-227
Oxford	The Lithosphere	182-191
Platinum	The Lithosphere	219-232
Sasol Inzalo Bk B	The Lithosphere	250-281
Solutions for all	The Lithosphere	281 - 284
Step-by-Step	The Lithosphere	194 - 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?v=7HN-Ltjorbk (44 min) [Build it bigger – the World's deepest mine – East Rand Gold – Gauteng]
2. https://www.youtube.com/watch?v=MCsAI6ItU60 (43 min) [Coal Mining: The Dangerous Job on EARTH – DOCFILMS]

4 C

Term 4, Week 4, Lesson C
Lesson Title: Mining of Mineral Resources
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Refining Materials
CAPS Page Number	80

Lesson Objectives

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

- recall that some minerals require physical and some require chemical processes to extract materials from ore

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
Projector	Chalkboard
Board	Resources booklet
Computer with an internet connection	Resource 18 - 21

C CLASSROOM MANAGEMENT

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

Briefly explain the term 'physical processing' in mining .

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.

Physical processing involves the processes of ore being milled or crushed into smaller pieces, in order to extract the minerals.

D ACCESSING INFORMATION

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

MINING OF MINERAL RESOURCES

a. Physical processing:
    1. Crushing and milling mined rocks to remove minerals.
    2. Placing rocks into a floatation tank so that the dense ore sinks to the bottom.
b. Chemical processing:
    1. Further purifying of the metals using chemical reactions
    2. Chemicals used include cyanide, other strong acids, and chlorine.
    3. Leaching and electrolysis are two types of chemical processing.
    4. Leaching is the process where solvent is run in order to remove soluble components.
    5. Electrololyis - chemical seperation using the conduction of electricty through a melted or dissolved mixture.
    6. Chemical processing always involves a chemical reaction.

2. Explain the following to the learners:
    a. Physical processing involves crushing and milling the rocks which have been dug out of the ground. The rocks are then put into a floatation tank so that the dense ore sinks to the bottom.
    b. Chemical processing involves further purifying of the metals using chemical reactions. Chemicals used include cyanide and strong acids.
    c. Processing **iron** first involves crushing and milling. The fine-grained iron ore is then processed in a blast furnace. Coal is cleaned of impurities in a coker furnace to produce pure carbon. A mixture of iron ore and carbon is the heated in a blast furnace to produce molten iron and pig iron from which steel is made.
    d. Gold ore is crushed and then usually placed in a solution of sodium cyanide. The process of leaching dissolves some of the impurities. Zinc is then added to separate the gold from the mixture. Floatation then separates the heavy and light particles. Sulphuric acid is then added to make sludge. The sludge is then heated to further separate the mineral gold from impurities using electrolytes.
    e. Leaching and electrolysis are two types of chemical processing. Chemical processing always involves a chemical reaction.
3. Give learners some time to copy this information into their workbooks.

Checkpoint 1

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

a. What is chemical processing?
b. Name a poisonous chemical that is used to extract gold.

Answers to the checkpoint questions are as follows:

a. Using chemicals to process ore.
b. Cyanide.

E CONCEPTUAL DEVELOPMENT

1. If possible show the learners the two videos:
    a. https://www.youtube.com/watch?v=fZM_NF93gWo (6mins) [Mining]
    b. https://www.youtube.com/watch?v=pMEiyKZ4H4g (6 mins) [Electrolytic refining of metals]
2. Draw the following table onto the chalkboard:

METHODS OF REFINING MINERALS DURING THE MINING PROCESS		
Type of refining	**Physical Methods**	**Chemical Methods**
Processes		
Examples of minerals		
Crushing, panning, cyanide, sulphuric acid, separating; iron, lead zinc, smelting, heat and oxygen; charcoal or coke; electro- magnetism, diamonds, coal, potash, milling, panning, electro-magnetism, hand sorting, florescent x-rays, sluicing, alluvial gold, aluminium, potassium		

3. Explain this task to the learners as follows:
   a. Ask learners to copy the above table into their workbooks.
   b. Look at the mining pictures in the Resources 12 - 21.
   c. The learners need to use the given words to complete the table.
4. Write the model answer on the chalkboard:

METHODS OF REFINING MINERALS DURING THE MINING PROCESS		
Type of refining	**Physical Methods**	**Chemical Methods**
Processes	crushing milling panning electro-magnetism hand sorting florescent x-rays sluicing	smelting heat chemicals cyanide Sulphuric acid oxygen
Examples of minerals	some alluvial gold diamonds coal potash aluminium potassium iron gold	

5. Give learners some time to complete this task in their exercise books.

Checkpoint 2

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

a. State one of the toxic chemicals associated with gold mining.
b. Which 2 processes are needed to extract gold ore?

Answers to the checkpoint questions are as follows:

a. Cyanide is a toxic chemical used in gold mining.
b. Chemical and physical processes are needed to extract gold from ore bearing rock.

6. 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
Viva Africa	Mining of mineral resources	178-181
Spot On	Mining of mineral resources	157- 161
Top Class	Mining of mineral resources	211-219
Shuters	The Lithosphere	211-227
Oxford	The Lithosphere	182-191
Platinum	The Lithosphere	219-232
Sasol Inzalo Bk B	The Lithosphere	250-281
Solutions for all	The Lithosphere	281 - 284
Step-by-Step	The Lithosphere	194 - 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:

7. https://www.youtube.com/watch?v=fZM_NF93gWo (6mins) [Mining]
8. https://www.youtube.com/watch?v=pMEiyKZ4H4g (6 mins) [Electrolytic refining of metals]

5 A

Term 4, Week 5, Lesson A
Lesson Title: Mining of Mineral Resources
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Mining in South Africa
CAPS Page Number	80

Lesson Objectives

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

- list at least 6 of the main minerals mined in South Africa
- identify the provinces in South Africa where large-scale mining occurs
- recall the methods of extracting and refining various types of minerals

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
Projector	Chalkboard
Board	Resources booklet
Computer with an internet connection	Resource 13 and Resource 21

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 does the chemical processing of gold involve?

3. Learners should enter the classroom and answer the question in their workbooks.
4. Remind them to look at the notes copied from the last lesson.
5. Discuss the answer with the learners.
6. Write the model answer onto the chalkboard.

The crushed ore is mixed with sodium cyanide to dissolve the gold. Zinc is then added to get the gold to separate from the mixture. Sulphuric acid is then added to the zinc and gold to make a sludge. The sludge is then melted to form gold bars.

D ACCESSING INFORMATION

1. Draw the following table and write the questions on the chalkboard before the lesson starts:
2. You may also want to draw Resource 12 onto the chalkboard.

Mining in South Africa

a. Which province in South Africa appears to have the most mines according to the given simplified map on Resource 12.
b. What province has the greatest variety of mineral resources?
c. Which provinces appear to have one or less than one mineral deposit?
d. Name the main minerals that are mined in your province.
e. Use the map to complete the table below.

Province	**Type of mineral deposits**
Eastern Cape	
Free State	
Kwa-Zulu Natal	
Gauteng	

Limpopo	
Mpumalanga	
Northern Cape	
North West	
Western Cape	

1. Tell the learners to look at the simplified map on Resource 12.
2. To help the learners to understand the map on Resource 12, please ask the learners the following questions about the map and then discuss each answer:
   a. What is the heading of the map?
      Mineral Map of South Africa
   b. How many provinces are there in South Africa?
      Nine.
   c. What is the symbol representing Lead and Zinc on this map?
      
   d. According to this map, which province in South Africa has most mineral reserves?
      Northern Cape
   e. Why don't all the provinces have the same minerals available to be mined?
      During the rock cycle, over thousands of years different rocks were formed in different areas in South Africa. Different processes such as weathering, chemical reactions and erosion resulted in deposits of different mineral deposits in different areas.
3. Tell the learners to complete the table and answer the questions which are written on the board.
4. Give the learners time to complete the task.
5. Write the model answer on the chalkboard:

Mining in South Africa

a. The Northern Cape appears to have the most mines according to the given map on Resource 12.
b. The Northern Cape has the most variety of mineral resources.
c. Eastern and Western Cape appear to have one or less than one mineral deposit?
d. This answer depends on the province of the school.
e. See table below:

Province	Type of mineral deposits
Eastern Cape	No major mines
Free State	2 Diamond 1 Gold
Kwa-Zulu Natal	2 Iron Ore
Gauteng	4 Gold
Limpopo	2 Iron ore 2 Copper 2 Tin 1 Platinum
Mpumalanga	1 Chrome 2 Asbestos
Northern Cape	3 Diamond 2 Copper 1 Lead and Zinc 2 Manganese 1 iron ore
North West	1 Diamond 1 Platinum
Western Cape	2 Iron ore 2 Copper

3. Explain the following points to the learners as follows:
   a. Copper is a valuable and useful metal, that is used in all electrical wiring .
   b. Copper can be found in different types of ore.
   c. If copper is found in chalcocite (a type of copper ore) it is called copper (I) sulphide (Cu_2S); but copper can also found in a different type of ore, called chalcopyrite then it is called copper iron sulphide ($CuFeS_2$).
   d. Iron has been mined for centuries. Iron is used in everything you can think of, from cars to machinery, from furniture to buildings.
   e. Iron is not found in its elemental state in the ground, but in several types of ores. Hematite (Fe_2O_3) is the most common form and there are several large hematite mines in Limpopo and in the Northern Cape.
   f. These ores are processed both physically and chemically to extract the metal from the ore.
4. Show the learners the diagram of the furnace in Resource 21.
5. Explain the process of how the iron moves through the furnace. (You may want to draw this onto the chalkboard). Remind the learners that a furnace is extremely hot. The heat helps to separate the molten or melted iron from the crushed ore as slag.
6. Explain the following points to the learners as follows:
   a. Iron ore is made into steel by adding carbon and other metals like manganese, nickel and chromium. Steel is an alloy of iron and does not rust.

b. Iron used to be heated with charcoal to make lumps of iron in a homemade furnace. The iron ore was heated up until the iron melted out of the ore. The iron was then used to make weapons and jewelry.

c. If iron is not mixed with carbon and chromium it will rust.

d. Copper is processed in a similar way.

5. If possible allow the learners to watch: https://www.youtube.com/watch?v=9l7JqonyoKA(6mins) [Steel production]

Checkpoint 1

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

a. How is iron turned into steel?

b. What is coke in the industry of mining?

Answers to the checkpoint questions are as follows:

a. Iron is heated with chromium and carbon to make steel.

b. Coke is a type of carbon made from charcoal used to extract iron from ore.

E CONCEPTUAL DEVELOPMENT

1. Write the following onto the chalkboard:

PROCESSING MINERALS

1. Name two ways in which ore is processed?
2. Name two methods of physical and chemical refining.
3. Draw a flow diagram to show how hematite is processed.
4. Name two chemicals which are added to pig iron to make steel.
5. Give 1 advantage of steel over iron.
6. Explain why cyanide and mercury could be a problem if they were accidentally spilt.

2. Read over the above questions with the learners.
3. Explain this task to the learners as follows:
   a. Tell the learners to answer the questions in their workbooks.
   b. Tell the learners they may have to refer back in their workbooks.
4. Give learners some time to complete this task in their exercise books.
5. Write the model answers on the chalkboard:

1. *Ore can be processed by chemical and/or physical processes.*
2. *Floatation and smelting are chemical processes and crushing and using a magnet are physical processes.*
3. *Mined → crushed → separated using a magnet → smelted.*
4. *Carbon, nickel, chromium and manganese are added to iron to make pig iron.*
5. *An advantage is that steel does not rust.*
6. *Mercury and cyanide are toxic and poisonous. If these chemicals are spilt they may leak into the water systems and then may cause humans to have health issues, kill crops and animals and destroy ecosystems.*

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

1. 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
Viva Africa	Mining in South Africa	181-184
Spot On	Mining in South Africa	160-163
Top Class	Mining mineral resources	215-220
Solutions for All	Mining of Mineral resources	277-284
Shuters	The Lithosphere	211-227
Oxford	The Lithosphere	182-191
Platinum	Mining in South Africa	227-228
Sasol Inzalo Bk B	The Lithosphere	250-281
Solutions for all	The Lithosphere	285 - 297
Step-by-Step	The Lithosphere	194 - 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?v=9l7JqonyoKA (6mins) [Steel production]
2. https://www.youtube.com/watch?v=i6BIyQJZdTg (3mins) [iron ore – ste

5 B

Term 4, Week 5, Lesson B
Lesson Title: Pros and cons of mining in South Africa
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Mining in South Africa
CAPS Page Number	80

Lesson Objectives

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

- identify a number of minerals that are mined on a large scale in South Africa
- list a few significant environmental impacts of mining

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
Projector	Chalkboard
Board	Resources booklet
Computer with an internet connection	

C CLASSROOM MANAGEMENT

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

> Name three advantages of mining minerals in South Africa.

3. Learners should enter the classroom and answer the question in their workbooks.
4. Tell the learners to **recall information from previous lessons and to look around the classroom environment** for clues.
5. Write the model answer onto the chalkboard.

> *There are many advantages about mining minerals in South Africa.*
>
> *Such as creating employment for thousands of people.*
>
> *The minerals mined are also useful such coal for making electricity or iron used in the building industry – door frames and handles, furniture such as desk legs, jewellery, etc.*
>
> *(Extension: Mining minerals also boosts the South African economy when overseas countries buy the resources. Mineral reserves give our currency their value.)*

D ACCESSING INFORMATION

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

> MINING AND THE ENVIRONMENT
>
> a. Mining can damage the environment in different ways.
> b. Open cast mines occur on the surface of the Earth and are barren areas and ugly to look at.
> c. Mine dust can contribute to air pollution.
> d. Some mining can produce carbon dioxide which causes global warming.
> e. Frequently dangerous chemicals are used to extract minerals from ore.
> f. Chemical wastes from extracting minerals can mix with groundwater supplies.
> g. Acid mine drainage caused from the chemicals used in extracting gold, is a big problem in Gauteng.
> h. Polluted water can damage the soil and animal life.

h. Mining can damage all the Earth's spheres namely the lithosphere (land) hydrosphere (water), the atmosphere (air) as well as the biosphere (plant and animal life).

i. Damaging the environment will threaten our economy resulting from conservation and tourism.

2. Give learners some time to copy the information from the chalkboard into their workbooks.
3. Explain this to the learners as follows:
   a. Mining causes damage to the environment. Open cast mines are ugly and can leave dangerous holes in the ground.
   b. Dust from open pit mines contains poisonous gases like sulphur dioxide which contributes to air pollution and acid rain.
   c. Mining releases carbon dioxide into the atmosphere which contributes to global warming.
   d. The waste from mining is usually dumped in heaps on the land surface. Dangerous chemicals can leach into the ground water and contaminate water supplies.
   e. When mines extract gold from ore, cyanide and sulphuric acid are used. (This was mentioned in a previous lesson – Extracting minerals) Rain and underground water mix with the mining waste. This acid mine drainage is causing a lot of concern especially around Gauteng. Johannesburg has huge mine dumps from gold mining. The waste in these dumps contains lots of dangerous chemicals including sulphites and toxic heavy metals like cadmium.
   f. Sulphites mix with rain water and the water then becomes acidic. This solution then drains into groundwater supplies and can cause destruction of ecosystems.
   g. Polluted water can kill crops, and/or animals.
   h. Air pollution can also cause health problems for humans.

If possible please allow the learners to watch one of the videos in the Resources ection.

Checkpoint 1

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

a. List two environmental problems associated with mining.
b. What is acid mine drainage and why is it so dangerous?

Answers to the checkpoint questions are as follows:

a. Two environmental problems are land, water and air pollution. (Only two options required).
b. Acid mine drainage is water that contains toxic chemicals which leak from mines. It is so dangerous because it kills crops and animals when it pollutes water supplies.

