Interesting Science fact #14

It takes 8 minutes 17 seconds for light to travel from the Sun's surface to the Earth.

NATURAL SCIENCES

LESSON PLAN

GRADE 8 TERM 3

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 & Technology 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 9 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* section 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 a sample assessment task, an examination and memorandum. Feel free to use this task with your learners in the first year of this programme. Thereafter, use it as a model to structure your own assessment tasks, in the same way.

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 8			
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**
Photosynthesis and respiration Interactions and interdependence within the environment Micro-organisms	Atoms Particle model of matter Chemical reactions	Static electricity Energy transfer in electrical systems Series and parallel circuits Visible light	The Solar System Beyond the Solar System Looking into space
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 8		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:

Static electricity

Term 3, Weeks 1A – 1C

A. TOPIC OVERVIEW

TERM 3, WEEKS 1A – 1C

- This topic runs for 1 week.
- It is presented over 3 X 1 hour lessons.
- This topic counts for 20% in the end-of-year exam.
- 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 8	GRADE 9
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
- N/A	• Friction between certain materials transfers electrons between the atoms • Electrons move from one material causing a positive charge on its surface and causing a negative charge on the surface of the other material • Objects with like charges repel each other • Objects with unlike charges attract each other • A discharge of the electrons causes the sparks or shock of static electricity	• Forces o Field forces (non-contact forces)

C. SCIENTIFIC VOCABULARY

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

	TERM	EXPLANATION
1.	friction	Friction is a resistance against the movement of an object as a result of its contact with another object.
2.	electric charge	It is the positive or negative property of a particle.
3.	static electricity	It is an electrical charge caused by the build-up of electric charges on the surface of an isolator of electricity.
4.	electric discharge	It is the release of electric charge through a solid, liquid or gas.
5.	attract	Attract means to make something move towards another thing.
6.	repel	Repel means to push away from something.
7.	static	Something is static when it is not moving.
8.	isolator	An isolator is a material that does not allow a charge to flow through it.
9.	neutral	An object is neutral when it has the same number of positive and negative charges.

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

Learners will understand that objects can be electrically charged by friction, which results in negative charges moving from one object to another. The objects become electrically charged and can attract or repel other charged objects. A negatively charged object can release its charge when it comes into contact with another object and this is called electric discharge.

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 3, Week 1, Lesson A
Lesson Title: Charging materials
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Friction and static electricity
CAPS Page Number	47

Lesson Objectives

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

- describe the structure of an atom
- define static electricity
- explain how a material becomes electrically charged
- explain friction.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 1: Structure of the atom	
Resource 2: Rubbing hair with a balloon	
Resource 3: Electrical charging through friction	
A balloon	

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 is a combustion reaction an example of a chemical change?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

A combustion reaction is a chemical change because new substances are formed with different properties to the reactants.

D ACCESSING INFORMATION

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

STATIC ELECTRICITY

1. Atoms are made up of positively charged protons and neutral neutrons that are tightly packed in the nucleus. The negatively charged electrons are moving freely in a space around the nucleus.
2. A neutral atom has an equal number of negatively and positively charged particles.
3. Friction between objects causes electrons to move from one object to another.
4. The object that gains electrons becomes negatively charged because it has more electrons than protons.
5. The object that loses electrons becomes positively charged because it has fewer electrons than protons.
6. Electrons are never created or destroyed. The number of electrons that the one object loses is the same as the number of electrons that the other object gains.
7. Only isolators can become electrically charged through friction.
8. The separation of charges is called static electricity.

2. Explain this to the learners as follows:
    a. Atoms are made up of tiny particles called protons, neutrons and electrons. Protons are positively charged, the neutrons are neutral and the electrons are negatively charged. Show the learners Resource 1.
    b. In some atoms, the electrons that are far from the nucleus are not held very tightly by the nucleus.
    c. The positive and negative charges in an atom balance each other so that the total charge of an atom is neutral.
    d. Friction is a force caused by rubbing things together.
    e. During friction, electrons are transferred between objects. The object that gains electrons becomes negatively charged and the object that loses electrons becomes positively charged.
    f. Electrons cannot be created or destroyed. They can only be transferred from one place to another.
    g. The imbalance that occurs between the negative and positive charges in an atom is called static electricity.
    h. Insulators do not conduct electricity, but they can hold a substantial charge.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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. How do electrons move from one object to another?
b. What is static electricity?

Answers to the checkpoint questions are as follows:

a. Electrons move from one object to another through friction.
b. It is an electrical charge that is caused by the build-up of electric charges on the surface of an isolator.

E CONCEPTUAL DEVELOPMENT

ACTIVITY

1. Blow up the balloon. Rub it with a soft cloth, jersey or against your hair. Explain the following to the learners:
   a. The balloon and hair are neutral, which means that they have equal numbers of positive and negative charges.
   b. When the balloon is rubbed against hair, there is a force of friction between the balloon and the hair. The hair resists the movement of the balloon.
   c. The friction causes the outer electrons of the atoms of the hair to be transferred to the balloon. The positive protons do not move because they are held tightly in the nucleus.
   d. Show the learners Resource 2. The hair loses electrons, which causes a positive charge on its surface. It has fewer electrons than protons.
   e. The balloon gained electrons, which caused a negative charge on its surface. It has more electrons than protons.
   f. The number of electrons that the hair lost is equal to the number of electrons that the balloon gained.
   g. Both the hair and balloon are isolators and cannot conduct electricity. The charges remain **static** on their surfaces. The negative build-up on the surface of the balloon remains static.
   h. Through friction we can charge materials, such as plastic, perspex, glass, nylon and wool. The separation of charges through friction is called static electricity.
2. Ask the learners to complete the following task in their workbooks (always try to do this before the lesson starts).
3. Write the task on the chalkboard.
4. Show the learners Resource 3. Explain to the learners that the duster, polythene rod and cellulose acetate rod are neutral before rubbing. After rubbing the duster, the polythene rod and cellulose acetate rod are electrically charged.

TASK

Some materials give up electrons more easily than other materials. Look at the resource that the teacher is showing you and answer the following questions.

1. Which rod gave up some of its electrons during rubbing?
2. Does this rod now have more positive or negative charges?
3. Which rod gained electrons?
4. What is the charge of this rod now?
5. In which rod are the electrons more strongly attracted to the nucleus?
6. Which duster became positively charged?
7. How did the rods become charged?

5. Give the learners enough time to complete the task.
6. Give the answers to the learners.
7. Model Answer

MODEL ANSWER

a. The cellulose acetate rod
b. It has more positive charges.
c. The polythene rod
d. It is negatively charged.
e. In the polythene rod
f. The duster that rubbed the polythene rod
g. By means of friction

Checkpoint 2

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

a. What charges move when objects are rubbed against each other?
b. What is the electric charge of an object that loses electrons?