E CONCEPTUAL DEVELOPMENT

1. Explain this task to the learners as follows:
   a. Ask the learners to write a letter to the Department of Mineral Resources, or the Department of Water and Sanitation or the Department for Environmental Affairs.
   b. In their letter, they should express their concerns at the environmental impact of mining in South Africa and ask what the government is doing to ensure the quality of water, the air and the landscape of South Africa.
3. Ask the learners if they have any questions and provide answers and explanations.
4. Write the following layout format on the chalkboard to help the learners do the given task:

Own address

House number and Street

Suburb

Postal code

Date

Department of Mineral Resources /

Department of Water and Sanitation/ Department for Environmental Affairs

Environment House,

473 Steve Biko,

Arcadia,

Pretoria, 0083

South Africa

Dear _____

Heading of your concern

I am concerned about _____

XXXXXX

XXXXXXXXXXX

There is a possibility that this situation will get worse because_____

XXXXXX

XXXXXXXXXXXXX

I believe that the following action is needed to improve the situation_____

XXXXXX

XXXXXXXXXXXXX

Yours Sincerley

Your Name

4. Read over the format with the learners and provide explanations if needed.
5. Allow learners time to complete the task.
6. Assist them with words they may need to complete the letter.
7. Write the model example on a few pieces of paper or onto the chalkboard so that learners can see good examples of the answer.

5045 Klipper Street
Johannesburg
2094
29 December 2017

Department of Mineral Resources
Environment House,
473 Steve Biko,
Arcadia,
Pretoria, 0083
South Africa

Dear Sir

Informal settlement built next to gold mine dumps near acid mine drainage

I am concerned about the squatters living in next to the mine dumps next to the Soweto highway. These people have decided to move onto this vacant land and are totally unaware of the dangerous chemicals that can leach into the ground water and contaminate water supplies.

There is a possibility that this situation will get worse because when mines extract gold from ore, cyanide and sulphuric acid are used. The waste ore containing these toxic chemicals are dumped on vacant land. When it rains, the water mixes with the mining waste. The people living in the area will be poisoned when they drink water that collects in holes around and on the dump. I am very concerned about the children paddling in the water after rain storms.

I believe that the following actions are needed to improve the situation for these people, the squatters need to be warned about the dangers of living on or near mine dumps. Signs need to be erected all over the dangerous area. Also, safe drinking water needs to be supplied to these people until alternative land can be found and these people can be relocated.

I look forward to hearing your response, regarding my concern about the negative impact that gold mining is having on some of the people of South Africa.

With sincere thanks,

Naledi Nkosi

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
Viva Africa	Mining in South Africa	184- 186
Spot On	Mining in South Africa	162- 164
Top Class	Mining in South Africa	220-222
Shuters	The Lithosphere	211-227
Oxford	The Lithosphere	182-191
Solutions for All	Impact of Mining on the environment	290-297
Platinum	Mining in South Africa	227 - 229
Sasol Inzalo Bk B	Ming in South Africa	269-281
Solutions for all	The Lithosphere	285 - 297
Step-by-Step	The Lithosphere	194 - 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?v=qMw-Q8ns-FQ (6mins)[the environmental impact of gold mining in South Africa]
2. https://www.youtube.com/watch?v=ie5V-K70JUk (18mins) [Toxic Gold mine]
3. https://www.youtube.com/watch?v=1PktACVFT94 (4mins) [acid mine drainage in Krugersdorp]
4. https://www.youtube.com/watch?v=ZxlAagQKsDg (2mins) [solving the acid mine drainage problem]
5. https://www.youtube.com/watch?v=ynN39sfqT8w (3mins) [Coal mining's environmental impact]

5 C

Term 4, Week 5, Lesson C
Lesson Title: Mining of Mineral Resources
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Mining in South Africa – Who should benefit?
CAPS Page Number	80

Lesson Objectives

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

- identify the group of people who should benefit from mining
- justify arguments of who should benefit with a legitimate reasoning
- recall that mining has significant environmental impact

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
Plain Paper	Plain paper
Cardboard	
Computer with an internet connection	
Projector	

C CLASSROOM MANAGEMENT

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

> Name at least 3 negative impacts that mining in South Africa has on the environment.

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.

> *There are a wide variety of negative impacts that mining has on the environment, such as:*
>
> *a. Damage to the to the land surface by open pit mining and deep shaft mining.*
>
> *b. Mine dumps are ugly to look at and can contain dangerous chemicals that can get into drinking water.*
>
> *c. Dust and carbon dioxide can upset the atmosphere by causing air pollution.*
>
> *d. Mines be very dangerous as mines dig huge holes.*
>
> *e. Mining can also cause noise pollution as big machinery, drilling and blasting is noisy.*

D CONCEPTUAL DEVELOPMENT

1. Write the following information and questions on the board.

> MINING IN SOUTH AFRICA – WHO SHOULD BENEFIT?
>
> 1. The mining rights in South Africa are owned by big companies like Lonmin, De Beers, Anglo and Exxaro.
> 2. Mining brought in an income of R408 billion in 2016.
> 3. Of that R78 million was paid in salaries, R18 billion was paid in tax.
> 4. R40 million was invested back into the mines.
> 5. R221 billion was spent on transport and purchasing material for the mines.
> 6. The industry employs over one million people.
> 7. 92% of the income from mining is spent in South Africa.

MINING IN SOUTH AFRICA – WHAT IS THE COST?

1. Mining creates environmental damage. Mines destroy the landscape, ecosystems and displace local communities.
2. The mines themselves are ugly, dirty and noisy places.
3. Air pollution is a big problem which is caused by some mines.
4. Dump heaps can contain toxic substances which end up in the water cycle, and with time these substances can cause the heaps to become unstable and cause local landslides or sink holes.
   a. Should the state of the environment be a concern to the mine owners? Why?
   b. Who should be responsible for the clean-up of area once a mine has been closed?
   c. Should local authorities be responsible for acid mine drainage and the quality of drinking water? Why?
   d. Suggest two laws we need to have with regards to mining and protecting the different spheres in the environment.

2. Read and discuss the information written on the board with the learners.
3. Write the following questions onto the chalkboard (always try to do this before the lessons starts):

MINING IN SOUTH AFRICA – WHO SHOULD BENEFIT?

a. Who do you think should own the minerals? - Big companies or the government? Explain your choice.
b. Should a few people or the government own the all the mining rights?
c. What role should the government play in allocating (giving) mining rights?
d. Do you think that mines, and the profits from mining, be controlled by the government?

MINING IN SOUTH AFRICA – WHAT IS THE COST?

e. Should the state of the environment be a concern to the mine owners? Why?
f. Who should be responsible for the clean-up of area once a mine has been closed?
g. Should local authorities be responsible for acid mine drainage and the quality of drinking water? Why?
h. Suggest two laws we need to have with regards to mining and protecting the different spheres in the environment.

4. Walk around the class to assist learners with answering the questions.
5. Add the model answers to the questions on the board or read the answers to the class to help the learners to correct their work:

MINING IN SOUTH AFRICA – WHO SHOULD BENEFIT?

a. *This answer may differ depending on the beliefs of the learners. But they need to justify their answers.*

   e.g. The government should own them as then the government can use the money to improve South Africa.

b. *Yes because if more people had mining rights – the environment would be stripped. The minerals would not be controlled and will lose value; OR - No, more people should be able to mine as then the wealth can be shared amongst the people.*

c. *The government should have a sector who allocates mining rights to people who are able to mine safely and will ensure the environmental impact is limited; OR - The government cannot have a major role in allocating rights as this would allow the opportunity for corruption. Experts in mining and environment should be left to make critical decisions in this industry.*

d. *Yes or No with a valid reason.*

   Ideally it should be a collective or group approach – sound advice and balance between costs and impact and profits and stakeholders.

MINING IN SOUTH AFRICA – WHAT IS THE COST?

e. *The environment determines the quality of life people have. Water and air need to be cared for to ensure healthy lives.*

f. *The mine which obtained the wealth from the resources should use some of the profits to "repair" the damage made during the mining process.*

g. *Partly yes. As local authorities are in charge of allocating mining rights. So they need to ensure that the mines comply with the agreement attached to mining rights.*

h. *This answer may differ:*

   Laws need to monitor the amount of minerals that are extracted by the mines.

   Laws need to ensure that all people in and around the mine are safe.

   Laws need to protect the miners and environment.

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

E 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
Viva Africa	Mining in South Africa	184- 186
Spot On	Mining in South Africa	162-163
Top Class	Mining in South Africa	220-222
Solutions for all	Mining in South Africa	290 - 297
Shuters	The Lithosphere	211-227
Oxford	The Lithosphere	182-191
Platinum	The Lithosphere	228-232
Sasol Inzalo	The Lithosphere	250-281
Solutions for all	The Lithosphere	285 - 297
Step-by-Step	The Lithosphere	194 - 199

F 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=UxF9l6bedZU (17.28 min) [Environmental impact of mining.]
2. https://www.youtube.com/watch?v=tvVV-tjnmiU (3.39min) [How Does Mining Affect the Environment?]

TOPIC OVERVIEW:
The Atmosphere
Term 4, Weeks 6A – 7C

A. TOPIC OVERVIEW

Term 4, Weeks 6a – 7c

- This topic runs for 2 weeks.
- It is presented over 6 x 1 hour 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, 11 and 12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• The Solar System: The sun and planets, the Earth's position in the solar system. • Beyond the Solar System: The Milky Way Galaxy, our nearest star, light years, light hours and minutes, beyond the Milky Way Galaxy. • Looking into space, early viewing into space and the use of the telescopes.	• The Atmosphere made up of the Troposphere, Stratoshere, Mesosphere, Therosphere. • The Greenhouse Effect.	GRADE 12 • Matter and classification • States of matter and the kinetic molecular theory. GRADE 11 • Molecular structure • Intermolecular forces (states of matter; density; kinetic energy; temperature) • Ideal gases (motion and • kinetic theory of gases; gas laws)

C. SCIENTIFIC VOCABULARY

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

	TERM	EXPLANATION
1.	Atmosphere	The mixture of gases held round Earth by gravity.
2.	Air	The three main gases in the atmosphere are oxygen, nitrogen and carbon dioxide.
3.	Gravity	The force of attraction that the Earth or another astronomical object exerts on an object on or near its surface.
4.	Mass	Is the amount of matter of an object. Matter is anything you can touch physically.
5.	Density	The amount of mass in a given volume of a material. A pillow of feathers is less dense than a brick of lead.
6.	Troposphere	The lowest layer of the atmosphere, closest to the surface of Earth. It extends 10km from the surface upwards. Usually heated from the Earth's surface.
7.	Stratosphere	The second layer of the atmosphere from Earth's surface lying between 10 -50km above the Earth's surface. The stratosphere is thinner than the troposphere. It is layered with the inner layer being cooler than the outer layer.
8.	Mesosphere	The layer third layer of the atmosphere from Earth's surface lies 50km to 80km above the Earth. The air is extremely thin and cold.
9.	Thermosphere	The fourth and thickest layer of the atmosphere. It lies from about 80km to about 350km from the Earth's Surface. Most satellites orbit the Earth in this layer.
10.	Altitude	The height above sea level.
11.	Ultraviolet radiation	Invisible rays that are part of the energy that comes from the sun. UV radiation is made up of three types of rays --ultraviolet A (UVA), ultraviolet B (UVB), and ultraviolet C (UVC)
12.	Green House	A structure made of glass in which plants are grown because heat is trapped in the structure.
13.	Green House Effect	A warming effect caused by the trapping of energy in the atmosphere by air pollutants such as high levels of carbon dioxide and carbon monoxide.
14.	Fossil fuels	Include coal, oil and gas made from the remains of plants and animals that lived long ago. These fuels are expected to run out one day.
15.	Ozone	A form of oxygen found in the stratosphere which absorbs high levels of energy from the sun before it enters the troposphere.
16.	Climate change	Long term changes in the Earth's temperature and precipitation patterns. High levels of air pollution are seen as a cause of climate change.

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

The opportunity of learning about the structure of the atmosphere should encourage learners to recognise the importance of this sphere. The troposphere in atmosphere gives us air to breathe. However, the stratosphere, mesosphere and thermosphere all contribute to the existence of life. Each layer of the atmosphere provides a unique type of protection.

By learning about the five layers of the Earth's atmosphere, learners are given an opportunity to appreciate the unique structure the Earth's atmosphere and the urgency to work towards taking care of the atmosphere and to try and slow down global warming and climate change.

Knowledge about the Earth and its atmosphere may promote a deeper interest and a wider choice of possible careers such as forecaster, environmentalists, astronomy, tele-communications.

E. PERSONAL REFLECTION

Reflect on your teaching at the end of each topic:

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

6 A

Term 4, Week 6, Lesson A
Lesson Title: How the sun emits light and heat energy
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The Atmosphere
CAPS Page Number	80

Lesson Objectives

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

- recall that the layers of the atmosphere: troposphere, stratosphere, mesosphere, thermosphere and the main characteristics of these layers.
- explain that the atmosphere as a mixture of gases held around the earth by gravity.
- List the types of gases in the troposphere as the mixture of air is 78% nitrogen, 21% oxygen, carbon dioxide less that 1% and other gases including water vapor less than 1%.
- explain that the density of air particles decreases the further away from the Earth's surface.
- name the four layers of the atmosphere, each one having a different temperature gradient which changes with height above sea level.

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
Projector	Chalkboard
Board	Resources booklet
Computer with an internet connection	Rulers
Resource 22	Resource 23

C CLASSROOM MANAGEMENT

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

Name three important gases found in the atmosphere which support life?

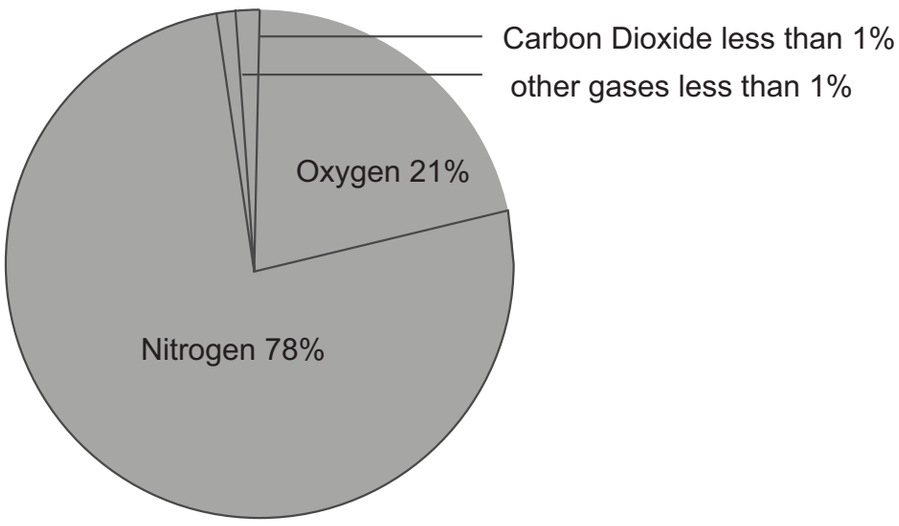
3. Learners should enter the classroom and answer the question in their workbooks.
4. Discuss the answer with the learners.
5. Write the model answer onto the chalkboard.

Three essential gases needed to support life are: oxygen, carbon dioxide and nitrogen.

D ACCESSING INFORMATION

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

The composition of air on Earth



Type of gas	%	Main Use
Nitrogen	78	All life needs nitrogen to make proteins.
Oxygen	21	Animal Life uses oxygen for cellular respiration.
Other gases including argon and water vapor	≤1	Water vapour is water in gaseous form.
Carbon Dioxide	≤1	Plant life requires carbon dioxide for photosynthesis – the manufacture of oxygen and food.

2. Explain this to the learners as follows:
    a. The atmosphere is made up of a mixture of gases. The mixture of gases is made up of nitrogen, oxygen, which are the two main gases and the rest is made up of carbon dioxide, water vapor and other gases like helium.
    b. Oxygen makes up 21% of the air in the atmosphere near the surface of the earth. All living organisms need oxygen for respiration (refer to this knowledge from term 1) but animals need to get oxygen into their systems by breathing.
    c. The gases are held around the Earth by gravity. Gravity is a force which pulls two bodies together. So in this instance, gravity pulls the air towards the center of the Earth.
    d. The density of the air decreases as one increases the altitude above sea level. Air is denser at the sea and less dense on top of mountains. The air gets less dense as you travel further through the atmosphere.
3. Tell the learners to copy the above table into their workbooks.
4. Give learners some time to copy this information into their workbooks.

Checkpoint 1:

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

a. Name the layers of the atmosphere.
b. What elements and compounds is air a mixture of?

Answers to the checkpoint questions are as follows:

a. Troposphere, stratosphere, mesosphere and Thermosphere are the four layers of the atmosphere.
b. Nitrogen, oxygen, carbon dioxide, water vapour and argon.

E CONCEPTUAL DEVELOPMENT

1. Draw and label a scale drawing of the layers of the atmosphere.
2. Copy the following instructions on the board. Give the learners step by step instructions to draw and label the layers of the atmosphere.

A SCALE DRAWING OF THE LAYERS OF THE ATMOSPHERE.

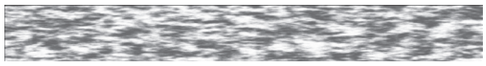
a. The scale for this drawing is 1cm = 20 km
b. Complete the scale measurements:

	Troposphere	**Stratosphere**	**Mesosphere**	**Thermosphere**
Thickness of the layer of the layer	20 km	50km	80km	350km
Length according to the cm scale	1 cm	2,5 cm	4 cm	17,5 cm
Temperature range	-50ºC to 20ºC	-50ºC to 30ºC	30ºC to -90ºC	-90ºC to 50ºC
What you find in this layer	satellites	Meteorites	Ozone	Earth's surface Mountains aeroplanes

3. Tell the learners that they are going to draw a table showing the layers of the earth. Draw the table below onto the chalkboard and use the instructions below to help the learners draw the table into their workbooks.

length	**What can you find in this layer?**	**Layer and details**
17,5 cm		
4 cm		
2,5 cm		
1 cm		
The Surface of the earth		

4. Give the learners the following instructions:
   a. Rule a line of 25 cm along the margin of the page.
   b. Along the bottom line rule a horizontal line and label it the surface of Earth.
   c. Rule another horizontal line 0,5 cm from the surface of the Earth.
   d. Label this as the Troposphere.
   e. 2,5 cm from the last horizontal line, rule another horizontal line. This is the Stratosphere.
   f. Rule a line 4 cm from last horizontal line.
   g. This section is called the Mesosphere.
   h. Lastly the Thermosphere should be 17,5 cm wide.
5. Explain the following to the learners to help them add details to their table drawings of the atmosphere.
   a. The atmosphere has four layers
   b. Each layer of the atmosphere has a different temperature gradient. This means that in the atmosphere the temperature changes from 0Km above sea level to 120km above sea level. Within each layer the temperature also changes. Once you have entered the thermosphere from space the temperatures can reach 2000ºC. On Earth the average temperature is 15ºC.
   c. The average temperature of the Troposphere is 15ºC but it can get as cold as -89.2ºC in Antarctica and as hot as 54ºC. As you go higher into the troposphere, the temperature will drop and so will the density of the air. Climbers who climb Everest (the highest mountain on Earth) need to carry oxygen with them because at an altitude of 8484m above sea level, there is not enough oxygen left in the air to breath.
   d. The Stratosphere ranges in temperature from -15ºC at the top and -51ºC near the boundary of the troposphere. In the stratosphere the density of the air is nearly zero.
   e. At the top the temperature range in the Thermosphere can reach temperatures of 2000ºC but because there is no air it would feel very cold if you went outside your spacecraft.
6. Tell the learners that they should draw an illustration for what might be found in each layer.
7. Complete the table to show the learners the model answer:

length	What can you find in this layer?	Layer and details
17,5cm		**THERMOSPHERE** From 85km – 600km. Temperature range -120ºC to 2000ºC. Where satellite travel
4 cm		**MESOSPHERE** From 50km – 85km. Temperature range -15ºC to -120ºC Meteorite shower
2,5 cm	 Ozone Layer	**STRATOSPHERE** From 20km – 50km . Temperature range from -51ºC at the boundary with the Troposphere to -15ºC at the boundary with the Mesosphere. Density of air is almost zero.
1,5 cm	 	**TROPOSPHERE** From the Earth's surface to 20km. Temperature range from an average of 15ºC to -57ºC. Air is at its most dense
The Surface of the earth		

8. If possible, please allow the learners to watch: https://www.youtube.com/watch?v=CibvtVMTA2E (4mins) [Layers of the Atmosphere]
9. Give learners some time to copy this information into their workbooks.

Checkpoint 2

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

a. Explain how density of air changes as you travel from the troposphere to the thermosphere.
b. Why does density change?

Answers to the checkpoint questions are as follows:

a. Density decreases. Air is most dense in the troposphere and there is no air left once you leave the troposphere.
b. Gravity pushes air towards the center of the Earth. As you travel further away from the center of the Earth, gravity decreases. The density of the air decreases with gravity.

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
Viva Africa	The Atmosphere	187- 190
Spot On	The Atmosphere	166-167
Top Class	The Atmosphere	223-226
Solutions for all	Atmosphere	298 – 309
Oxford	The Atmosphere	192-200
Platinum	The Atmosphere	233-245
Shuters	The Atmosphere	223-241
Sasol Inzalo	The Atmosphere	282-315
Solutions for all	The Atmosphere	298
Step-by-Step	The Atmosphere	200 - 205

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.srh.noaa.gov/jetstream/atmos/layers.html [Jet Streams]
2. https://www.youtube.com/watch?v=CibvtVMTA2E (4mins) [Layers of the Atmosphere]
3. https://en.wikibooks.org/wiki/High_School_Earth_Science/Atmospheric_Layers [Layers of the atmosphere]

6 B

Term 4, Week 6, Lesson B
Lesson Title: The Atmosphere
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The Troposphere
CAPS Page Number	81

Lesson Objectives

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

- recall that this layer extends from sea level to about 20 km above the Earth's surface.
- explain that the troposphere contains more than 70% of the mass of the atmosphere and this enables this layer of air to support all life.
- record characteristics of the troposphere, such as the types of gases and their high density.
- Explain why all weather occurs in this layer.

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
Projector	Chalkboard
Board	Resources booklet
Computer with an internet connection	Resource 23 and Resource 24

C CLASSROOM MANAGEMENT

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

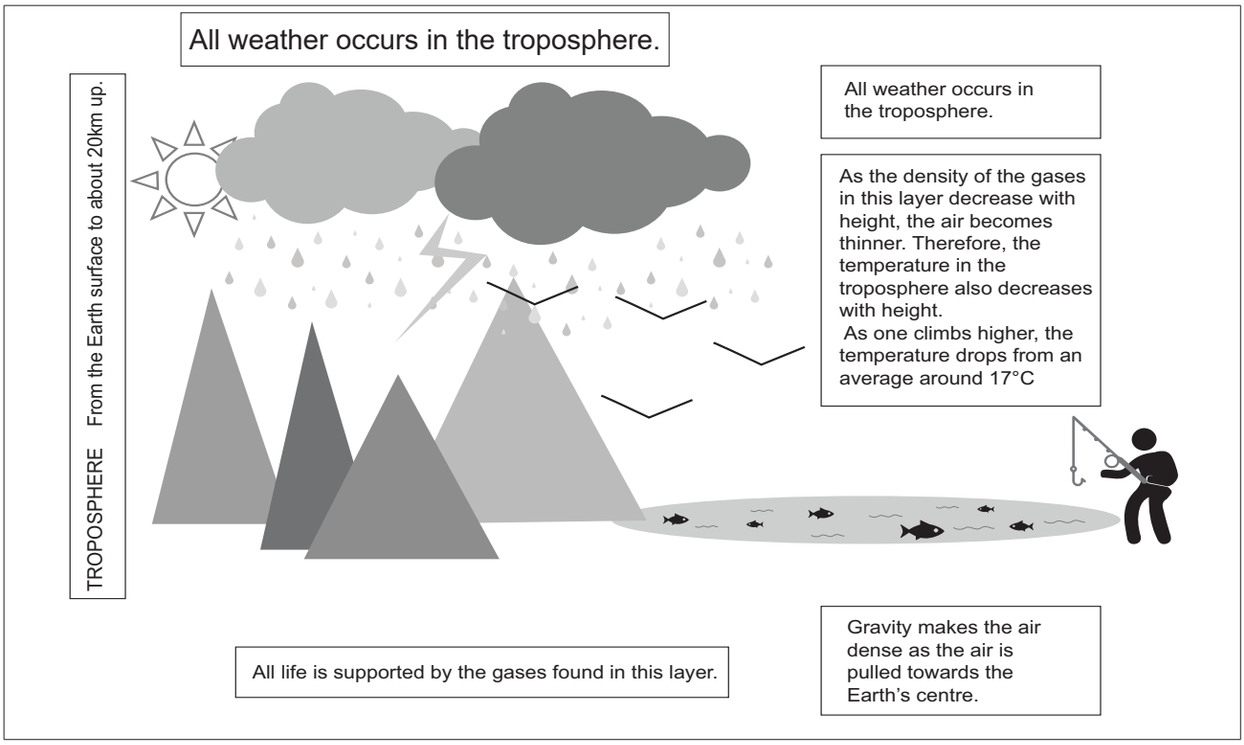
> Which gases, found in the air, are necessary to support all life on Earth?

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.

> *Life needs oxygen, carbon dioxide, nitrogen and a small amount of other gases such as argon and water vapour.*

D ACCESSING INFORMATION

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



2. Explain this to the learners as follows:
    a. The troposphere extends from sea level to about 20 km up into the sky. Its height does vary – it's about 9km high over the equator and about 17 km high over the poles.
    b. The troposphere is mostly heated by energy transfer from the surface so the Earth's surface is the warmest part of the troposphere and the temperature drops and the altitude increases.
    c. The troposphere contains about 70% of the mass of the atmosphere. The mass of the atmosphere is 5 quadrillion tons (5 000 000 000 000 000). The mass is made up of air – the main gases are nitrogen, oxygen, argon, water vapor and carbon dioxide. 50% of the mass sits in the first 6km from the Earth's surface.
    d. Most life lives within the troposphere and all weather happens in this layer. All wind generated clouds form in the troposphere, but very tall cumulonimbus clouds (thunder clouds) can stretch into the stratosphere. Most planes fly within the troposphere.
    e. Air is at its most dense in this layer because gravity is at its strongest.
3. Ask learners to copy this information into their workbooks.
4. Give learners some time to copy this information into their exercise books.

Checkpoint 1

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

a. What is the troposphere?
b. What 3 things would you find in the troposphere?

Answers to the checkpoint questions are as follows:

a. The troposphere is the first layer of the atmosphere found from 0 – 20km from the Earth's surface.
b. Most of life, weather and 70% of the atmosphere's mass is found in the troposphere.

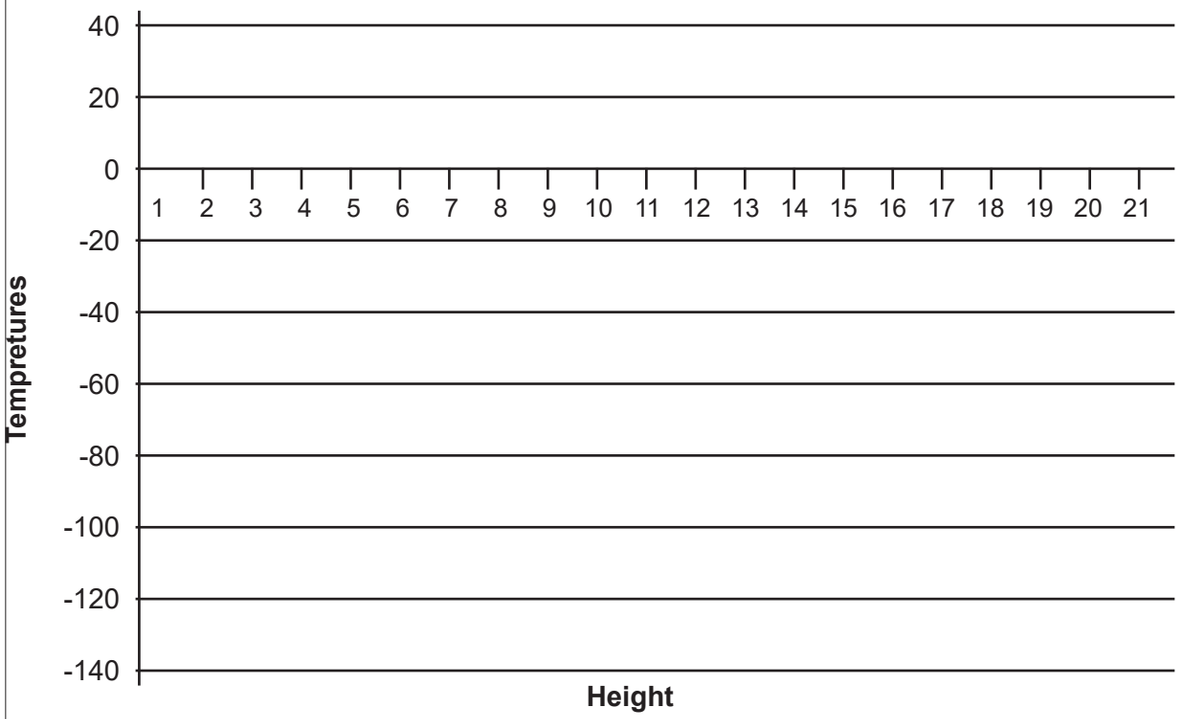
E CONCEPTUAL DEVELOPMENT

1. Write the following onto the chalkboard (always try to do this before the lesson starts). Tell learners to copy this in to their workbooks.

DRAW A GRAPH TO SHOW THE RELATIONSHIP BETWEEN HEIGHT AND TEMPERATURE IN THE TROPOSPHERE

The temperature decreases as altitude increases at a rate of about 6.5ºC per kilometre. Draw a line graph to show the temperature decrease from sea level (altitude 0Km) to an altitude of 20km. Assume that the temperature at the surface of the Earth is 15ºC.

Altitude - Height above Sea Level and Temperature of the Troposphere



a. *What does your graph tell you about the temperature in the troposphere?*
b. *Look at your graph and predict the following: What will the temperature be at 16km above sea level?*
c. *What is the altitude when the temperature is -10ºC?*
d. *Explain why the temperature decreases as altitude increases.*

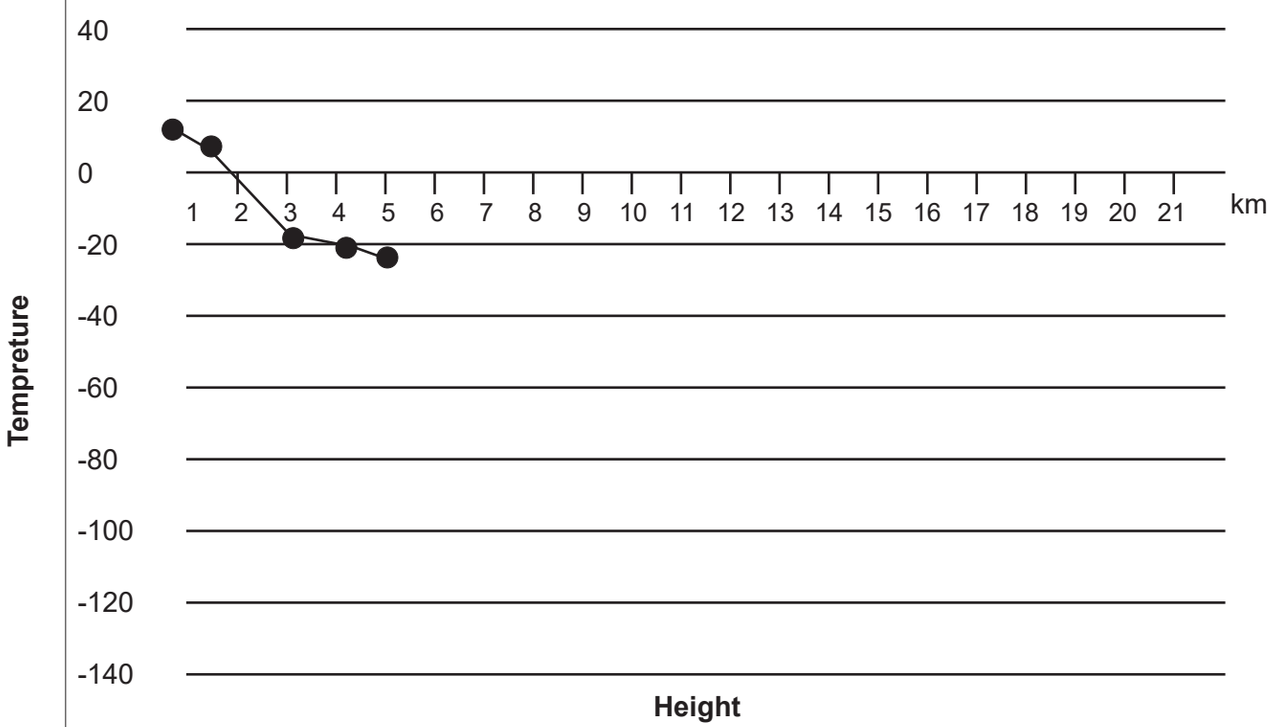
2. Give the learners the following instructions to help them complete the template for the graph:
   a. Rule a vertical line of 10 lines down the margin. This is the y axis and represents the temperature reading.
   b. Fill in the following points on the temperature line: 40ºC ; 20ºC; 0ºC; -20ºC; -40ºC and so on until you get point -140ºC.
   c. Rule a horizontal line along the 0ºC line.
   d. Every 0,5cm make a mark. 0 km; 1; 2; 3; until you have 20km.