Answers to the checkpoint questions are as follows:

a. The negative charges
b. The object will become positively charged

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
Successful Natural Sciences	Static electricity	104-105
Top Class Natural Sciences	Static electricity	103-104
Via Africa Natural Sciences	Static electricity	102
Solutions for All	We get energy from our food	111
Natural Science	Static electricity	127-128
Spot on Natural Sciences	Static electricity	99
Platinum Natural Sciences	Static electricity	126-127
Step-by-step	Static electricity	80-81
Natural Sciences	Static electricity	127-128

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://i.ytimg.com/vi/FYLyi7o8zoQ/hqdefault.jpg?sqp=-oaymwEWCKgBEF5IWvKriqkDCQgBFQAAiEIYAQ==&rs=AOn4CLBzr3dqdBegdq2EYKfcXlplu9Hgng (7min 57sec) [Static electricity balloon experiment]

1 B

Term 3, Week 1, Lesson B
Lesson Title: Effect of charged materials
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Friction and static electricity
CAPS Page Number	47

Lesson Objectives

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

- describe how like charges repel and opposite charges attract each other
- explain how charged objects attract neutral objects
- investigate the electric charge of an object.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 4: Attractive and repulsive electrostatic forces	
Resource 5: Charged object attracting neutral object	
Resource 6: Effect of static electricity on a girl's hair	
Two balloons, tissue pieces, plastic rulers or rods, glass or perspex rods, soft cloth, cotton thread	

C CLASSROOM MANAGEMENT

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

What is friction?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

Friction is the force that resists the movement between two objects.

D ACCESSING INFORMATION

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

THE EFFECT OF CHARGED OBJECTS ON EACH OTHER

1. An object obtains an **electric charge** through friction. This charge can either be positive or negative.
2. A charged object has an effect on other charged or neutral objects.
3. Objects with different electric charges **attract** each other. They move closer to each other.
4. Objects with the same electric charge **repel** each other. They move further apart from each other.
5. A charged object can attract a neutral object. The charges in the neutral object that are opposite to the charged object are rearranged closest to the charged object.
6. Electrostatic charges are best obtained in dry weather.

2. Explain this to the learners as follows:
   a. An object becomes electrically charged when it is rubbed against another object.
   b. An object that is electrically charged has an effect on other charged or neutral objects.
   c. When objects have different electric charges, they will attract each other.

d. Objects with the same electric charge will repel each other.
e. Repulsion is the tendency of objects with the same electric charge to move away from each other.
f. A charged object can attract a neutral object. The charged particles of the neutral object that are oppositely charged to the charged object will rearrange themselves so that they can attract the opposite charges of the charged object.
g. Show the learners Resource 4, which is a summary of the effect of charged objects on each other.

3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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. How does a charged object affect another charged object?
b. How does a charged object affect a neutral object?

Answers to the checkpoint questions are as follows:

a. It can attract or repel another charged object.
b. It can attract a neutral object.

E CONCEPTUAL DEVELOPMENT

1. This will be a group activity, so you will need to divide the learners into groups of 4 – 6.
2. PLEASE NOTE: This activity will not be successful on a very wet day!
3. To do this activity, each group will need:
   - two balloons or latex gloves
   - a few sheets of tissue or toilet paper
   - String or wool
   - An empty coke can
   - A jersey/sock
   - A ruler
   - A marker pen
4. Ensure you have these materials prepared for each group before the lesson starts.
5. Tell the learners that they are going to be doing an investigation where they will be exploring static electricity.
6. Write the following onto the chalkboard (always try to do this before the lesson starts):

TOPIC: Static electricity

PRACTICAL TASK

1. We are going to be exploring the presence and qualities of static electricity.
2. We are going to experiment with various materials to see how static electricity is generated and how it behaves.

7. Read through the practical task with the learners.
8. Have the learners move into there groups and collect the equipment needed.
9. Call the learners to attention.
10. The following will need to be written onto the chalkboard:

Task 1: (6 marks)

- Blow up both the balloons.
- Label one as “A” and the other as “B” with the marker.
- Tear up some toilet tissue into little pieces.
- Rub balloon “B” against a jersey or sock for a few seconds.

1.1. What do you think will happen if you hold balloon “A” near the toilet tissue?

1.2. What do you think will happen if tou hold balloon “ B” near the toilet tissue?

- Test your predictions.

1.3. What happened when you held the balloons to the toilet tissue?

1.4. What is the scientific explanation for this?

11. Read through task 1 with the learners.
12. Ask them if they have any questions.
13. Tell the learners they have 10 minutes to complete this task.
14. Tell the learners that all group members must complete the written answers in their workbooks.
15. Supervise the learners whilst they complete the task and answer any questions they may have.
16. After 10 minutes call the learners back to attention.
17. Tell the learners that they are now going to complete task 2.
18. The following will need to be written on the chalkboard:

Task 2: (6 marks)

- Tie a piece of string onto each balloon.
- Charge the surface of each balloon by rubbing it on a jersey.

2.1. What do you predict will happen when you bring the two balloons near each other?

- Holding only the string and bring the two balloons closer together.

2.2. What do you observe?

2.3. Why do you think this has happened?

19. Read through the task with the learners.
20. Ask them if they have any questions.
21. Tell the learners they have 5 minutes to complete this task.
22. Supervise the learners whilst they complete the task and answer any questions they may have.
23. After 5 minutes call the learners back to attention.
24. Tell the learners they are now going to complete task 3.
25. The following will need to be written on the chalkboard:

Task 3: (8 marks)

Aim: To make a coke can move using _____.

Method:

Conclusion:

26. Tell the learners that they are going to attempt to make the coke can move using only static electricity.
27. Tell the learners that they may only use the materials that they have and that they may have to try a few different things before the coke can will move.
28. Once they have achieved the aim, they need to write the method up in 2 or 3 points.
29. Explain that the method should describe:
    - What they did; and
    - How they did it.
    - They may also want to mention why they did it.
30. They must then write a conclusion giving a scientific explanation for this movement.
31. Explain that ther conclusion should explain what happened in the experiment – the explanation should be scientific.

32. Tell the learners they have 10 minutes to conduct this experiment.
33. Supervise learners as they work and answer any questions that they may have.
34. After 10 minutes call the learners back to attention.
35. Tell the learners to return all equipment and to tidy their work areas and return the equipment.
36. Collect 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
Successful Natural Sciences	Static electricity	104-105
Top Class Natural Sciences	Static electricity	104
Via Africa Natural Sciences	Static electricity	103-104
Solutions for All Natural Science	Static electricity	129
Spot on Natural Sciences	Static electricity	98
Platinum Natural Sciences	Static electricity	128-129
Step-by-step	Static electricity	81
Natural Sciences	Static electricity	129-131
Sasol Inzalo Bk B	Static electricity	8-10

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=ViZNgU-Yt-Y (5min 39sec) [9 awesome Science tricks using static electricity]

1 C

Term 3, Week 1, Lesson C
Lesson Title: Discharge of static electricity
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Friction and static electricity
CAPS Page Number	47

Lesson Objectives

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

- explain why electrostatic discharge occurs
- describe what happens during electrostatic discharge
- give examples of electrostatic discharge in everyday life
- explain the dangers of electrostatic discharge.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 7: Lightning: electrostatic discharge	

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 two charged balloons push each other away?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

Both balloons are negatively charged and like charges repel each other.

D ACCESSING INFORMATION

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

ELECTRIC DISCHARGE

1. Static electricity is the build-up of electric charges on the surface of an object, which is usually a non-conductor of electricity.
2. The charges remain static on the surface of the object because they are not moving.
3. When the build up of charges becomes too big for the object the electrons will be discharged to a neutral or positive object.
4. **Electric discharge** is the release of electrons through a solid, liquid or gas. It can take place during contact between two objects or across a small gap of air between two objects.
5. A discharge of electrons causes the sparks, or shock of static electricity, especially when the air is dry.
6. Lightning is an example of an electric discharge.
7. Although sparks caused by static electricity are harmless, electric discharge can also be dangerous.