3. Draw the following onto the chalkboard:

Calculate the relationship between temperature and height of the troposphere.											
. 0km	1km	2km	3km	4km	5km						20km
15°C	8.5°C	2°C	-4.5°C	-11°C	-17.5°C						

4. Tell the learners to complete the table above and use it to plot the graph.
5. Tell the learners to answer the questions onto the chalkboard into their workbooks.
6. Give learners some time to complete this task in their workbooks.
7. Fill in the model answers onto the chalkboard:

Altitude - Height above Sea Level and Temperature of the Troposphere



a. *The temperature drops as goes higher in the troposphere.*
b. *The temperature at 16km above sea level will be about -90º.*
c. *The altitude will be 3km when the temperature is -10ºC.*
d. *The temperature decreases as altitude increases in the troposphere, because the air in the troposphere is heated by the Earth's surface. The air, in the troposphere, furthest from the surface is the coldest.*

Checkpoint 2

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

a. What is the average thickness of the troposphere at the poles and the equator?
b. Why is air at its most dense closer to the ground?

Answers to the checkpoint questions are as follows:

a. The thickness of the troposphere at the poles is 17km and at the equator it is 9km.
b. Gravity is stronger the closer you get to the center of the Earth so it is pulling the very strongly so it will be the most dense.

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
Viva Africa	The Atmosphere	190
Spot On	The	168
Top Class	The Troposphere	226
Solutions for all	Atmosphere	302 – 309
Oxford	The Atmosphere	192-200
Platinum	The Atmosphere	235-243
Shuters	The Atmosphere	223-241
Sasol Inzalo	The Atmosphere	282-315
Solutions for all	The Atmosphere	299 - 320
Step-by-Step	The Atmosphere	200 - 205

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://scied.ucar.edu/shortcontent/troposphere-overview [The troposphere]
2. https://en.wikibooks.org/wiki/High_School_Earth_Science/Atmospheric_Layers [Atmospheric layers]

6 C

Term 4, Week 6, Lesson C
Lesson Title: The Stratosphere
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The Stratosphere
CAPS Page Number	81

Lesson Objectives

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

- identify the stratosphere which extends above the troposphere to 50km high in the atmosphere
- recall the characteristics of the stratosphere such as, it being very thin compared to the troposphere.
- explain that a layer of ozone found in the stratosphere plays an important role in absorbing harmful ultraviolet radiation from the sun.
- discuss that the absorption of sun radiation increases the temperature of the stratosphere causing the temperature of the air to be warmer the further away from the earth one travels.

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
Projector	Chalkboard
Computer with an internet connection	Resources booklet
Various reference books and posters	Resource 23 - 25 Resource 28 and 29

C CLASSROOM MANAGEMENT

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

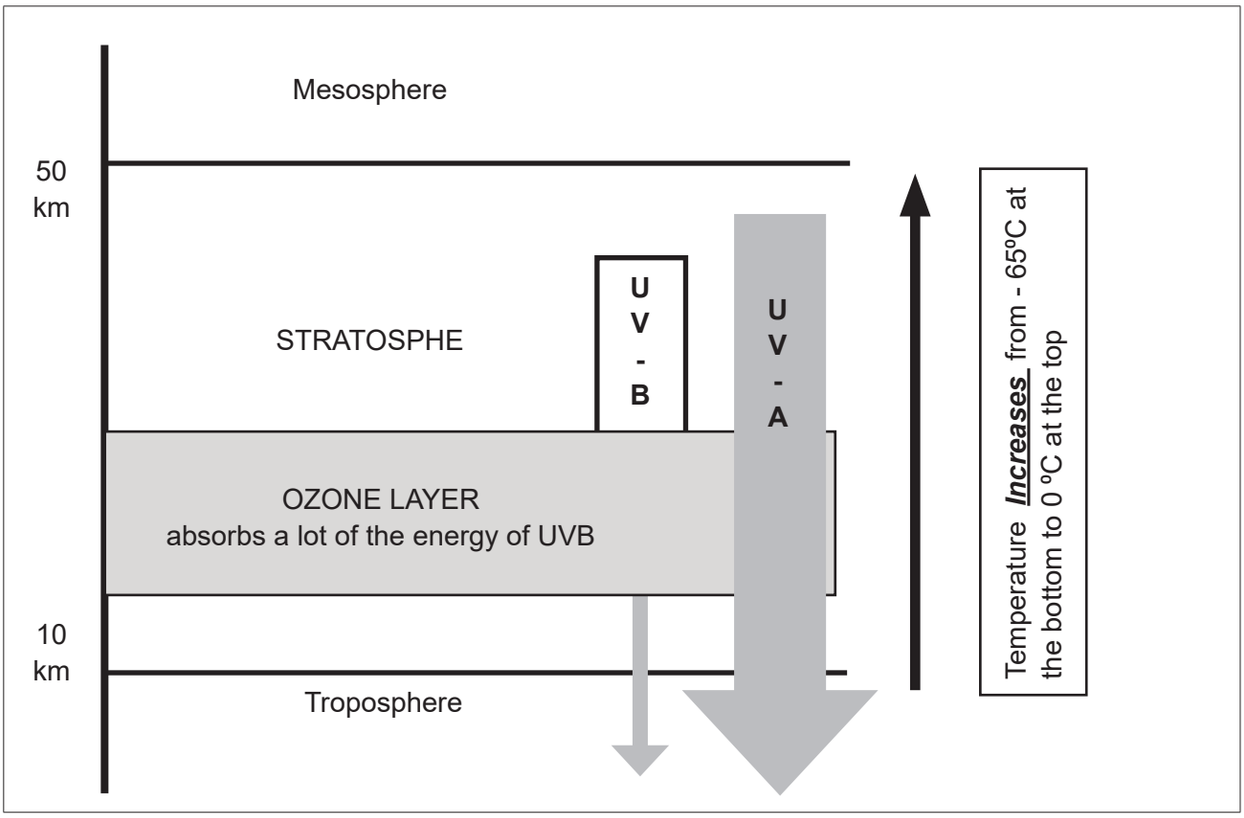
Explain why the temperature of the troposphere decreases as you get higher up.

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 temperature of the troposphere decreases as the altitude increases because the air in the troposphere is warmed by energy transfer from the surface of the Earth.

D ACCESSING INFORMATION

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



2. Explain this to the learners as follows:
    a. The stratosphere extends from about 10km from the surface of the earth to 50km into the atmosphere. (Get the learners to refer to their scale drawing of the atmosphere)
    b. The air is less dense in the stratosphere compared to the air in the troposphere.
    c. Some aeroplanes fly in the stratosphere to avoid turbulence.
    d. Turbulence is pockets of air which are at a different pressure to the air around it. It can cause aeroplanes to lose altitude.
    e. Please show the learners Resource 22 and 23.
    f. In the stratosphere there is the ozone layer. Ozone (O_3) is formed when free oxygen atoms react with an oxygen molecule to form ozone. Show the learners Resources 25 and 26.
    g. Ozone is natural split into atoms and molecule by UV radiation. Show the learners Resources 27 and 28.
    h. Please show the learners the Resource 23 and 24.
    i. The ozone layer protects the earth from harmful radiation from the sun. It allows ultra-violet UVA through but blocks most of UVB.
    j. Uva is necessary for humans to make vitamin D in skin, but if you are over exposed it can cause sun burn and skin cancer.
    k. Uvb radiation is dangerous to all living things. Your clothes do block uvb.
    l. Uvb can cause damage to an organisms dna.
    m. Uvb causes a reduction in photosynthesis and can cause plants to flower at different times of the year. This can then have consequences food webs.
    n. Holes in the ozone layer allow all uvb radiation from the sun to reach the earth's surface.
    o. Ozone is broken down by chemicals called cfc's. These chemicals used to be found in all aerosols (spray deodorants for example) and in fridges.
    p. The stratosphere's temperature gradient is also caused by the ozone layer. The temperature increases as the altitude increases because it absorbs uv radiation from the sun.
    q. The temperature in the stratosphere is more stable so there is nearly no weather in the stratosphere.
3. Ask learners to copy the following points into their workbooks:

The Stratosphere

1. This part of the atmosphere extends from about 10 km to about 50 km above the Earth's surface.
2. The air in the stratosphere is very thin compared to the air in troposphere.
3. Aeroplanes can fly as high as the stratosphere.
4. The stratosphere includes a band of ozone gas (03) which absorbs ultraviolet radiation from the sun.
5. The temperature range of the stratosphere is
6. Absorption of ultraviolet radiation increases the temperature of the stratosphere - as a result, the further away from the Earth, the warmer the air becomes.
7. Too much ultraviolet radiation can interfere with human health, photosynthesis, life cycles of various species of life and the size of populations of species.

4. Give learners some time to copy this information into their workbooks.

Checkpoint 1

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

a. What important layer is found in the stratosphere?
b. Why is this layer so important?

Answers to the checkpoint questions are as follows:

a. The ozone layer is found in the stratosphere.
b. The ozone layer absorbs harmful ultra-violet radiation before it reaches the Earth's surface.

E CONCEPTUAL DEVELOPMENT

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

MORE ABOUT THE STRATOSPHERE

a. What causes the temperature gradient to change in the stratosphere? Explain how this happens.
b. Look at the diagram of the stratosphere. Explain what happens when UVA and UVB radiation moves through the ozone layer.
c. What would happen to life on Earth if the ozone layer was damaged?
d. Explain why there is little or no weather in the stratosphere.

2. Tell the learners to use what they have learned in this lesson to answer the questions that follow.
3. Give learners some time to complete this task in their workbooks.

Write the answers on the board:

a. *The temperature gradient changes in the stratosphere when the ultra-violet radiation is absorbed by the ozone. The temperature increases the further away one gets from the Earth.*
b. *As the UVA and UVB radiation moves through the ozone layer the ozone absorbs most of the harmful UVB radiation which prevents it from damaging life on Earth.*
c. *If the ozone layer was damaged more UVB would reach the Earth. This would mean more people would get skin cancer, photosynthesis would be affected so plants would not make food. Life cycles would be affected resulting in population numbers dropping.*
d. *There is little or no weather in the stratosphere.*

Checkpoint 2

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

a. What damage does UVB radiation cause to plants?
b. Explain why some aeroplanes fly in the stratosphere.

Answers to the checkpoint questions are as follows:

a. UVB disrupts photosynthesis and causes some plants to flower at different times.
b. Planes fly in the stratosphere as there is no weather in the stratosphere and there is no turbulence. This helps to save fuel.

4. 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
Viva Africa	The Stratosphere	190
Spot On	The Stratosphere	169
Top Class	The Stratosphere	227-228
Solutions for all	The Stratosphere	303
Oxford	The Atmosphere	192-200
Platinum	The Atmosphere	242-243
Shuters	The Atmosphere	223-241
Sasol Inzalo	The Atmosphere	282-315
Solutions for all	The Atmosphere	299 - 320
Step-by-Step	The Atmosphere	200 - 205

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://earthobservatory.nasa.gov/Features/UVB/ [Ultraviolet Radiation]
2. https://en.wikibooks.org/wiki/High_School_Earth_Science/Atmospheric_Layers [Atmospheric Layers]

7 A

Term 4, Week 7, Lesson A
Lesson Title: The Mesosphere
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The Mesosphere
CAPS Page Number	82

Lesson Objectives

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

- identify the mesosphere as the level that extends from about 50 km to 80 kms above the surface of the Earth
- recall the characteristics of the mesosphere, as this layer of air is very thin and very cold
- explain that there is still enough oxygen to burn up small rocks and dust entering the mesosphere from space
- explain that burning rocks are meteorites entering the mesosphere and are visible from Earth and are called 'shooting stars'

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
Projector	Chalkboard
Board	Resources booklet
Computer with an internet connection	Resource 32, 34 and 35

C CLASSROOM MANAGEMENT

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

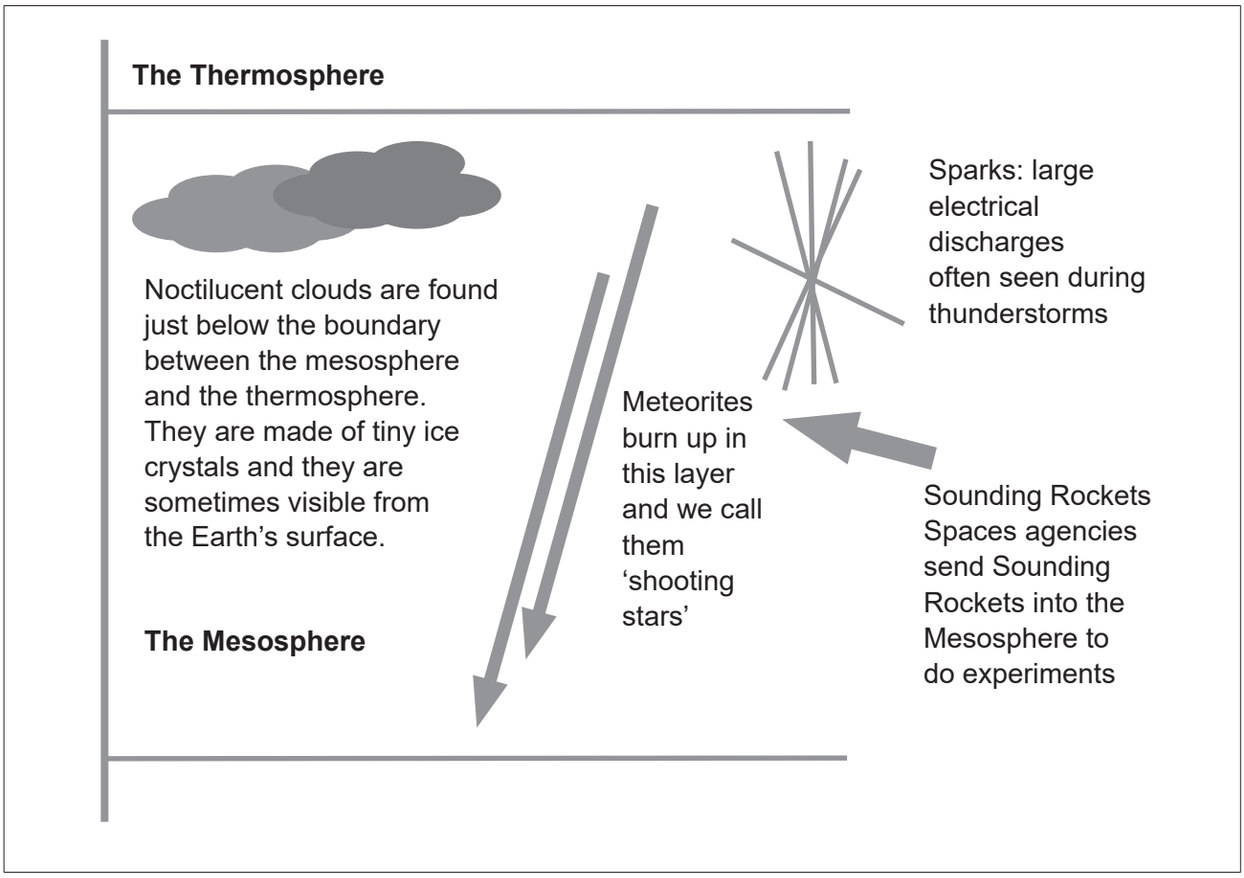
How does the stratosphere protect the Earth from harmful UV radiation?

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 stratosphere has a layer of Ozone gas which absorbs harmful rays of UV radiation.