2. Explain this to the learners as follows:
   a. When a non-conducting object is electrically charged, there is a build-up of charges on its surface.
   b. The charges do not move because they cannot be conducted.

c. When there are too many charges on the surface of an object the charges will move to a neutral object. This is called electric discharge.
d. Discharging can take place when objects touch each other but also when one object is brought near another object without touching the object.
e. An electric discharge can cause an electrostatic spark or shock.

3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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 electrostatic discharge?
b. What is the result of a discharge of electrons?

Answers to the checkpoint questions are as follows:

a. It is the flow of electrons from a charged object to a neutral or positive object.
b. A spark or a shock

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners. If possible, the learners can attempt the discharging examples.
   a. When a person walks across a room with a carpet, friction occurs between the person's shoes and the carpet. As a result, the person becomes positively charged because electrons are transferred from the person to the carpet.
   b. There is a build-up of positive charges on the surface of the person. The charge remains static.
   c. When the person touches a doorknob, electrons from the doorknob will be attracted to the positively charged person. They will move quickly to the hand of the person. The person will experience this flow of electrons as an electric shock.
   d. A static electric spark is a flash of light caused by the electric discharge of static electricity. The person touching the doorknob will experience a spark that can jump from the knob to the finger, giving the person a slight shock.
   e. When electrons move across an air gap they can heat the air enough to make it glow. This glow is called a spark.
   f. A similar effect can be obtained when you rub yourself with a blanket and then touch your friend. Sparks of electric discharge can be seen at night when it is dark.
   g. The charge remains static until it is able to move away by means of electrostatic discharge. During an electrostatic discharge, only electrons are moving from one object to another.
   h. The discharge will be greater if the object has a greater build up of negative charge.
   i. Although the sparks caused by static electricity cannot harm you they can be dangerous if you are near fuel because it can cause an explosion.

2. Let the learners complete the task below in their workbooks. Show them Resource 7.
3. Write the following questions on the chalkboard (always try to do this before the lesson starts):

TASK

Look at the picture and answer the following questions on lightning:

a. What is the charge of the Earth? Why do you say so?
b. What is the charge of the clouds? Why do you say so?
c. During a thunderstorm the clouds move past each other. How are they charged?
d. Why do the clouds discharge electric charge to the Earth?
e. Do clouds discharge electric charge to other clouds as well? Why do you say so?
f. What do we call this type of discharge?
g. Why is lightning dangerous?

4. Give the learners enough time to complete the task.
5. Model answer

MODEL ANSWER

a. The Earth is positively charged because it has more positive charges than negative charges.
b. The clouds are negatively charged because they have more negative charges than positive charges.
c. They are charged through friction.
d. There is a negative charge build-up on the clouds that are attracted to the positive Earth.
e. Yes, because some clouds have positively charged sides that attract the negative electrons.
f. Lightning
g. Lightning can cause fires and can kill people.

Checkpoint 2

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

a. What will happen when you are electrically charged and you touch your friend?
b. What does your friend experience when you touch him/her?

Answers to the checkpoint questions are as follows:

a. There will be an electrical discharge to the friend.
b. The friend will experience a slight shock and might see a spark.

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
Successful Natural Sciences	Static electricity	104-105
Top Class Natural Sciences	Static electricity	105-106
Via Africa Natural Sciences	Static electricity	104-105
Solutions for All Natural Science	Static electricity	129-130
Spot on Natural Sciences	Static electricity	100-101
Platinum Natural Sciences	Static electricity	130-133
Step-by-step	Static electricity	82-83
Natural Sciences	Static electricity	134-135
Sasol Inzalo Bk B	Static electricity	10-15

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=KY8yajgPWPo (3min 31sec) [Electrostatic discharge]
2. https://www.youtube.com/watch?v=h-0gNl5f4BU (2min 39sec) [The science of lightning]

TOPIC OVERVIEW:

Energy transfer in electrical systems

Term 3, Weeks 2A – 4C

A. TOPIC OVERVIEW

TERM 3, WEEKS 2A – 4C

- This topic runs for 3 weeks.
- It is presented over 9 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 8	GRADE 5
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• A source of energy has energy stored waiting to be used, or energy that is needed to make something happen • The National Electricity Grid is a system (circuit) • The wires transfer energy to the electrical appliances and lights	• A circuit is a system for transferring electrical energy • A closed circuit is needed to make a device work • A circuit is a complete conducting pathway for electricity with a number of components • Conducting wires are made of metal • Switches control electrical circuits • Cells/ batteries are sources of energy • Resistors are made of materials that resist the flow of an electrical current • Effects of an electric current o A current can heat a resistance wire	• A cell is a system in which certain chemical reactions can cause the flow of electricity through an external circuit • Cells are a source of electricity • A battery is a group of cells that are connected together • A resistor is a conducting material selected to control the current or to provide useful energy transfer, such as in bulbs, rheostats, motors, light sensitive diodes and light emitting diodes

	o A current causes a magnetic field o A current can cause a chemical reaction in a solution	

C. SCIENTIFIC VOCABULARY

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

	TERM	EXPLANATION
1.	system	A system consists of parts that work together to make something happen.
2.	electric circuit	A path through which electric charges can move
3.	conducting wire	A material through which electric charges can flow
4.	switch	A device that is used to control the flow of charge in a circuit
5.	cell	A chemical system that stores electrical potential energy
6.	battery	Two or more cells forming a chemical system that stores electrical potential energy
7.	resistor	A device that opposes the flow of current
8.	circuit diagram	A simple diagram of an electric circuit that use standard symbols to represent the basic components of the circuit
9.	electrical current	The flow of electric charges in a closed circuit
10.	filament	Very thin thread or wire
11.	delocalised	Electrons are delocalised when they are able to move from one atom to another. They do not stay with one nucleus.
12.	resistance	Opposition to flow of electrical current
13.	electrolyte	A solution that contains positive and negative ions and can conduct electricity
14.	short circuit	A short circuit occurs when an electric current takes the path of lowest resistance along an unintended path
15.	electrolysis	The process by which a compound is decomposed into simpler substances when an electric current passes through it
16.	fuse	Its a short length of metal that breaks the circuit when it overheats and melts
17.	ion	An atom or molecule with a positive or negative electric charge due to the loss or gain of electrons

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

Learners will understand that a circuit is a system for transferring electrical energy from a battery, which is a source of electrical energy, through conducting wires, to a device, such as a light bulb or a resistor that resists the flow of current. A closed circuit is needed for an electrical current to flow. The flow of current can then be controlled by switch. Lastly, learners will know that an electrical current can cause a resistor to be heated, a magnetic field around a conductor and a chemical reaction in a solution.

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 3, Week 2, Lesson A
Lesson Title: Circuits: Electrical systems
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Circuits and current electricity
CAPS Page Number	47

Lesson Objectives

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

- define a circuit
- explain how a circuit works
- describe the energy changes in a circuit.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 8: Parts of a light torch	Light torch
Resource 9: Simple circuit	

C CLASSROOM MANAGEMENT

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

What is lightning?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

Lightning is the discharge of negative charges or electrons from the clouds to the Earth.