D ACCESSING INFORMATION

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



2. Explain the information to the learners as follows:
    a. The mesosphere extends from 50km to 80 km above the Earth's surface.
    b. The air in the mesosphere is very thin and it's very cold
    c. This layer of the atmosphere still has enough oxygen to burn up space dust and small rocks from space.
    d. Temperatures drop from -15°C to -90°C at the top of the mesosphere.
    e. The mesosphere helps to protect the surface of the Earth from debris which enters out atmosphere in space.
    f. When you look in the night sky and see a bright long streak in the sky, those are bits of rock, meteorites which burn up as they enter the mesosphere. We call them shooting stars.
    g. Some meteorites are too big to burn up completely in the mesosphere, and crash into the surface of the Earth.
    h. These crashes cause craters to form on the surface. South Africa has 2 of these craters; one in Pretoria called Tswaing Crater and is 1.1km wide. The other is Vredefort and is 300km wide. It is widely accepted that a meteorite which crashed into Mexico was the reason dinosaurs became extinct.
    i. The mesosphere is the layer in the atmosphere the scientists know the least about. Show learners Resources 29 - 31.
    j. Aeroplanes and weather balloons can't fly in this layer.
    k. NASA and other space agencies send special rockets, called sounding rockets, into the mesosphere to do chemical experiments. Show learners Resource 33.
    l. Lightening can occur in the mesosphere, called sprites or elves. These are huge electrical discharges, and only happen above a thunder storm in the troposphere.
    m. A special type of cloud called noctilucent (high atmospheric cloud formations visible during summer nights in high altitudes) clouds form in the mesosphere. You can see them from the surface of the Earth but they are quite rare because they need special conditions to form. They are made from tiny ice crystals and dust from space. They can only be seen in the early morning in summer when the sun is still below the horizon.
3. Give learners some time to copy the diagram into their workbooks.

Checkpoint 1

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

a. Describe the main characteristics of the mesosphere.
b. What are shooting stars?

Answers to the checkpoint questions are as follows:

a. The mesosphere stretches from 50 – 80km above the Earth's surface, it is very cold in temperature and the temperature gradient is from -15°C to -90°C. The air is also very thin.
b. Shooting stars are small rocks/meteorites which burn up as they enter the mesosphere.

E CONCEPTUAL DEVELOPMENT

1. Write the following onto the chalkboard (always try to do this before the lesson starts)
2. Tell learners to copy down the sentences and fill in the missing words.

THE MESOSPHERE

c. The mesosphere is a thin and cold layer from 50 km to _____ above the Earth's surface.

d. _____ drop from -15°C to -90°C at the top of the mesosphere.

e. The mesosphere helps to protect the surface of the Earth from _____ which enters out atmosphere in space.

f. When you look in the night sky and see a bright long streak in the sky, those are bits of rock, _____ which burn up as they enter the mesosphere. We call them _____ stars.

g. Some meteorites are too big to _____ completely in the mesosphere, and crash into the surface of the Earth.

h. These crashes cause _____ to form on the surface. South Africa has two of these craters; the Tswaing Crater and the other is Vredefort.

i. A special type of cloud called _____ clouds form in the mesosphere. You can see them from the surface of the Earth but they are quite rare because they need special conditions to form. They are made from tiny ice _____ and dust from space. They can only be seen in the early morning in summer when the sun is still below the horizon.

3. Give the learners some time to complete the activity and then fill in the answers for them to mark their own work:

THE MESOSPHERE

a. The mesosphere is a thin and cold layer from 50 km to 80 km above the Earth's surface.

b. Temperatures drop from -15°C to -90°C at the top of the mesosphere.

c. The mesosphere helps to protect the surface of the Earth from debris which enters out atmosphere in space.

d. When you look in the night sky and see a bright long streak in the sky, those are bits of rock, meteorites which burn up as they enter the mesosphere. We call them shooting stars.

e. Some meteorites are too big to burn up completely in the mesosphere, and crash into the surface of the Earth.

f. These crashes cause craters to form on the surface. South Africa has two of these craters; the Tswaing Crater and the other is Vredefort.

g. A special type of cloud called noctilucent clouds form in the Mesosphere. You can see them from the surface of the Earth but they are quite rare because they need special conditions to form. They are made from tiny ice crystals and dust from space. They can only be seen in the early morning in summer when the sun is still below the horizon.

Checkpoint 2

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

a. Why is it so cold in the mesosphere?
b. Explain why the mesosphere is the layer scientists know the least about.

Answers to the checkpoint questions are as follows:

a. The mesosphere is so cold because the air is very thin.
b. Aeroplanes and weather balloons can't fly this high, therefore they have not been able to study it and satellites orbit too high and they cannot see in to this layer.

4. 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
Viva Africa	The Mesosphere	191
Spot On	The Mesosphere	169
Top Class	The Mesosphere	228-229
Solutions for all	The Mesosphere	304
Oxford	The Atmosphere	192-200
Platinum	Mesosphere	244
Shuters	The Atmosphere	223-241
Sasol Inzalo	The Atmosphere	282-315
Solutions for all	The Atmosphere	299 - 320
Step-by-Step	The Atmosphere	200 - 205

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.space.com/37340-nasa-launch-makes-colorful-artificial-clouds.html [Clouds]
2. https://www.windows2universe.org/earth/Atmosphere/mesosphere.html [The Mesophere]
3. http://study.com/academy/lesson/mesosphere-definition-facts-temperature-characteristics.html [The Mesophere]

7 B

Term 4, Week 7, Lesson B
Lesson Title: The Atmosphere
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The Thermosphere
CAPS Page Number	82

Lesson Objectives

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

- identify the thermosphere, which starts 80km above the surface of the Earth and fades into space 370km above the Earth's surface.
- recalls that satellites and the International Space station orbit the Earth in the thermosphere.
- explain that the lowest part of the thermosphere absorbs ultraviolet light and dangerous x-rays from the sun.
- list the activities occurring in the thermosphere, such as the reflection of TV and radio signals back to the Earth.

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
Projector	Chalkboard
Board	Resources booklet
Computer with an internet connection	Resource 23 and Resource 30 - 36

C CLASSROOM MANAGEMENT

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

Describe the main characteristics of the mesosphere

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 mesosphere is the outer layer of the Earth's atmosphere lying about 50 – 80Km above the surface of the Earth. It is air is very thin, very cold. The thermosphere slowly diminishes at about 350 km and space begins after that.

D ACCESSING INFORMATION

1. Explain this to the learners as follows:
   a. The thermosphere is the outermost layer of the Earth's atmosphere before space begins. Show the learners Resource 32.
   b. This part of the atmosphere begins 80km above the Earth's surface and reaches to 370km. It is the largest layer of the atmosphere.
   c. 99% of the Earth's atmosphere, namely the air, is below the thermosphere.
   d. The thermosphere is made up of helium, nitrogen and oxygen. Temperatures can reach over 2000°C but it is very hard for scientists to take the temperature because the air is so thin.
   e. The thermosphere blocks harmful X-rays and ultraviolet rays from the sun. When the sun is more active the temperature in the thermosphere increases. The temperature changes at night and during the day.
   f. The Aurora Borealis occurs in the thermosphere. This is when charged particles from space collide with molecules of air and the energy created emits light. This happens close to both the South and North Poles.
   g. Please show the learners the photos in the Resources 36.

2. If possible please show the learners the you tube video https://www.youtube.com/watch?v=izYiDDt6d8s (4 mins) [Northern lights]
3. Write the following onto the chalkboard (always try to do this before the lesson starts):

SATELLITES

1. Satellites and the International Space Station orbit the Earth in the thermosphere.
2. The International Space Station is where astronauts live and work all year round.
3. Satellites allow us to transmit and receive radio and telephone signals immediately and they work because of the spherical shape of the Earth.
4. Communications satellites allow radio, television, and telephone transmissions to be sent live anywhere in the world.
5. Satellites are in orbit, and therefore the signals can be sent instantly into space and then redirected to another satellite or directly to their destination
6. Satellites are launched into orbit for various reasons like defense, weather monitoring and to broadcast radio waves and cell phone signals.
7. Satellites don't fall back to the Earth's surface, despite being pulled by the Earth's gravitational pull, because they are constantly moving. If they stop moving they will crash back to Earth.

4. Explain the information above to the learners. Show learners Resources 34 and 35.
5. Give learners some time to copy this information into their workbooks.

Checkpoint 1

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

a. Describe the density of the air in the thermosphere and explain why it is so hot.
b. What gases make up the thermosphere?

Answers to the checkpoint questions are as follows:

a. The air is very thin therefore there is a low density, but it is also so hot because it is close to the sun.
b. Helium, nitrogen and oxygen are the gases in the thermosphere.

E CONCEPTUAL DEVELOPMENT

1. Copy the following onto the chalkboard (always try to do this before the lesson starts):
2. Tell learners to:
   a. Copy down the table and fill it in using the information that they have learnt.
   b. Answer the questions that follow.

The Atmosphere	
Atmospheric Layer	**Important Characteristics of the Layer**
Troposphere	
Stratosphere	
Mesosphere	
Thermospehere	

1. List three things the atmosphere does for us.
2. What important layer exists within the stratosphere? Why is it important?
3. What do you think will happen to Earth if the hole in the ozone increases?

3. Give learners some time to complete this task in their exercise books. Assist leaners where necessary.
4. Fill in the answers on the board for learners to mark their work:

Atmospheric Layer	**Important Characteristics of the Layer**
Troposphere	*Lowest region of the atmosphere, extends for about 6-10km, there is a decrease in temperature with height, it contains our weather conditions, 75% of the atmosphere's mass is found here, 99% of the total mass of water vapour and aerosols*
Stratosphere	*The inversion layer and ozone layer is found here, temperature increases with height, it extends for 10-13km, the gas ozone found here absorbs harmful UV rays*
Mesosphere	*Temperature decreases with height, it extends for 55-85km above the earth's surface, meteors burn up in this layer*
Thermospehere	*The biggest layer of the atmosphere that extends from 90- 1000km, the orbit of the International Space Staion is in this layer, temperature increases in this layer, the Northern and Southern lights occurs in this layer*

5. Refer learners to Resources 23 and 24 to explain what we find in each layer of the atmosphere.

The Atmosphere

1. List three things the atmosphere does for us.
   Protects us against harmful rays, extreme temperatures and meteorites
2. What important layer exists within the stratosphere? Why is it important?
   The ozone layer. It contains ozone gas that absorbs harmful UV rays.
3. What do you think will happen to Earth if the hole in the ozone increases?
   More harmful gases will be allowed through and will reach the earth's surface, causing damage to people and plants.

Checkpoint 2

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

a. What happens when the gases in the air collide with space dust?
b. How do satellite companies like DSTV, broadcast television to you?

Answers to the checkpoint questions are as follows:

a. The collision between gases and space dust causes energy to be transferred and light to be emitted which causes the Aurora Borealis.
b. Satellite companies get TV signals are transmitted via a satellite to a receiving dish on the side of people's houses.

6. 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
Viva Africa	The Thermosphere	191-192
Spot On	The Thermosphere	170
Top Class	The Thermosphere	228-229
Solutions for all	The Thermosphere	305
Oxford	The Atmosphere	192-200
Platinum	The Atmosphere	233-245
Shuters	The Atmosphere	223-241
Sasol Inzalo	The Atmosphere	282-315
Solutions for all	The Atmosphere	299 - 320
Step-by-Step	The Atmosphere	200 - 205

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=izYiDDt6d8s (4 mins) [Northern lights]
2. http://www.softschools.com/facts/weather/thermosphere_facts/2201/ [The thermosphere]

7 C

Term 4, Week 7, Lesson C
Lesson Title: The Atmosphere
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The Greenhouse Effect
CAPS Page Number	82

Lesson Objectives

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

- Identify that the greenhouse effect is a natural phenomenon. It warms the atmosphere sufficiently to sustain life on Earth.
- Illustrate that greenhouse gases trap ultraviolet radiation which then warms the air closet to the surface of the Earth.
- Identify that the main greenhouses gases are carbon dioxide, methane and water vapor
- Describe that an increase in greenhouse gases causes an increase of the average temperature of the atmosphere and this leads to global warming
- Identify the issue where global warming is a potentially life threatening problem on Earth, and it can lead to: sea level rises, changes to the climate, food shortages and mass extinctions

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
2 thermometers	Ice cubes
A clear plastic bag	Dish
Stopwatch	Clear plastic bag

C CLASSROOM MANAGEMENT

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

> List the four layers of the atmosphere, and underline the name of the two layers which block ultraviolet radiation from the sun.

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.

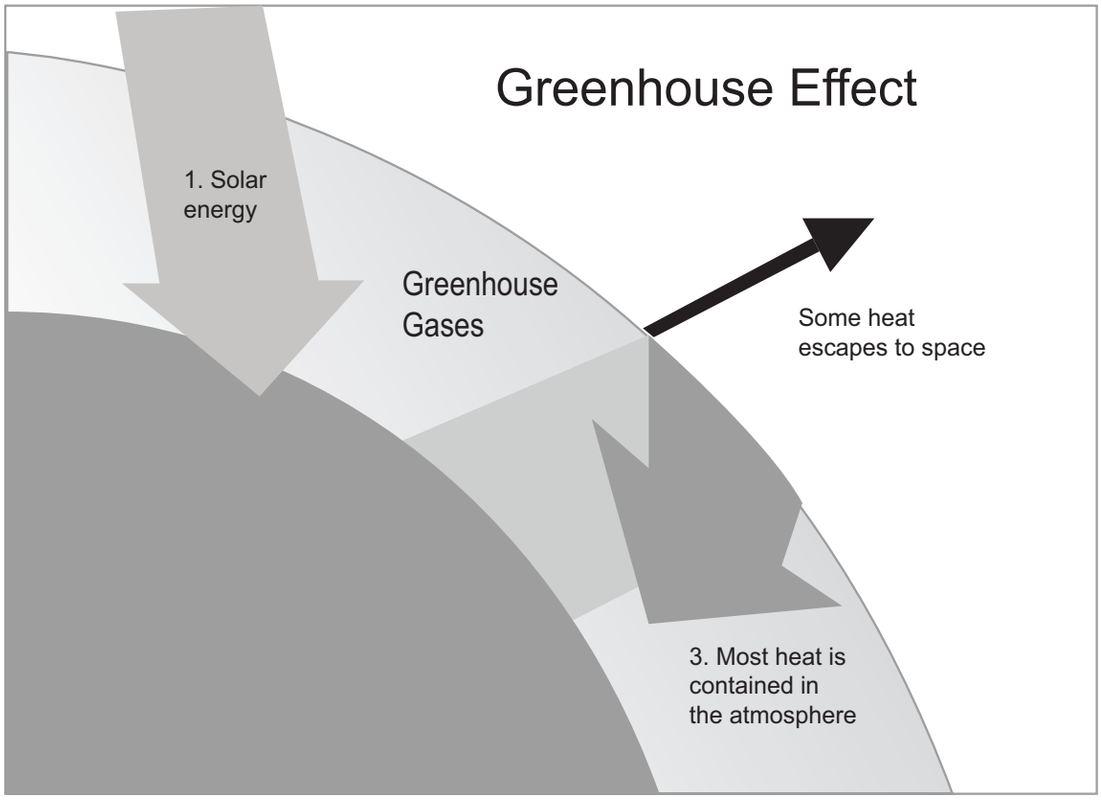
> *Troposphere, stratosphere, mesosphere, thermosphere*

D ACCESSING INFORMATION

1. Explain this to the learners as follows:
    - The greenhouse effect is a natural process which happens on the Earth. It is the warming of the Earth's surface by radiation from the sun.
    - It is called the greenhouse effect because gases in the atmosphere trap some of this ultraviolet radiation and help to keep the Earth warm
    - The main greenhouse gases are carbon dioxide, methane and water vapour.
    - Carbon dioxide is a waste product of combustion and respiration and plants use carbon dioxide for photosynthesis. (they learnt about this in grade 8) and before humans began burning fossil fuels, the concentration of carbon dioxide in the atmosphere was fairly stable
    - Carbon dioxide is responsible for two-thirds of the additional warming caused by all the greenhouse gases emitted as a result of human activity.
    - Methane is a gas found naturally in the atmosphere. It is made when dead plants and animals decompose in airless conditions – like marshes and rice fields. Human activity has increased the atmospheric volume of methane.
    - Water vapour is the responsible for 50% of the greenhouse effect. 25% because of clouds, 20% because of carbon dioxide and the last 5% is made up of the other greenhouse gases including methane.

- The amount of water vapour in the atmosphere is determined by the temperature. Once the temperature changes, the amount of water vapour decreases. Although it is a major greenhouse gas is does not accumulate over time – it doesn't last for long.