D ACCESSING INFORMATION

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

CIRCUITS

1. A **circuit** is a **system** that transfers electrical energy to a device, such as an electrical appliance, to make it work.
2. An input energy is needed for a system to work. It is changed to output energy: input energy → system → output energy.
3. Devices, such as a light bulb or a resistor wire in an oven, can only work when they are connected in a circuit.
4. A circuit provides a complete conducting pathway for electricity to move to an appliance.
5. In a circuit, there is a transfer of electrical energy to other forms of energy, such as heat energy or light energy.
6. In a light bulb, electrical energy is converted to light and heat energy: Electrical energy → light bulb → light and heat energy

2. Explain this to the learners as follows:
   a. A circuit is a system for transferring electrical energy through the movement of charges.
   b. A circuit provides a complete conducting pathway along which electric charges can move to an appliance where it does its work.

c. The electrical energy in the circuit is used to make a device, such as a light bulb, shine.
d. A system needs input energy to produce output energy that is useful.
e. A circuit converts electricity into other types of energy.
f. Electricity is the common word that we use for electrical energy.

3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners to copy the information on the chalkboard into their workbooks.
6. Tell the learners 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 electrical circuit?
b. What is the purpose of a circuit?

Answers to the checkpoint questions are as follows:

a. It is a system used for the transfer of electrical energy.
b. A circuit is used to make an electrical device work.

E CONCEPTUAL DEVELOPMENT

1. Show the learners Resource 8. If a light torch is available, it can be opened and the components shown to the learners. Explain the following to the learners:
   a. In the previous lesson, you have learned that electric charges can be transferred from one object to another. Electrical charges can jump from one object to another object to cause a spark or a shock.
   b. A path can be created for these electric charges to move from one object to another. This path is called a circuit. A circuit is a complete pathway of electrical conductors (including cell and battery) through which charges flow.
   c. A torch is a system that uses the energy from the batteries to provide light.
   d. The torch is made up of parts that make the light bulb shine.
   e. All the components of the torch work together to form a system that transfers energy. These components are the battery, conducting wires, switch and light bulb.
   f. Inside the casing of the torch a circuit provides a pathway for the electrons to take electrical energy to the light bulb so that it can work.
   g. Electrons get electrical energy from the battery. When the electrical energy reaches the light bulb, some of the electrical energy is used to heat the filament in the light bulb and make it glow.
   h. Electrical energy is transferred to heat and light energy.
2. The learners have to complete the following task in their workbooks. Write the task on the chalkboard (always try to do this before the lesson starts). Show the learners Resource 9.

TASK

Study the example of the simple circuit, and then answer the following questions.

a. What are the parts that make up this system?
b. What is the system used for?
c. What part does the work?
d. What part provides the electrical energy?
e. How is the electrical energy transferred to the light bulb?
f. What is the input energy of the system?
g. What is the output energy of the system?
h. What energy transfer takes place in the system?

3. Give the learners enough time to complete the task.
4. Give the answers to the learners.

MODEL ANSWER

a. A battery, light bulb, switch, conducting wire
b. It is used for transferring electrical energy to the light bulb.
c. The light bulb
d. It is the battery
e. The electrical energy is carried through the charges to the light bulb.
f. Electrical energy
g. Light and heat energy
h. Electrical energy transfers into light and heat energy.

Checkpoint 2

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

a. Why is a torch a system?
b. What are the components of a torch?

Answers to the checkpoint questions are as follows:

a. It has many components that work together to let the light bulb of the torch shine.
b. Battery, conducting wire, light bulb, switch

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
Successful Natural Sciences	Energy transfer in electrical systems	106
Top Class Natural Sciences	Energy transfer in electrical systems	107-108
Via Africa Natural Sciences	Energy transfer in electrical systems	106
Solutions for All Natural Science	Energy transfer in electrical systems	136
Spot on Natural Sciences	Energy transfer in electrical systems	104-105
Platinum Natural Sciences	Energy transfer in electrical systems	135-137
Step-by-step	Energy transfer in electrical systems	84
Natural Sciences	Energy transfer in electrical systems	141-142
Sasol Inzalo Bk B	Energy transfer in electrical systems	20-22

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=VnnpLaKsqGU (2min 27sec) [Explaining an electrical circuit]

2 B

Term 3, Week 2, Lesson B
Lesson Title: Electrical current
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Circuits and current electricity
CAPS Page Number	47

Lesson Objectives

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

- explain what an electrical current is
- give the requirements for an electrical current
- differentiate between an open and a closed circuit
- use a model to explain an electrical current.

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
Garden hose connected to a water tap	Any pipe, jug of water
A wheel that can spin on an axis	A cardboard wheel with a pencil as an axis

C CLASSROOM MANAGEMENT

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

What is a circuit?

3. Learners should enter the classroom, then discuss the seven life processes with the teacher and then answer the question in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

A circuit is a system which is used to transfer electrical energy to devices to do work.

D ACCESSING INFORMATION

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

ELECTRICAL CURRENT

1. An **electric current** is the flow of negative charges along a conductor in a closed circuit.
2. A closed circuit is a complete pathway through which current is flowing.
3. An open circuit is an open pathway through which no current is flowing.
4. An electric circuit provides an uninterrupted endless path for the flow of a current.
5. The battery provides energy to electrons so that they can move in the circuit.

2. Explain this to the learners as follows:
   a. Electric current is a constant movement of negative charges from an energy source along a conductor in a circuit.
   b. A complete or closed circuit is one in which there are no breaks in the circuit, and the electricity can flow in a continuous pathway around the circuit.
   c. An open circuit is one in which electric current cannot flow, as the pathway for the charges to flow is not complete.
   d. An electric circuit must have a complete conducting pathway for the electrical current to flow to a device.
   e. Only negative charges flow in an electrical current
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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 electrical current?
b. When is a circuit open?

Answers to the checkpoint questions are as follows:

a. It is a flow of negative charges.
b. In an open circuit, the circuit is broken so that the charges cannot move.

E CONCEPTUAL DEVELOPMENT

1. Take the learners to where the garden hose is connected to a tap. Explain the following to the learners:
   a. Current electricity is different to static electricity. Let a learner fill his/ her mouth with water and then spit it out. This is the build-up of (water in the mouth) and discharge of electrical charge in the form of a shock or spark.
   b. If we provide a path for the electrical charges to flow to a device, the charges will move through the electrical circuit. Similarly, the hose provides a path for the water to flow to a place where we need it.
   c. This flow of electric charges is called an electrical current.
   d. The electrons will not move by themselves. They need a source of energy to move. The battery provides them with energy to move through the circuit. In the case of the water, the tap provides pressure for the water to move through the hose.
   e. A closed circuit is needed to take the electric charges to a device, such as a light bulb, so that it can work.
2. When the garden hose is cut in half, the water will not be able to flow past the break in the hose to the place where it is needed.
   Ask the learners to model an electrical current. Write the task on the chalkboard (always try to do this before the lesson starts).

TASK

We use a model to explain something that we cannot see. We cannot see the flow of electric charge. So, we will use a model to explain an electrical current.

Follow the steps below:

a. Each learner is a negative charge. Let the learners stand behind each other in a circle.
b. Put the wheel on a table next to a learner.
c. Another learner acts as the battery and pushes one learner. That learner pushes the learner in front and so on until all the learners are moving. The 'battery learners' push each learner who passes the wheel.
d. When the learners pass the wheel, they must give it a spin and each passing learner must keep it spinning.

3. Give the learners enough time to complete the task.
4. Explain to the learners the following:
    a. The learner who pushes the other learners provides the input energy or electrical energy.
    b. The learners who spin the wheel provide output energy or kinetic energy to the wheel. They are the electrical current that moves through the circuit.

Checkpoint 2

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

a. What is needed for an electrical current to flow?
b. What happens when a circuit is open?

Answers to the checkpoint questions are as follows:

a. A source of energy and a closed circuit
b. The current cannot flow through the circuit.

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
Successful Natural Sciences	Energy transfer in electrical systems	106
Top Class Natural Sciences	Energy transfer in electrical systems	108
Via Africa Natural Sciences	Energy transfer in electrical systems	106
Solutions for All Natural Science	Energy transfer in electrical systems	136
Spot on Natural Sciences	Energy transfer in electrical systems	104-105
Platinum Natural Sciences	Energy transfer in electrical systems	136-137
Step-by-step	Energy transfer in electrical systems	84
Natural Sciences	Energy transfer in electrical systems	141-142
Sasol Inzalo Bk B	Energy transfer in electrical systems	20-22

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=KprFTxjQAoE (1min 24sec) [Electrons flow]

2 C

Term 3, Week 2, Lesson C
Lesson Title: Components of a circuit: Cells
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Components of a circuit
CAPS Page Number	47

Lesson Objectives

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

- explain the function of a cell in a circuit
- state the energy transfer that takes place in a circuit
- differentiate between a cell and a battery
- describe how cells are connected to form a battery.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 10: Parts of a dry cell	
Different types and sizes of batteries	

C CLASSROOM MANAGEMENT

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

What is an electrical current?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

It is the flow of charge in a closed circuit.

D ACCESSING INFORMATION

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

CELLS AND BATTERIES

1. Circuits are made up of different components. These components include cells, conductors, resistors and switches.
2. An electric circuit needs a source of energy to provide energy to the electrons so that they can move along a wire.
3. A cell is a source of electrical energy that can create an electric current.
4. A battery consists of two or more cells that are connected.
5. Cells are chemical systems that store potential energy in the form of chemical substances.
6. When the cell is connected in a circuit the chemicals react to produce electrical energy.
7. The electric current is the flow of charge along a conductor and is a form of kinetic energy, because the electrons are flowing.
8. All electric cells have two terminals, a positive terminal and a negative terminal.
9. Electrons move from the negative terminal of a cell to the positive terminal of the cell.
10. The positive terminal of a cell is connected to the negative terminal of the following cell to make a battery.
11. A cell goes flat when it no longer can provide energy to the circuit.

2. Explain this to the learners as follows:
    a. Several components make up an electrical circuit. These components include metal wires, switches, cells or batteries, resistors and light bulbs.
    b. Electrons do not move by themselves along a wire. They need energy to push them along a wire. All electric circuits must have a source of energy.
    c. A cell is a source of energy. A battery consists of two or more cells that are connected.
    d. Cells can be considered as chemical systems that are sources of energy. This stored energy is potential energy.
    e. A cell converts chemical energy into electrical energy.
    f. An electric cell has a positive terminal and a negative terminal.
    g. Electrons move out of the negative terminal of the cell through the connecting wires and back, to enter the cell through the positive terminal.
    h. When the chemicals in the electric cell are used up, the electric cell stops producing electrical energy. We say the cell is flat.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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. Why is it important that a cell be connected in a circuit?
b. What type of energy is stored in a cell?

Answers to the checkpoint questions are as follows:

a. A cell provides energy to the electrons so that an electric current can flow.
b. Potential energy

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners:
    a. There must be at least three components in a circuit. One is a source of electrical energy, such as a cell or battery of cells. The others are a wire and a light bulb.
    b. There are different types of cells. Cells with different sizes provide different amounts of energy. Show the learners examples of different cells.
    c. Electric cells are used in cameras, clocks, remote controls and motor cars.
    d. Cells are sold as batteries in shops but in Science a battery has the meaning of two or more cells that are connected.
    e. Show the learners Resource 10. An electric cell has a small metal cap on one side and a metal disc on the other side. The metal cap is the positive terminal and the metal disc is the negative terminal of the cell.

f. A cell contains chemicals that store energy in the form of potential energy. It produces electrical energy from the potential energy in the chemicals.

g. This energy causes a current to flow as it works to move the charges through the circuit. The electrons move from the negative terminal of a cell to the positive terminal of the cell.

h. When the chemicals are used up, the cell cannot produce energy and the cell is flat.

i. In rechargeable batteries, the chemical reaction that generates electrical energy is reversible. These batteries can be used over and over again.

2. The learners must complete the following task in their workbooks. Write the task on the chalkboard (always try to do this before the lesson starts).

TASK

Draw a battery that contains three cells that are correctly connected. Now answer the following questions.

a. Indicate the positive and negative terminals of the cells.

b. Indicate the direction in which the electrons move through the cells.

c. What type of energy does a cell have?

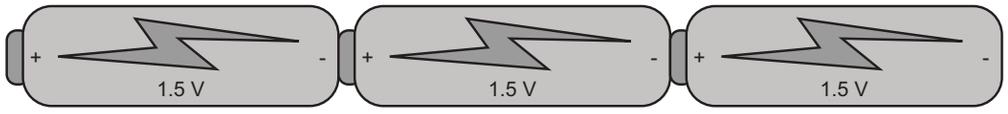
d. What is the energy change that takes place in a cell?

3. Give the learners enough time to complete the task.

4. Model answer

MODEL ANSWER

a.



b. See diagram in a.

c. Potential energy

d. Chemical energy to electrical energy

Checkpoint 2

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

a. What is the positive terminal of a cell?

b. How are cells connected in a battery?

Answers to the checkpoint questions are as follows:

a. The positive terminal of a cell is the metal cap.

b. The positive terminal of a cell is connected to the negative terminal of the following cell.

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
Successful Natural Sciences	Energy transfer in electrical systems	108
Top Class Natural Sciences	Energy transfer in electrical systems	110
Via Africa Natural Sciences	Energy transfer in electrical systems	107
Solutions for All Natural Science	Energy transfer in electrical systems	139
Spot on Natural Sciences	Energy transfer in electrical systems	104
Platinum Natural Sciences	Energy transfer in electrical systems	139-140
Step-by-step	Energy transfer in electrical systems	84
Natural Sciences	Energy transfer in electrical systems	142-143
Sasol Inzalo Bk B	Energy transfer in electrical systems	26

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.explainthatstuff.com/batteries.html [How do batteries work? A simple introduction]

3 A

Term 3, Week 3, Lesson A
Lesson Title: Components of a circuit: Wires and switches
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Components of a circuit
CAPS Page Number	47

Lesson Objectives

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

- describe what a conductor is
- explain why a metal is a conductor
- explain how a switch works
- determine what materials are good conductors of electricity.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 11: Electric conductor	
Resource 12: Circuit with open switch	
Resource 13: Circuit with closed switch	
Cell, light bulb, connecting wires, different objects, such as wood, paper, key, nail, coins, wool	

C CLASSROOM MANAGEMENT

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

What is the difference between a cell and a battery?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

A cell is one device that can provide electrical energy while a battery consists of two or more cells that are connected.