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



3. Explain to the learners that:
   a. an increase in greenhouse gases causes global warming
   b. Global warming is causing:
      - weather patterns to change – the northern hemisphere is going to become wetter and milder, the southern hemisphere is going to become drier and warmer
      - Ice at the poles to melt – this causes 2 serious problems: sea level rise which will cause flooding of coastal areas and because the ice is melting less UV radiation will be reflected back into space. Ice melting is also releasing huge amounts methane into the atmosphere as the frozen ground starts to defrost
      - Food security will decrease because of the climate change farmers won't be able to grow the volume of food needed
4. If possible please allow the learners to watch:

   https://www.youtube.com/watch?v=eRLJscAlk1M (6mins) [global warming – Sorry]
5. Give learners some time to copy the illustration into their workbooks.

Checkpoint 1

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

a. Name the three main global warming gases.

b. List four effects, an increase in greenhouse gases, will have on Earth.

Answers to the checkpoint questions are as follows:

a. Methane, carbon dioxide, water vapour

b. Rise in sea level, climate change, food shortages and mass extinctions

E CONCEPTUAL DEVELOPMENT

1. To do this activity, each group will need the following:
   - 2 thermometers
   - 1 large clear plastic bag
   - string or something similar to seal the bag
2. Ensure you have these materials prepared for each group before the lesson starts.
3. Tell the learners that they are going to be doing an investigation.
4. Divide the learners into groups so that each group will have access to the materials.
5. 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.
2. Each group will be doing an investigation on the effect of thickness of a conductor on resistance.
3. Each person in the group must participate in the investigation and complete the answers to the written activities in their workbooks.
4. Each group will need the following materials and equipment to do the investigation:
   - 2 thermometers
   - 1 large clear plastic bag
   - string or something similar to seal the bag

6. Read through the practical task with the learners.
7. Remind the learners that greenhouse effect is a warming effect caused by the trapping of energy in the atmosphere.
8. Tell the learners that today they are going to be making a model to show the greenhouse effect.
9. Have each group collect the equipment they will need for the task.
10. Tell the learners that they will have 5 minutes to set up the experiment and then they will be given the task to complete.
11. The following will need to be written onto the chalkboard. (Try to do this before the lesson starts):

Experiment set-up

1. Copy the table to record the temperature readings.

Time	**Temperature in bag (degrees Celsius)**	**Temperature next to bag (degrees Celsius)**	**Difference between the two temperatures (degrees Celsius)**

2. Find a sunny place with enough space a bag and two thermometers to rest on the same surface.
3. Place one thermometer in the bag and seal the bag.
4. Place the bag on the surface.
5. Place the second thermometer next to the bag.
6. Read and record the temperatures on both thermometers.
7. Wait for 15 minutes. Read and record the temperature on both thermometers.
8. Wait another 15 minutes. Read and record the temperatures again.
9. Calculate the information you need to complete the last column and row of the table.

12. Read through the experiment set-up with the learners.
13. Ask them if they have any questions.
14. Tell the learners they have 5 minutes to set up the experiment.
15. Supervise the learners whilst they complete the task and answer any questions they may have.
16. After 5 minutes call the learners back to attention.
17. Tell the learners that they are now going to complete the practical task.
18. The following will need to be written on the chalkboard:

PRACTICAL TASK: (20 marks)

1. Copy the table to record the temperature readings.

Time	Temperature in bag (degrees Celsius)	Temperature next to bag (degrees Celsius)	Difference between the two temperatures (degrees Celsius)
1			
2			
3			
Difference (+ or –) in temperature between reading 1 and reading 3			

(12)

2. How did the temperature change in each place? (1)
3. Were the changes the same in each place? Explain in what ways they were the same or different? (2)
4. What could explain the differences you observed? (1)
5. How did this investigation model the greenhouse effect on Earth? (2)
6. Write the conclusion for this investigation. (2)

19. Read the practical task with the learners.
20. Ask them if they have any questions.
21. Tell the learners they have 10 minutes to answer these questions in their workbooks.
22. Supervise the learners whilst they complete the task and answer any questions they may have.
23. After 10 minutes call the learners back to attention.
24. Tell the learners to return all equipment and to tidy their work areas.
25. Collect their books for assessment.

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
Viva Africa	The Greenhouse Effect	193-195
Spot On	The Greenhouse Effect	171-174
Top Class	The Greenhouse Effect	230-235
Solutions for all	The Greenhouse Effect	311-316
Oxford	The Greenhouse Effect	200-203
Platinum	The Greenhouse Effect	246-250
Shuters	The Atmosphere	223-235
Sasol Inzalo	The Greenhouse Effect	299-309
Solutions for all	The Atmosphere	299 - 320
Step-by-Step	The Atmosphere	200 - 205

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=oJAbATJCugs (3mins) [Global warming]
2. https://www.youtube.com/watch?v=Ok8rMT2KCy0 (2mins) [Climate change]

TOPIC OVERVIEW:
The birth, life and death of a star
Term 4, Weeks 8A – 8C

A. TOPIC OVERVIEW

Term 4, Weeks 8a – 8c

- This topic runs for 1 weeks.
- It is presented over 3 x 1 hour 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, 11 and 12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• The solar system: The sun; objects around the sun; Earth's position in the solar system. • Beyond the Solar System: The Milky Way galaxy; our nearest star; light years, light hours, light minutes; beyond the Milky Way galaxy. • Looking into space: Early viewing of space; telescopes.	• Birth, life and death of stars: The birth of a star; the life of a star; the death of a star	GRADE 10 • States of matter and the kinetic molecular theory. Atomic structure • Periodic table GRADE 11 • Intermolecular forces • Ideal gases

C. SCIENTIFIC VOCABULARY

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

	TERM	EXPLANATION
1.	helium	Lightest of noble gases. Component of the sun.
2.	hydrogen	Highly flammable gas. Component of the sun.
3.	star	A shiny point in the night sky. A ball of burning gas in the universe.
4.	nebulae	A cloud of gas and dust in space which may develop into a star.
5.	nuclear fusion	A process using a huge amount of pressure and heat to combine many small atoms to form larger atoms and massive amounts of energy.
6.	Kelvin	The unit of Kelvin is used in the scientific measurement of temperature. The temperature in Kelvin (K) is equal to the temperature in degrees Celsius (°C) plus 273.15. Absolute zero = 0K = -273.15°C
7.	solar mass	A standard unit of mass used in astronomy. Equal to the mass of the sun. The **solar mass** ($M_\odot$) is a standard unit of mass in astronomy, equal to approximately 1.99×10^{30}kilograms.
8.	red giant star	A very big, old and cold star.
9.	white dwarf	A dense, low –mass star, typically the size of a planet.
10.	planetary nebula	A cloud of gas that surrounds an old star.
11.	supernova	An explosion in a high-mass star that emits most of its mass.
12.	black hole	A dark region of space with a large gravitational field.
13.	light years	A unit of astronomical distance, equivalent to the distance that light travels in one year.

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

If learners are given the opportunity to learn about the birth, life and death of a star they may be encouraged to become more aware of the world around them and all the amazing phenomenon that occur in daily sights. Looking at the night sky, learners may become more appreciative of their environment and place in this universe. Recognising the marvel of stellar evolution (birth, life and death of stars) learners may become motivated to follow a career in astronomy or environmental studies. South Africa has a sky well-known for its clear astronomy sightings.

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 4, Week 8, Lesson A
Lesson Title: The birth of a star
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The birth of a star
CAPS Page Number	83

Lesson Objectives

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

- explain how a star is born using a flow diagram
- identify the gasses needed to form a star

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
Projector	Lesson plans with information
Board	Resource 37 - 39
Computer with an internet connection	

C CLASSROOM MANAGEMENT

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

STARS

1. What celestial bodies (objects in the sky) do you see in the night sky?
2. What is the difference between a star and a planet?

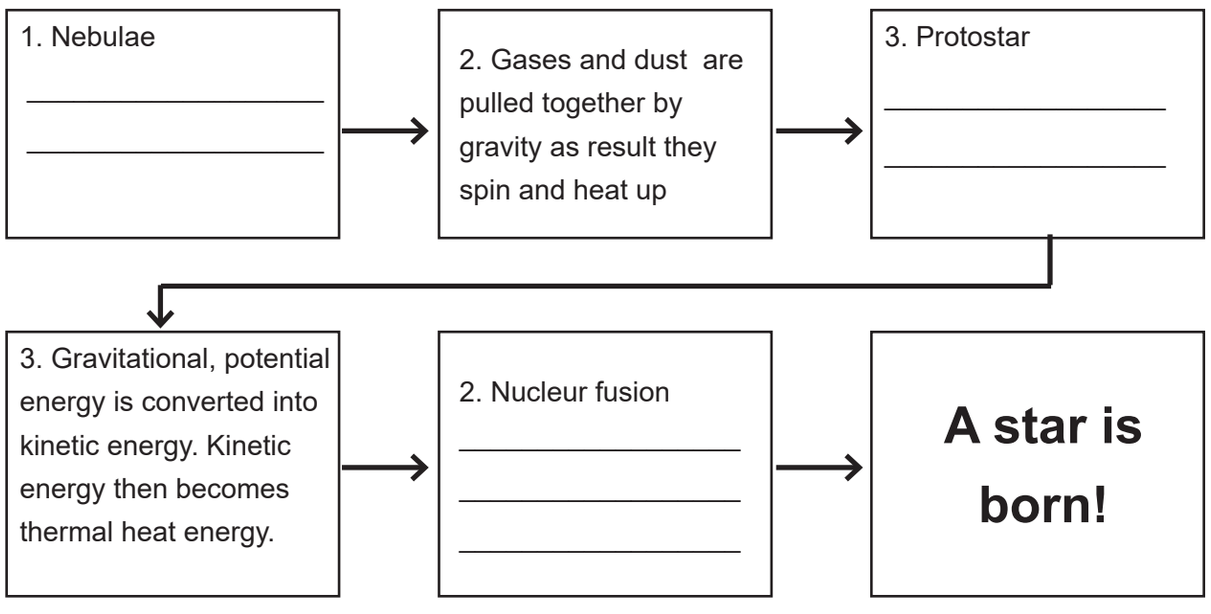
3. Learners should enter the classroom and answer the question in their workbooks.
4. Remind the learners to recall information that they learnt in grade 7.
5. Discuss the answer with the learners.
6. Write the model answer onto the chalkboard.

1. *At night, we can see many celestial bodies, such as stars, a moon, the Milky Way and planets.*
2. *A star is a massive luminous sphere of plasma held together by forces of gravity. Stars exist for a finite period of time and twinkle in the night sky. Stars are extremely big and stay in a fixed position. Whereas, planets have make no light and are made up of rock/ice/water. Planets revolve around the sun along set paths.*

D ACCESSING INFORMATION

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

Stellar evolution - The birth of a star



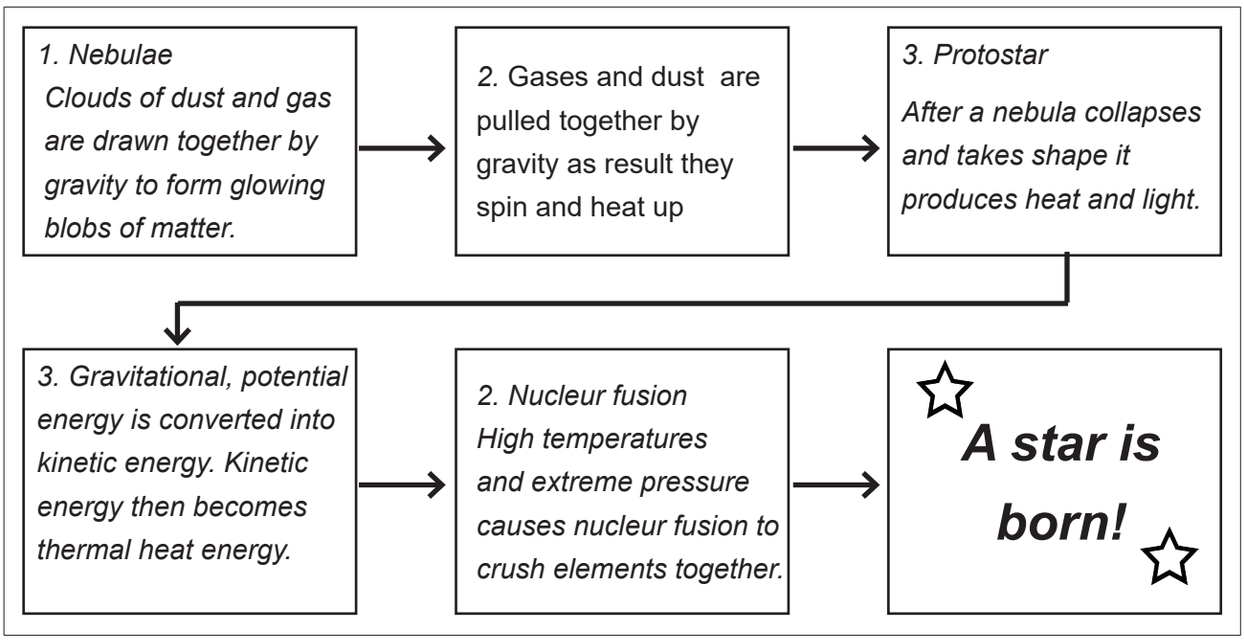
2. Remind the learners that our sun is our closest star.
3. Write the following onto the chalkboard:

TOPIC: The birth, life and death of a star

THE BIRTH OF A STAR

1. Stars form inside huge clouds of gas and dust called **nebulae**, far out in space.
2. These nebulae (huge amounts of dust and gas) are pulled together by gravity and therefore the nebula slowly come together to form blobs of matter.
3. A protostar begins to form as the nebula contracts and heats up.
4. The gravity has a pulling energy which causes the gas to move.
5. This moving energy is called kinetic energy.
6. When the gas and dust particles crash into each other, they heat up and this is called thermal energy.
7. Once the temperature and pressure is high enough, a **nuclear fusion** reaction begins. This reaction changes many small **hydrogen** atoms into large **helium** atoms.
8. This reaction radiates large amounts of light and heat energy into space.

2. Read through the information written on the chalkboard with the learners.
3. Tell the learners:
   - Stars are formed when clouds of dust and gas (called **nebulae**) are pulled together by gravity to form a more solid body. Show the learners Resource 37.
   - As this nebula comes together it starts to heat up to form what is called a protostar.
   - As the gas and dust particles crash into each other they heat up and once the temperature and pressure are high enough, a **nuclear fusion reaction** begins.
   - This reaction changes many small **hydrogen** atoms into large **helium** atoms.
   - This reaction radiates large amounts of heat and light energy out into space.
4. Ask the learners to use the above points to complete the flow diagram: THE BIRTH OF A STAR.
5. Give the learners some time to complete the activity from the chalkboard into their workbooks.
6. Write the model answer on the chalkboard:



Checkpoint 1

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

a. What is a nebula?
b. Explain the energy change that occurs during the birth of a star.

Answers to the checkpoint questions are as follows:

a. A nebula is a large cloud of gas and dust found in space.
b. During the birth of a star, gravitational pulling energy becomes kinetic energy which then becomes heat and light energy.

E CONCEPTUAL DEVELOPMENT

1. Write the following onto the chalkboard:

MORE ABOUT STARS

1. **Stars** do not live forever, just like people.
2. Stars are born, live their lives changing or evolving as they age, and eventually they die.
3. Stars are born in enormous, slowly rotating, clouds of cold gas and dust called nebulae (singular nebula).
4. Nebula have masses somewhere between one hundred thousand and two million times the mass of our sun and their diameters range from 50 to 300 light years across.

2. Read through the information on the chalkboard with the learners.
3. Write the following questions on the chalkboard:

MORE ABOUT STARS

1. Why are stars like humans?
2. Is our sun larger or smaller than most nebula? Give a reason for your answer.

4. Have the learners answer the questions in their workbooks.
5. Write the model answers on the chalkboard:

1. *Stars are like humans as they do not live forever. They are both born. Both exist for a while getting old over time and eventually die.*
2. *Our sun is a lot smaller than most nebula. Most nebulae are between one hundred thousand and two million times the mass of our sun.*

Checkpoint 2

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

a. What is nuclear fusion?

b. Put the following stages of the birth of a star into the correct order:

- star
- nebula
- protostar

Answers to the checkpoint questions are as follows:

a. Nuclear fusion is a process involving an enormous amount of heat and energy which results in atoms being fused (pushed together) to form another element, releasing huge amounts of energy.

b. Order of the birth of a star: nebula – protostar – star.