D ACCESSING INFORMATION

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

CONDUCTORS AND SWITCHES

1. A material that allows electrical energy to flow through it easily is called a conductor.
2. Metals, such as copper, are good conductors of electricity.
3. A **conducting wire** is made of metal and can carry electricity over short and long distances.
4. Electrical current is the flow of electrons in a closed, conducting circuit.
5. A metal contains many free electrons that can easily move through the metal.
6. A **switch** is a device that is used to control the flow of current through a circuit.
7. If a switch is open, the circuit is broken and no current will flow.
8. If a switch is closed, the circuit is complete and a current will flow.
9. A switch provides a convenient way of protecting a circuit from damage, if the flow of electricity is too high.

2. Explain this to the learners as follows:
    a. One of the basic components of an electric circuit is a conducting wire. It is insulated with plastic.
    b. A conductor, such as copper, allows an electric current to flow through it.
    c. Metals contain free electrons in the outermost shells of their atoms.
    d. Electrical current is the flow of electrons and, therefore, metals can conduct electricity readily due to the presence of these free electrons.
    e. A switch is connected to a circuit so that it can break the flow of electric charge in the conducting wire. It provides a convenient way of controlling electrical circuits, because it allows you to stop or start the electric current.
    f. When the switch is open, there is a break in the circuit and the charges stop flowing.
    g. When the switch is closed, the circuit is complete, and a charge can flow.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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 a conductor of electricity?
b. Why is a switch included in a circuit?

Answers to the checkpoint questions are as follows:

a. A conductor is a material that allows an electrical current to flow through it.
b. A switch can be used to allow a current to flow or not.

E CONCEPTUAL DEVELOPMENT

1. Take the learners to where the garden hose is connected to a tap. Explain the following to the learners:
    a. A conducting material is needed to provide a path for the electrons to move from the source of energy, which is a cell or battery, to a device, such as a light bulb.
    b. Show the learners Resource 11. It shows the atoms of a metal. The protons and neutrons of an atom are situated in the nucleus.
    c. The electrons move freely in the outer space around the nucleus of the atom.
    d. The nuclei and inner electrons are arranged in a fixed pattern, while the outer electrons are able to move from one atom to another. We say that they are delocalised because they do not stay with one nucleus.
    e. When the metal wire is connected to a source of energy, the electrons get energy and move in the same direction through the wire to form an electric current.
    f. The electrons will move only when the circuit is closed and there is a complete pathway through which they can move.

g. Show the learners Resource 12. A switch in a circuit can open a circuit so that the electrons cannot move and no electrical current can travel to the light bulb. The result is that the light bulb will not shine.

h. Show the learners Resource 13. A switch can also close a circuit so that electrons can move and form an electrical current through the light bulbs which will then shine.

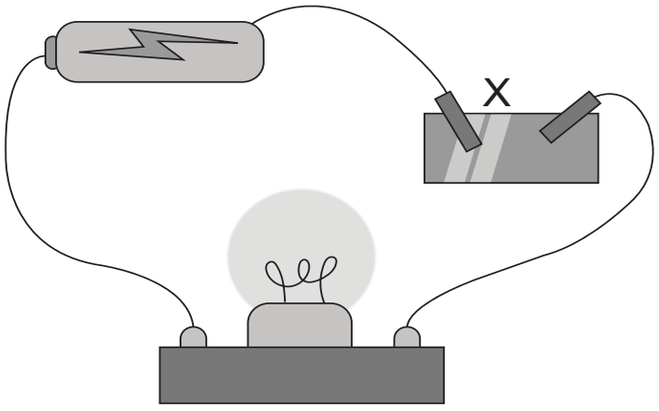
i. We use switches to turn electrical appliances, such as fans, lights and heaters, on and off.

j. The mains switch in a house controls how much electrical energy flows into a house. When there is a sudden increase in electrical energy, the mains switch will 'trip' and break the circuit so that a current cannot flow.

2. Ask the learners to complete the following investigation in their workbooks. Write the task on the chalkboard (always try to do this before the lesson starts). Hand out cells, connecting wires, light bulbs and different materials.

INVESTIGATION

Some materials conduct electricity while others do not. Set up an electric circuit, as in the diagram below, to investigate which materials are good conductors of electricity.



Connect the different materials in the circuit at X. Write down your observations in the table below.

Objects	Material the object is made of	Does the light bulb shine?	Is the material a conductor?

What is your conclusion?

3. Give the learners enough time to complete the investigation.
4. *Model answer (only a few examples are given below).*

MODEL ANSWER

Objects	Material the object is made of	Does the light bulb shine?	Is the material a conductor?
Wooden block	*Wood*	*No*	*No*
Paper	*Paper*	*No*	*No*
Keys	*Metal*	*Yes*	*Yes*
Nails	*Metal*	*Yes*	*Yes*

What is your conclusion?

Any object that is made of a metal conducts electricity and lets the light bulb shine. All other materials do not conduct electricity and the light bulb will not shine.

Checkpoint 2

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

a. Why is a metal able to conduct electricity?
b. What happens to a light bulb in a circuit when the switch is open?

Answers to the checkpoint questions are as follows:

a. It has electrons that are free to move between atoms.
b. The light bulb will not shine because a current is not flowing through it.

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
Successful Natural Sciences	Energy transfer in electrical systems	108
Top Class Natural Sciences	Energy transfer in electrical systems	109
Via Africa Natural Sciences	Energy transfer in electrical systems	107
Solutions for All Natural Science	Energy transfer in electrical systems	137
Spot on Natural Sciences	Energy transfer in electrical systems	104
Platinum Natural Sciences	Energy transfer in electrical systems	138-139
Step-by-step	Energy transfer in electrical systems	84
Natural Sciences	Energy transfer in electrical systems	144
Sasol Inzalo Bk B	Energy transfer in electrical systems	22

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=KprFTxjQAoE (1min 24sec) [Electrons flow]

3 B

Term 3, Week 3, Lesson B
Lesson Title: Components of a circuit: Resistors
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Components of a circuit
CAPS Page Number	48

Lesson Objectives

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

- define resistor and resistance
- explain the function of a resistor in a circuit
- describe the components of an incandescent light bulb.

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

SCIENCE PROCESS SKILLS

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 14: Parts of a light bulb	
A light bulb	

C CLASSROOM MANAGEMENT

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

What is the function of a switch?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

A switch can control the flow of current by breaking or closing the circuit.

D ACCESSING INFORMATION

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

RESISTORS

1. A **resistor** is a component of a circuit that resists or opposes the flow of an electric current in a circuit.
2. **Resistance** of an electrical device is the opposition to the flow of an electric current through the device.
3. A component that offers low resistance is called a good conductor. A component that offers high resistance is a poor conductor.
4. A resistor uses the electrical energy that is carried by an electrical current and can change it to heat energy or light energy. A light bulb is an example of light energy.
5. Resistors in a circuit can be used to control the amount of electrical current flowing in that circuit and maintain a safe current through the components.
6. The higher the resistance in a circuit, the smaller the current will be that can flow through the circuit.
7. There are two types of resistors: fixed resistors with a fixed resistance, and variable resistors where the resistance can be changed.