6. 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
Viva Africa	Birth of a star	196-197
Spot On	Birth of a star	175- 176
Top Class	Birth of a star	236-237
Shuters	Birth of a star	
Solutions for All	Birth of a star	321-323
Oxford	Birth of a star	
Platinum	Birth of a star	251-253
Sasol Inzalo Bk B	Birth of a star	316-319
Solutions for all	Birth of a star	321
Step-by-Step	Birth of a star	206 - 215

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.esa.int/esaKIDSen/SEMY06WJD1E_OurUniverse_0.html [Stars and galaxies]
2. https://www.khanacademy.org/science/...and.../birth-of-stars(7min)[The birth of a star]
3. https://www.youtube.com/watch?v=MGalnuFS2O0(3min)[A star is born]
4. https://www.youtube.com/watch?v=aPYirMuvlKk(4min)[A star is born – Simplified]

8 B

Term 4, Week 8, Lesson B
Lesson Title: The life of a star
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The life if a star
CAPS Page Number	83

Lesson Objectives

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

- list the main stages in the life of a star
- explain and interpret the classification of different stars according to colour, age, temperature and mass

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
Projector	Chalkboard
Wifi	Resources booklet
Computer with an internet connection	Resource 39

C CLASSROOM MANAGEMENT

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

> 1. What are the main stages during the birth of a star?
> 2. What forms of energy are needed to create a star?

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.

> *1. The main stages during the birth of a star include: A nebula collapsing to form a protostar. The protostar then undergoes nuclear fusion to form a star and a huge amount of heat and light energy being released.*
> *2. Kinetic energy, heat energy and light energy.*

D ACCESSING INFORMATION

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

LIFE OF A STAR				
Age of a Star	**Colour**	**Ave surface temperature Celsius**	**Solar Mass**	**Class**
Very young	Blue	40 000ºC	≥16$M_{\odot}$	O
Young	White	10 000ºC	1,4-2,1 $M_{\odot}$	A
Middle aged	Yellow	6 000ºC	0,8 -1,04$M_{\odot}$	G
Old	Orange	4000ºC	0,45 – 0,8$M_{\odot}$	K
Very old	Red	3000ºC	≤0,45$M_{\odot}$	M

2. Write the following notes onto the board:

LIFE OF A STAR

1. The nuclear fusion reactions in a star cause stars to shine.
2. When stars have reached a stage of equilibrium (the pressure of gravity pulling into the star is equal to the energy pushing out of the star) they have reached their main sequence phase.
3. Stars change in their appearance over billions of years.
4. Stars can be classified according to their colour, mass and temperature.
5. Stars that look blue are hotter and usually younger than stars that appear red.
6. Our sun is about half way through its life cycle – it is a medium-sized yellow star with a lifespan of about 9 billion years.
7. For most of their life, stars change hydrogen to helium.
8. Older, stars like the sun will swell up to form a 'red giant'.
9. Our sun still has a life span of about nine million years.

3. Read through the information written on the chalkboard with the learners.
4. Tell the learners:
   - Stars are classified according to their colour, mass and temperature.
   - Stars change in appearance over their lifetime. Younger stars usually look blue and older stars are red in colour.
   - Show the learners Resource 39.
   - It is the ongoing process of nuclear fusion that causes the stars to shine.

Checkpoint 1

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

a. Why do stars appear to be different colours?
b. What is the main sequence phase of a star?

Answers to the checkpoint questions are as follows:

a. Age, size and temperature determine the colour of a star.
b. The main sequence phase of a star is when the star has reached a stage of equilibrium. The pressure of gravity pulling into the star is equal to the energy pushing out of the star. This is how the star will remain for most of its life.

E CONCEPTUAL DEVELOPMENT

1. Write the following onto the chalkboard:

MORE ABOUT THE LIFE OF A STAR

a. Our sun has a spectral classification of G. This means it is a middle-aged star. Record the average surface temperature, colour and mass of our sun.
b. What colour is the hottest star?
c. Stars with the lowest mass belong to what class?
d. Complete the sentence:

Stars with a solar mass of _____ shine with a white light and have a high temperature of_____. Whereas, stars with a low solar mass of _____ shine with a _____ light and have a surface temperature of 3000ºC.

2. Ask the learners to answer the above questions in their workbooks using the table written on the chalkboard at the beginning of the lesson.
3. Give learners some time to complete this task in their exercise books.
4. Write the model answers on the chalkboard:

MORE ABOUT THE LIFE OF A STAR

a. Our Sun has a spectral classification of G. This means it is a middle-aged star.
The average surface temperature is 6000ºC, colour is yellow and mass of our Sun is 0,8 -1,04M®.
b. The hottest star shines blue.
c. Stars with the lowest mass belong to what class M.
d. Complete the sentence:
Stars with a solar mass of 1,4-2,1 M☉ shine with a white light and have a high temperature of 10 000ºC. Whereas, stars with a low solar mass of ≤0,45M☉ shine with a red light and have a surface temperature of 3000ºC.
Stars with a solar mass of ≥ 1,4 -2,1 M shine with a white light and have a high temperature of 10 000ºC . Whereas, stars with a low solar mass of less than 4,5M☉ shine with a Red light and have a surface temperature of 3000ºC.

Checkpoint 2

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

a. Record the colours of the stars in order of age, starting at the youngest to the oldest.
b. What causes stars to shine?

Answers to the checkpoint questions are as follows:

a. The youngest stars shine blue then white. Middle aged stars go from yellow to orange and the oldest shine red.
b. The process of nuclear fusion causes the stars to convert hydrogen to helium which makes a lot of heat and light energy.

5. 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
Viva Africa	Life of a star	197-199
Spot On	Life of a star	177
Top Class	Life of a star	238-239
Shuters	Life of a star	
Solutions for All	Life of a star	324
Oxford	Life of a star	
Platinum	Life of a star	254-255
Sasol Inzalo Bk B	Life of a star	320-324
Solutions for all	Life of a star	322 - 328
Step-by-Step	Life of a star	206 - 215

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=kts_IeUHdpM (9min) [Stars - introduction to Star Birth, life and Death]
2. https://www.youtube.com/watch?v=DzMwg8S_OwM (3min) ["The Life of a Star" - as animated]

8 C

Term 4, Week 8, Lesson C
Lesson Title: The death of a star Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The death of a star
CAPS Page Number	78

Lesson Objectives

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

- define the terms red giant, planetary nebula and white dwarf
- explain why a star dies
- draw a diagram comparing the different stages of the evolution of a star with the life cycle of a person

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
Projector	Chalkboard
Board	Resources booklet
Computer with an internet connection	Samp seeds
Magazines with pictures of babies, children, teenagers, adults, old people	Pencil crayons
Balloons	Plastic bag
Black and white marker pens	Ball of Mealiemeal
2cm small Styrofoam ball (one per pair of learners)	

C CLASSROOM MANAGEMENT

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

> 1. What is a “red giant” star?
> 2. What provides the star with fuel to burn?

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.

> *1. A red giant is an old star.*
> *2. Nuclear fusion of hydrogen to helium provides the fuel for the star to shine.*

D ACCESSING INFORMATION

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

THE DEATH OF A STAR

1. All stars have a finite life span.
2. Eventually the star's nuclear reaction runs out of fuel.
3. The hydrogen on the outside burns while the helium inside the star is changed into carbon.
4. The core of red giant stars will contract to form a 'white dwarf'.
5. After a white dwarf is formed the outer gases will be ejected into space. This cloud of gas around the white dwarf is called a planetary nebula.
6. Planetary nebulae are lit up by their central white dwarf star.
7. A dwarf star shines with white hot light.
8. If a star in the white dwarf phase runs out of fuel it will no longer shine. It is now a black dwarf.
9. A star in the black dwarf phase may stay like that forever.
10. Some stars in the white dwarf phase may explode. This explosion is called a super nova.
11. Some stars eight times the size of our sun reach the white dwarf phase and then collapse inwards and become black holes.
12. A black hole is a region in space where the pulling force of gravity is so strong that light is not able to escape. Because no light can escape, black holes are invisible.
13. However, space telescopes with special instruments can help find black holes. They can observe the behaviour of material and stars that are very close to black holes.

2. Read over the above notes with the learners.
3. Explain the following to the learners:
   - Stars do not live forever.
   - When a star's nuclear reaction runs out of fuel, the star starts to die.
   - The star now becomes what is known as a dwarf star.
   - Sometimes a dwarf star can explode. This explosion is called a super nova.
   - When a very large dwarf star collapses inwards, it forms what is known as a black hole.
4. Tell the learners to write down the information from the chalkboard into their work books.
5. Remind the learners of the stages of the birth of the star. Recap the stages of a star in middle phase.

6. Do the following demonstration for the learners as follows:

Instructions:

1. Teacher should insert the white Styrofoam ball into the deflated balloon or the mealie meal ball into the plastic bag.
2. Follow the step-by-step instructions from the table below (listed in order).
3. Start with the star's birth which is given in the left-hand column, then demonstrate this using the balloon or plastic bag.
4. Follow the instructions very carefully. You will be demonstrating how a star evolves over time.

Step Number	**Instructions**
1. Star is born	Blow up the balloon or plastic bag to about 6cm in diameter
2. Five million years	Wait for 1 minute
3. 10 million years	Wait for 2 minutes
4. 500 million years	Wait 5 minutes – planets are being formed around the star
5. 1 billion years	Blow the balloon or plastic bag up a little bit.
6. 9 billion years	Blow up the balloon or plastic bag some more and colour it in red - it is now a red giant star.
7. 10 billion years	Blow the balloon or plastic bag up a little bit more. The outer layers are now being blown off. To show this, slowly allow the balloon or plastic bag to deflate. Cut the balloon or plastic bag into pieces and scatter them around the white ball. The star has now become a white dwarf (the ball) surrounded by planetary nebulae (pieces of the balloon).
8. 50 billion years	Move the planetary nebulae further away from the white dwarf.
9. 500 billion years	Remove the planetary nebulae and colour the ball black- the star is now a black dwarf.

Checkpoint 1

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

a. How long can a star live for?

b. Why does a star die?

Answers to the checkpoint questions are as follows:

a. A star can live for 500 billion years.

b. A star's nuclear fusion runs out of fuel – hydrogen and helium.

E CONCEPTUAL DEVELOPMENT

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

The stages of evolution of a star compared to the life cycle of a person						
	Birth	**Youth**	**Teen**	**Adult**	**Old**	**Dead**
STAR						
PERSON						

2. Ask the learners to complete the table to illustrate how the stages of evolution of a star is like the life cycle of a person in their workbooks:
3. The learners can cut and paste pictures or draw.
4. They must record the terms describing the different stages of a star:
5. nebula, protostar, red giant / red dwarf, white dwarf, black dwarf/ black hole.
6. Write and draw the model answers on the chalkboard:

The stages of evolution of a star compared to the life cycle of a person

	Birth	**Youth**	**Teen**	**Adult**	**Old**	**Dead**
STAR	Nebula	Protostar	Main sequence star – Blue/ white	Main sequence star – yellow/ Orange	Red giant red dwarf	White dwarf Black dwarf black hole
PERSON						

Checkpoint 2

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

a. List the main stages of the life cycle of a star.
b. What does a star become when it dies?

Answers to the checkpoint questions are as follows:

a. The main stages are: nebula; protostar; main sequence star; red giant; white dwarf; black dwarf/black hole.
b. When a star dies it becomes a black dwarf or a black hole.

6. 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
Viva Africa	Death of a star	200-201
Spot On	Death of a star	177
Top Class	Death of a star	239-241
Shuters	Death of a star	-
Solutions for All	Death of a star	324-325
Oxford	Death of a star	-
Platinum	Death of a star	256-257
Sasol Inzalo Bk B	Death of a star	324-332
Solutions for all	Death of a star	322 - 328
Step-by-Step	Death of a star	206 - 215

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.esa.int/esaKIDSen/SEM976WJD1E_OurUniverse_0.html [stars and galaxies]
2. https://www.youtube.com/watch?v=zeGxJT2_A0I (6min) [The death of a star]

NATURAL SCIENCES

ASSESSMENT
GRADE 9 TERM 4

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.

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 9 ASSESSMENT

Grade 9					
Programme of Formal Assessment					
Formal Assessments	**TERM 1**	**TERM 2**	**TERM 3**	**TERM 4**	**TOTAL % FOR THE YEAR**
School-based assessments	Test 1 [40 marks] Practical task/ investigation 1 [20 marks]	Test 2 [40 marks] Practical task/ investigation 2 [20 marks]	Test 3 [40 marks] Practical task/ investigation 3 [20 marks]	Practical task/ investigation 4 [20 marks] Project [50 marks]	40%
Exams [60 minutes]		Exam 1 on work from terms 1 and 2 [80 marks]		Exam 2 on work from terms 3 and 4 [80 marks]	60%
Number of formal assessments	2	3	2	3	Total: 100%

Refer to CAPS on the processes for converting marks to percentages and to the 7-point scale.

In this section of the booklet, you will find your science assessments for this term.

There are two assessments included:

A Practical Activity

The activity completed is drawn from one of the lessons in the lesson plans. The rubric or memorandum attached in this pack will assist you with assessing the task completed by the learners.

An Exam

The exam included will need to be copied onto the chalkboard for learners to complete. There is also an exam memorandum included to assist you with marking the learners completed test scripts.

All of the assessments are aligned to CAPS requirements and the marks allocated for each assessment are as stipulated in CAPS.

Natural Sciences
Grade 9
Practical Task
Term 4

20 marks
Time allocation: 40 minutes (15 minutes preparation, 25 minutes task time)

NOTE TO THE TEACHER:

1. This practical activity will be completed as part of section E of lesson 7C.
2. This practical will take place during the lesson after the teaching component in Section D, “Accessing Information”.
3. The first 15 minutes will be used to teach section D and prepare learners for the practical task.
4. The next 25 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. The memo for assessing the practical task is provided.
7. The learners will be working in groups and will need the following items for each group to complete the tasks:
    - 2 thermometers
    - 1 large clear plastic bag
    - string or something similar to seal the bag
8. Ensure that all the materials have been collected before the practical lesson. This may take a few days. Allow enough time for this.
9. The learners should complete the drawings with a sharp pencil and the written answers should be completed in pen.

GRADE 9
NATURAL SCIENCES
TERM 4
PRACTICAL TASK
MEMORANDUM

(see Section E of Lesson 7C for instructions and questions)

<table>
<tr><th>CAPS Topic</th><th>Task</th><th>Expected answer/outcome</th><th>Marks</th></tr>
<tr><td></td><td>1</td><td></td><td></td></tr>
<tr><td>Atmosphere</td><td>1</td><td>Note to educator: Answers may vary depending on season and provincial position.

The answers of the table may vary according to season and province climate. (Google Weather temperatures should be a guide).

The following trends should occur:

• Temperatures begin at the same reading. (in and out the bag).

• The temperatures outside the bag show little change.

• The temperatures inside the bag steadily increase.

<table>
<tr><td>Time</td><td>Temperature in bag (degrees Celsius)</td><td>Temperature next to bag (degrees Celsius)</td><td>Difference between the two temperatures (degrees Celsius)</td></tr>
<tr><td>1</td><td>10 ✓</td><td>10 ✓</td><td>0 ✓</td></tr>
<tr><td>2</td><td>11 ✓</td><td>14 ✓</td><td>3 ✓</td></tr>
<tr><td>3</td><td>11 ✓</td><td>16 ✓</td><td>5 ✓</td></tr>
<tr><td>Difference (+ or –) in temperature between reading 1 and reading 3</td><td>17 ✓</td><td>24 ✓</td><td>7 ✓</td></tr>
</table>
</td><td>12</td></tr>
<tr><td>Atmosphere</td><td>2</td><td>The temperature in the bag is warmer than the temperature next to the bag. ✓</td><td>1</td></tr>
<tr><td>Atmosphere</td><td>3</td><td>No. ✓ The temperature in the bag is warmer because the bag lets in the sun’s light energy and some of its heat energy and is trapped inside. ✓</td><td>2</td></tr>
</table>

CAPS Topic	Task	Expected answer/outcome	Marks
Atmosphere	4	In bright sunshine, the warm air inside the bag becomes warmer because it is trapped inside. ✓	1
Atmosphere	5	The greenhouse effect is a warming of Earth's surface and the air above it. ✓✓	2
Atmosphere	6	The greenhouse effect is a process that shows how gases trap the Sun's heat. ✓ This process makes Earth much warmer than it would be without an atmosphere. The greenhouse effect is one of the things that makes Earth a comfortable place to live. ✓	2
			TOTAL: 20

Grade 9
Natural Sciences
Term 4
Exam

80 Marks
90 Minutes

NOTE TO THE TEACHER:

If possible, photocopy this exam for each learner. If this is not possible, write the exam 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. Lightning is an example of …

a. gravitational force
b. electrostatic force
c. magnetic force
d. contact force

You have answered correctly if you have circled Ⓑ

GRADE 9 ASSESSMENT – EXAM TERM 4

SECTION A: Energy and Change

QUESTION 1: MULTIPLE CHOICE [5]

Read each question and circle the letter that shows the correct answer.