2. Explain this to the learners as follows:
    a. A resistor is a device that resists or opposes the flow of electrical current in a circuit. It makes it difficult for charges to flow along the conductor.
    b. Resistance is a terms that describes the forces that oppose the flow of electric current in a conductor.
    c. A resistor has two terminals across which electricity must pass, and it uses the energy of the electrons.
    d. A good conductor has a low resistance, while a poor conductor has a high resistance to the flow of electrical current.
    e. Some of the energy in an electric current is transferred to the resistor as the current flows through it. The electrical energy is then changed to useful energy.
    f. Resistors are used to control the amount of current flowing in a circuit. If there are no resistors to slow down the flow of an electrical current, too much current may flow through the circuit and damage its components or wires.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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 a resistor?
b. How does resistance affect the flow of an electrical current?

Answers to the checkpoint questions are as follows:

a. A resistor is a device that opposes the flow of an electrical current.
b. The higher the resistance, the lower the current and the lower the resistance, the higher the current.

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners:
    a. Resistance is a term that describes the forces that oppose the flow of electric current in a conductor.
    b. Whenever an electric current flows in a conductor, there is resistance to the flow of electrons. All materials naturally contain some resistance to the flow of electric current. Some substances provide more resistance than others.
    c. Resistors are found in computers, televisions and telephones where they are used to control the flow of electrical current.
    d. A variable resistor or rheostat can be used to change the resistance in a circuit. An example is a dimmer switch for lights. It makes the light in a room dimmer or brighter.
    e. Resistors are also used to provide useful output energy. Such an example is a light bulb.

f. Show the learners Resource 14 and explain to them how a light bulb works. You should also show them a real light bulb.

g. A light bulb contains a resistance wire, called a filament. The filament is connected to two contact points, which are the screw part or casing and the foot contact. These two points are separated by an insulator that prevents a flow of current between them.

h. When a current flows through the filament, the flow of current is slowed down. Some of the electrical energy is changed to heat energy as the filament heats up. Then the electrical energy is also changed to light energy as the filament becomes white hot and produces light.

i. An incandescent bulb is a bulb that gets so hot that it gives out light.

2. The learners have to complete the following task in their workbooks. Write the task on the chalkboard (always try to do this before the lesson starts).

TASK

Write down the following paragraph and fill in the missing words.

A resistor _____ the flow of electrical current. This is called _____. A resistor can be used to _____ the flow of electrical current or change _____ energy to _____ energy. A resistor that can change the resistance in a circuit is called a _____ or _____. If the resistance in a circuit is _____, the flow of current will decrease. If the resistance in a circuit is decreased, the flow of current will _____. The resistor in a light bulb is called a _____. It _____ to produce light.

3. Give the learners enough time to complete the task.
4. Let one of the learners read his or her completed paragraph and the rest of the class should evaluate the answer.
5. Model answer

MODEL ANSWER

A resistor resists/opposes the flow of electrical current. This is called resistance. A resistor can be used to control the flow of electrical current or change electrical energy to light energy. A resistor that can change the resistance in a circuit is called a variable resistor or rheostat. If the resistance in a circuit is increased, the flow of current will decrease. If the resistance in a circuit is decreased, the flow of current will increase. The resistor in a light bulb is called a filament. It heats up to produce light.

Checkpoint 2

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

a. What type of energy conversion takes place in a cell?
b. What part of a light bulb provides light?

Answers to the checkpoint questions are as follows:

a. Electrical energy is converted to light energy and heat energy.
b. The filament of the light bulb

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
Successful Natural Sciences	Energy transfer in electrical systems	109
Top Class Natural Sciences	Energy transfer in electrical systems	111
Via Africa Natural Sciences	Energy transfer in electrical systems	107
Solutions for All Natural Science	Energy transfer in electrical systems	140
Spot on Natural Sciences	Energy transfer in electrical systems	104
Platinum Natural Sciences	Energy transfer in electrical systems	140
Step-by-step	Energy transfer in electrical systems	86-87
Natural Sciences	Energy transfer in electrical systems	145-146
Sasol Inzalo Bk B	Energy transfer in electrical systems	27-30

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://youtu.be/25-IZe-9xCY (9min 54sec) [What is resistance?]

3 C

Term 3, Week 3, Lesson C
Lesson Title: Circuit diagrams
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Components of a circuit
CAPS Page Number	47

Lesson Objectives

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

- give symbols for electrical components in a circuit
- draw an electrical circuit diagram
- interpret an electrical circuit diagram.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 12: Circuit with an open switch	
Resource 13: Circuit with a closed switch	

C CLASSROOM MANAGEMENT

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

What is the function of a resistor?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

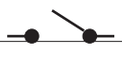
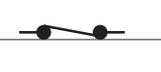
A resistor can control the flow of current or change electrical energy to heat and light energy.

D ACCESSING INFORMATION

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

CIRCUIT DIAGRAMS

1. A circuit is a complete pathway for conducting electricity. It connects a number of components.
2. A **circuit diagram** is a simplified representation of a circuit where symbols are used to represent the components.
3. There are standard symbols for the components of a circuit. These symbols are shown in the table.

Component	**Symbol**
Light bulb	
One cell	
Battery	
Open switch	
Closed switch	
Conductor	

4. The flow of electrons takes place from the negative terminal to the positive terminal of a cell. Conventional current flow takes place from the positive terminal to the negative terminal of a cell.

2. Explain this to the learners as follows:
   a. All the components of a circuit work together to form a system that transfers electrical energy.
   b. A circuit diagram is a simple diagram of an electric circuit that uses standard symbols to represent the basic components of the circuit.
   c. Conventional current is always indicated on the line of a conductor with an arrow from the positive terminal to the negative terminal of a conductor.
   d. The circle represents the glass light bulb and the cross inside represents the filament that lights up inside the bulb when the circuit is closed.
   e. The symbol for a cell is a long line that represents the positive terminal and the short line the negative terminal. If more than one cell is connected, a battery is formed.
   f. The conductor is represented by an unbroken line.
   g. We can draw a switch in an open or closed position.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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 the positive terminal on the symbol of a cell?
b. What does the cross on the symbol of a light bulb represent?

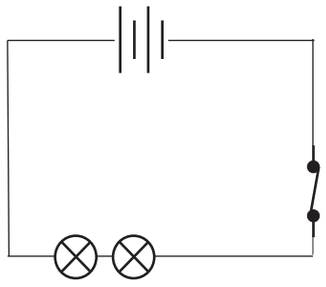
Answers to the checkpoint questions are as follows:

a. It is the longer line.
b. The filament

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners:
   a. Show the learners Resource 13. Ask them to draw the circuit exactly as it is on the page.
   b. Electrical symbols make drawing circuits easier than realistic pictures.
   c. A circuit diagram is a drawing of an electrical circuit using symbols for the components. Ask the learners to draw a circuit diagram below the one they drew of Resource 13.

   [Answer:]



d. The conventional current flow is shown on a circuit diagram, when a circuit is closed. Arrows are placed on the conducting wires.

e. Circuit diagrams are usually drawn in a rectangular or square shape.

2. Ask the learners to complete the following task in their workbooks. Write the task on the chalkboard (always try to do this before the lesson starts). Show the learners Resource 12.