1.1. Which of the following is NOT a contact force?

a. compression

b. friction

c. magnetic

d. tension

1.2. Potential difference is measured in …

a. amperes

b. volts

c. joules

d. ohms

1.3 (Note to educator: Use the picture below on Resource 15)

The picture above shows a …

a. resistor

b. fuse

c. buzzer

d. conductor

1.4. What is a simple device that opens and closes a circuit?

a. switch

b. cell

c. light bulb

d. fuse

1.5. Electric generation by falling water is called?

a. nuclear fission

b. sun-heated steam

c. wave

d. hydroelectric

QUESTION 2: TERMS [5]

Write the correct word for the following definitions.

2.1. Devices that produce electricity by converting chemical energy to electrical energy.

_____

2.2. The flow of electric charge through an electrical conductor.

_____

2.3. A safety device in a circuit that melts and breaks if the current exceeds a safe level.

_____

2.4. A substance that does not allow electric current to flow through it.

_____

2.5. A schedule of prices or fees used to charge for services.

_____

QUESTION 3: ANSWER THE QUESTIONS BELOW. [21]

3.1 In which unit is force measured in? (1)

3.2 (Note to educator: Use photographs from Resource 2, 3 and 4)

Identify the effect of forces shown below. (3)

3.2.1. _____

3.2.2. _____

3.2.3. _____

3.3 What is the difference between a balanced and an unbalanced force? (2)

_____

_____

_____

3.4 Calculate the weight of a box on the surface of the Earth. The mass of the box is 45kg and the gravitational pull is 10 m/s. Include the formula with the corrects unit of measurement. (4)

3.5 What instrument is used to measure mass? (1)

_____

3.6 Explain the term magnetic force. (2)

_____

_____

3.7 What is electrostatic force? (2)

_____

_____

3.8 Thato rubs a plastic ruler against her jersey. The ruler now has a negative charge. Choose the correct words and fill in into the sentence below: (2)

The ruler has a negative charge because it has _____ (gained/lost) _____ (protons/electrons).

3.9 Lightning can be very dangerous. List FOUR safety precautions that you should do during thunder and lightning storms. (4)

_____

_____

_____

_____

QUESTION 4 [9]

Answer the questions below:

4.1 Draw a circuit diagram that contains the following: a series battery with 2 cells, 2 light bulbs connected in series and a resistor. (5)

4.2 Calculate how much you would use in electricity per month for a geyser of 3500 watts that runs for 24 hours a day, if charges are fixed at R0,76 per kWh? Show your working. (4)

SECTION B: Planet Earth and Beyond

QUESTION 1: MULTIPLE CHOICE [6]

Read each question and circle the letter that shows the correct answer.

1.1 Which layer of the Earth's structure is made of liquid iron and nickel?

a. mantle
b. inner core
c. outer core
d. crust

1.2 Which of the colours below indicate the hottest star?

a. red
b. blue
c. yellow
d. white

1.3 Which layer of the Earth consists of life?

a. atmosphere
b. crust
c. mantle
d. inner core

1.4 Which gas is essential for life?

a. nitrogen
b. water vapour
c. oxygen
d. hydrogen

1.5 Which of the following is NOT an example of a fossil fuel?

a. gas
b. coal
c. oil
d. dead matter

QUESTION 2: SCIENTIFIC WORDS [5]

Write the correct word for the following definitions.

2.1. The gas that absorbs ultraviolet radiation.

_____

2.2. The mixture of gases held around Earth by gravity.

_____

2.3. Height above sea level.

_____

2.4. The process during which rock is broken up into smaller particles.

_____

2.5. The standard unit of mass in astronomy, equal to the mass if the Sun.

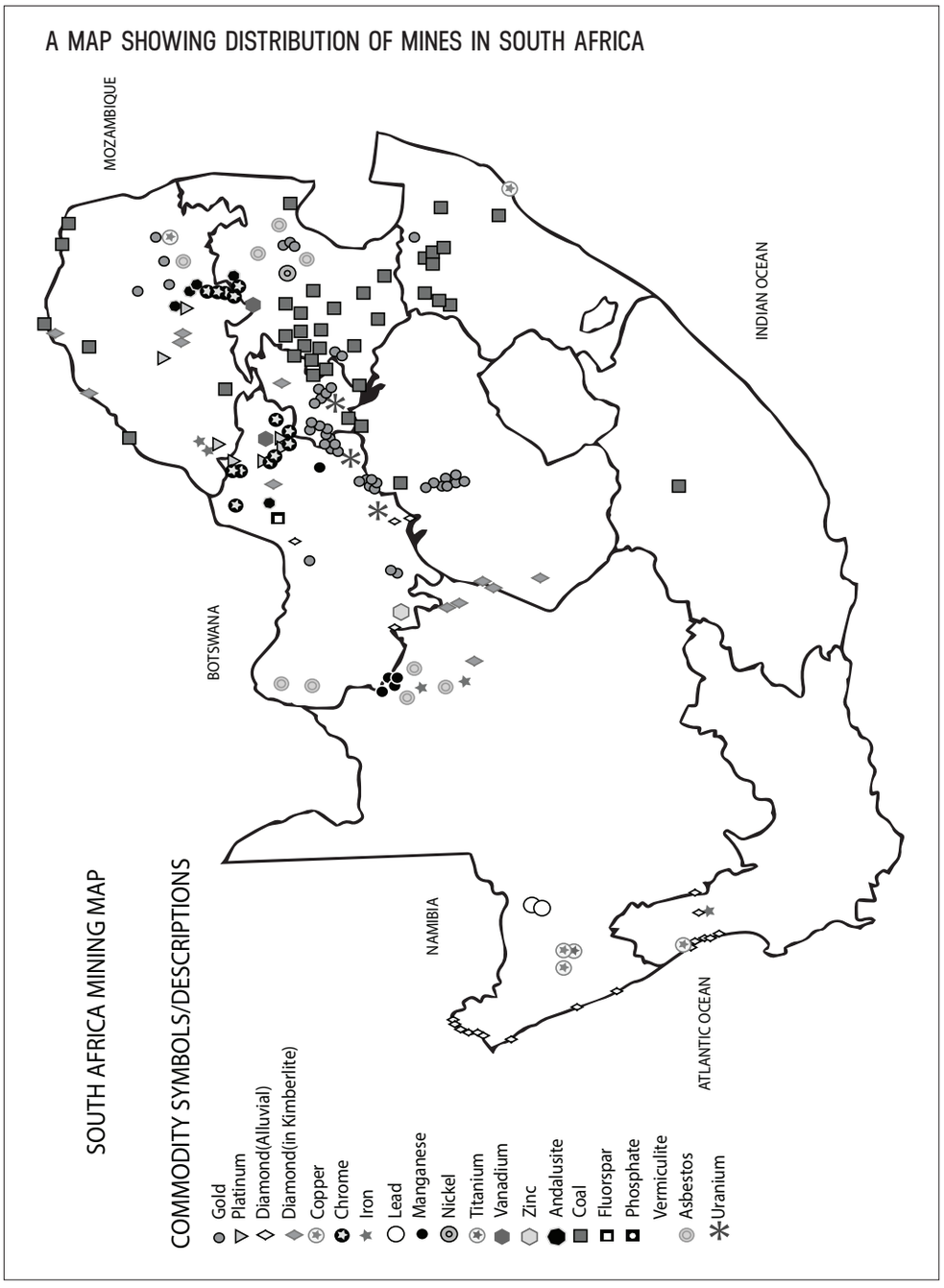
_____

QUESTION 3: [13]

Answer the following questions:

(Note to educator: Use map on Resource12)

Study the map below.



3.1 Which province has the most minerals? (1)

_____

3.2 Which province has the least minerals? (1)

_____

3.3 Complete the table below to show which minerals are found in each province.

Only write ONE example of the mineral for each province. (9)

Province	Mineral

3.4 Mining can have an impact on our country in many ways. Discuss TWO ways in which mining can have a positive impact. (2)

_____

_____

_____

_____

QUESTION 4: [12]

4.1 Give 2 functions of the atmosphere. (2)

_____

_____

_____

4.2 The atmosphere is divided into 4 layers. Name the 4 layers. (4)

_____

_____

_____

_____

4.3 Name the 3 greenhouse gases. (3)

_____

_____

_____

4.4 Provide 3 effects of global warming. (3)

_____

_____

_____

_____

_____

_____

QUESTION 5: [5]

5.1 Where are stars born? (1)

_____

5.2 What is a star made of? (2)

_____

_____

5.3 Briefly explain what a supernova is? (2)

_____

_____

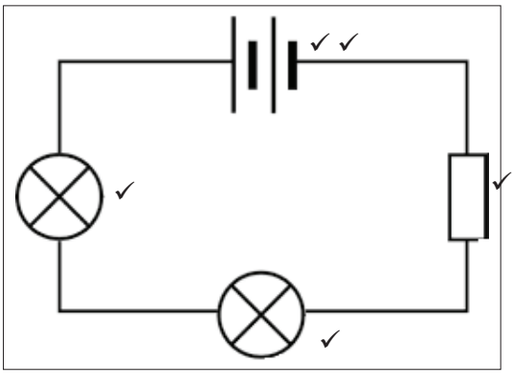
TOTAL: 80

Grade 9
Natural Sciences
Term 4
Exam

Memorandum

CAPS Topic	Questions	Expected answer(s)	Marks
PART A: Energy and Change			
	1		
Forces	1.1	C ✓	1
Electric cells as energy systems	1.2	B ✓	1
Electric cells as energy systems	1.3	A ✓	1
Electric cells as energy systems	1.4	A ✓	1
	1.5	D ✓	1
	2		
Electric cells as energy systems	2.1	Cell/battery ✓	1
Electric cells as energy systems	2.2	Current ✓	1
Electric cells as energy systems	2.3	Fuse ✓	1
Electric cells as energy systems	2.4	Insulator ✓	1
Cost of electrical power	2.5	Tariff ✓	1
	3		
Forces	3.1	Newtons ✓	1
Forces	3.2.1	Causes the object to move ✓	1
Forces	3.2.2	Causes the object to change shape ✓	1
Forces	3.2.3	Causes the object to rotate ✓	1
Forces	3.3	Balanced forces are two forces that have no visible effect because they are equal and opposite. ✓ Unbalanced are two forces that have a visible effect because they are not equal and not opposite. ✓	2

CAPS Topic	Questions	Expected answer(s)	Marks
Forces	3.4	Weight = mass x gravitational force ✓ = 45kg x 10 m/s ✓ = 450 N ✓ ✓	4
Forces	3.5	Scale ✓	1
Forces	3.6	Magnetic force is the force that magnets ✓ exert on magnetic materials over a distance. ✓	2
Forces	3.7	Electrostatic force is the force that two electrically charged objects ✓ exert on each other over a distance. ✓	2
Forces	3.8	The ruler has a negative charge because it has gained electrons. ✓ ✓	2
Forces	3.9	(Any four) ✓ ✓ ✓ ✓ • The best place to go is a sturdy building or a car, but make sure the windows in the car are shut. • Avoid metal sheds and open areas. • If there is no shelter around you, stay away from trees. • Crouch down in the open area, keeping twice as far away from a tree as far as it is tall. • Put your feet together and place your hands over your ears to minimize hearing damage from thunder. • If you're with a group of people stay about 15 feet from each other. • Stay out of water. It's a great conductor of electricity. Also, don't stand in puddles. • Avoid metal. Stay away from clotheslines, fences, and drop your backpacks because they often have metal on them. • If you're playing an outdoor activity, wait at least 30 minutes after the last observed lightning strike or thunder. • Avoid water. It's a great conductor of electricity, so do not take a shower, wash your hands, wash dishes or do laundry. • Do not use a corded telephone. Lightning may strike exterior phone lines • Do not use electric equipment like computers and appliances during a storm. • Stay away from windows and doors.	4

CAPS Topic	Questions	Expected answer(s)	Marks
	4		
Series and parallel circuits	4.1	 ✓ ✓ ✓ ✓	5
Cost of electric power	4.2	3500 W = 3500 ÷ 1000 = 3,5 Kw ✓ Cost = Power of device (kWh) x time x unit price ✓ = 3,5 x 24 x R 0,76 ✓ = R63,84 ✓	4
PART B: Earth and Beyond			
	1		
Lithosphere	1.1	C ✓	1
Birth, life and death of stars	1.2	B ✓	1
The Earth as a system	1.3	B ✓	1
Atmosphere	1.4	C ✓	1
Lithosphere	1.5	D ✓	1
	2		
Atmosphere	2.1	Ozone (O_3) ✓	1
Atmosphere	2.2	Atmosphere ✓	1
Atmosphere	2.3	Altitude ✓	1
Lithosphere	2.4	Weathering ✓	1
Birth, life and death of stars	2.5	Solar mass ✓	1
	3		
Mining of mineral resources	3.1	North West ✓	1
Mining of mineral resources	3.2	Eastern Cape ✓	1

<table>
<tr><th>CAPS Topic</th><th>Questions</th><th>Expected answer(s)</th><th>Marks</th></tr>
<tr><td>Mining of mineral resources</td><td>3.3</td><td>(At least two from each province – except EC)
<table><tr><th>Province</th><th>Mineral</th></tr><tr><td>Limpopo</td><td>Iron, gold, platinum, manganese, platinum, coal. chrome ✓</td></tr><tr><td>Gauteng</td><td>Gold, coal ✓</td></tr><tr><td>Mpumalanga</td><td>Iron, gold, coal, chromium, vanadium ✓</td></tr><tr><td>North West</td><td>Gold, chromium, diamonds, platinum, copper, Manganese, vanadium ✓</td></tr><tr><td>Free State</td><td>Gold, coal, uranium, diamonds ✓</td></tr><tr><td>KwaZulu Natal</td><td>Gold, coal, titanium ✓</td></tr><tr><td>Eastern Cape</td><td>Coal ✓</td></tr><tr><td>Northern Cape</td><td>Iron, diamonds, manganese, copper ✓</td></tr><tr><td>Western Cape</td><td>Iron, titanium, diamonds ✓</td></tr></table></td><td>9</td></tr>
<tr><td>Mining of mineral resources</td><td>3.4</td><td>(Any two) ✓ ✓
• Job creation
• Adds value to currency – foreign exchange
• Supplies raw materials needed for construction of roads, buildings or manufacturing of products such as cars, jewellery
• Source of income</td><td>2</td></tr>
<tr><td></td><td>4</td><td></td><td></td></tr>
<tr><td>Atmosphere</td><td>4.1</td><td>(Any two) ✓ ✓
• The atmosphere serves as a source of oxygen.
• It protects the Earth from dangerous UV rays of the sun.
• Reduces temperature variation between day and night.</td><td>2</td></tr>
<tr><td>Atmosphere</td><td>4.2</td><td>• Troposphere ✓
• Stratosphere ✓
• Mesosphere ✓
• Thermosphere ✓</td><td>4</td></tr>
<tr><td>Atmosphere</td><td>4.3</td><td>Carbon dioxide ✓, methane ✓ and water vapour ✓</td><td>3</td></tr>
</table>

CAPS Topic	Questions	Expected answer(s)	Marks
Atmosphere	4.4	(Any three) ✓ ✓ ✓ • Climate change • Rising sea levels • Food shortages • Mass extinction	3
	5		
Birth, life and death of stars	5.1	In the nebula ✓	1
Birth, life and death of stars	5.2	A star is made of hydrogen ✓ and helium ✓	2
Birth, life and death of stars	5.3	A supernova is a huge explosion ✓ that happens when a massive star dies ✓	2
			TOTAL: 80