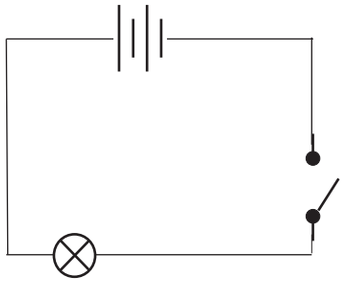
TASK

Look at the circuit that the teacher is showing you.

a. Draw the circuit diagram.
b. How many cells are in the circuit?
c. Which component stores electrical energy?
d. Is an electrical current flowing through the circuit? How do you know this?
e. What happens to the light bulb when the switch is closed? Why do you say so?
f. What do you have to add to the circuit diagram when the switch is closed?

3. Give the learners enough time to complete the task.
4. Model answer

MODEL ANSWER

a. 

b. Two cells
c. The two cells store electrical energy.
d. No, a current is not flowing because the switch is open.
e. The light bulb will shine because the circuit is closed.
f. The arrow that shows the direction of the flow of the conventional current

Checkpoint 2

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

a. What is the direction of the conventional current?
b. How are cells drawn to form a battery?

Answers to the checkpoint questions are as follows:

a. From the positive terminal to the negative terminal of a cell
b. The negative terminal of one cell is drawn next to the positive terminal of the following cell.

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

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
Successful Natural Sciences	Energy transfer in electrical systems	109
Top Class Natural Sciences	Energy transfer in electrical systems	111
Via Africa Natural Sciences	Energy transfer in electrical systems	107
Solutions for All Natural Science	Energy transfer in electrical systems	140
Spot on Natural Sciences	Energy transfer in electrical systems	104
Platinum Natural Sciences	Energy transfer in electrical systems	140
Step-by-step	Energy transfer in electrical systems	86-87
Natural Sciences	Energy transfer in electrical systems	145-146
Sasol Inzalo Bk B	Energy transfer in electrical systems	27-30

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=taszKVykMBQ (1min 10sec) [How to draw an electric circuit]

4 A

Term 3, Week 4, Lesson A
Lesson Title: Effect of an electric current: Heat
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Effects of an electric current
CAPS Page Number	48

Lesson Objectives

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

- explain the heating effect of a current
- explain what a short circuit is
- relate a short circuit to the heating effect of a current
- describe a fuse.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 15: Short circuit	
Resource 16: A fuse	
Cells, light bulbs, switches, conducting wires, resistors (steel wool, nichrome wire)	
Examples of fuses	

C CLASSROOM MANAGEMENT

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

What is the symbol of a battery?

3. Learners should enter the classroom, then discuss the seven life processes with the teacher and then answer the question in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

D ACCESSING INFORMATION

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

THE HEAT EFFECT OF AN ELECTRIC CURRENT

1. A resistance wire can be heated when an electric current flows through it.
2. When an electric charge flows through a resistor, electrical energy is converted to heat energy. This heat energy can be used in a light bulb, stove, heater and toaster.
3. The electrons that pass through a wire give some of their electrical energy to the atoms in the wire. These atoms start to vibrate more and the wire gets hotter.
4. A **short circuit** occurs when an electric current takes the path of lowest resistance.
5. Short circuits are dangerous. When too large a current passes through a conducting wire, it melts and causes the insulation to start burning.
6. As a safety precaution, circuits in houses and cars can be fitted with fuses to prevent fires caused by electrical faults. Fuses prevent circuits from overheating.
7. A **fuse** is a short length of metal with high resistance and low melting point. It breaks the circuit when it overheats and melts.

2. Explain this to the learners as follows:
    a. Electric currents cause many effects, such as the heating of a resistance wire.
    b. When the electrons pass through a wire, some of their electrical energy is given to the atoms in the wire. These atoms start to vibrate more and the wire gets hotter as more heat energy is transferred to the atoms.
    c. The greater the resistance of the wire, the more energy is transferred to the atoms.
    d. A short circuit occurs when there is an easier pathway with less resistance created in the circuit for the current to flow.
    e. A short circuit is dangerous. It causes large currents to flow, drain the energy from the cells, and may cause damage to other components in the circuit, or even electrical fires.
    f. A fuse is a type of safety device that is used to protect the circuit from the heating effect of an electric current. It consists of a special wire that melts when too much electric current flows through the appliance. Show the learners Resource 16 and other examples of fuses.
    g. When the fuse melts, it breaks the circuit and stops electricity flowing.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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 a short circuit?
b. What is the function of a fuse?

Answers to the checkpoint questions are as follows:

a. A short circuit is the pathway of least resistance that a current can take.
b. A fuse protects a circuit from overheating.

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners:
    a. A wire heats up when an electric current flows through it. We call this the heating effect of an electric current.
    b. When a current flows through a resistor, the electrons have to use their electrical energy to get past the resistance of the atoms of the resistor. The moving charges bump into the atoms of the metal with enough force to make them vibrate faster and gain kinetic energy. The result is that the wire gets hot.
    c. The greater the current the hotter the resistor becomes, because more energy is transferred to the atoms in the resistor.
    d. The greater the resistance of the resistor, the more energy is transferred to the atoms. The electrons have to use more electrical energy to overcome the resistance and this energy is changed to heat energy in the resistor.
    e. Electrical energy is converted to heat energy.

f. The heating effect of a current has many advantages. It is used in appliances that provide heat, such as heaters, stoves, kettles and hair dryers, all of which contain high resistance wires.

g. The heating effect is used in incandescent light bulbs where heat is used to produce light. The filament of a light bulb is made of tungsten, which is a metal with a very high resistance. When an electric current flows through a light bulb, the current in the circuit heats the filament to very high temperatures (2500°C). It becomes white-hot and gives off light.

h. Electricity tends to take the easiest path through a circuit, which is the path of least resistance. This path might not be intended and is called a short circuit. A lower resistance means a bigger current and a greater heating effect. This can cause a wire to melt or burn.

i. A short circuit can occur when a conductor is connected directly to both terminals of a cell or when two wires are not properly insulated and touch each other. The current will flow from the one wire to the next wire without completing the intended circuit.

j. Show the learners Resource 15. When the blue and red conductors touch at a place where they are not insulated, there is a direct path through the wires from the positive terminal to the negative terminal of a battery. The electric charges will flow directly back to the battery and will not flow to the light, because it is the path of least resistance.

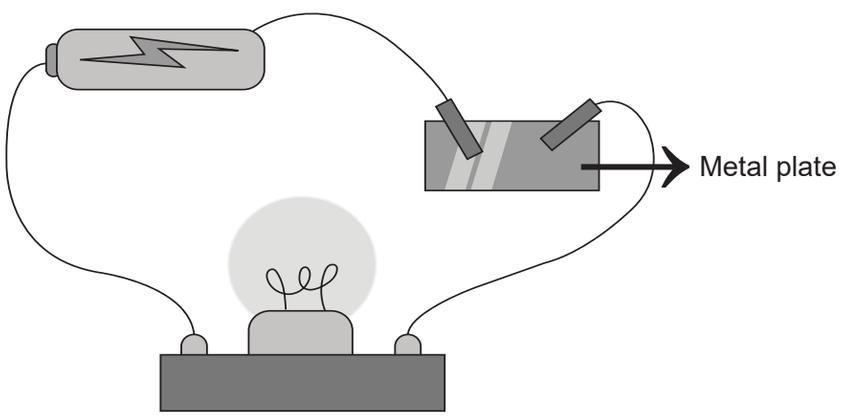
k. When a circuit overheats, the wire of a fuse will melt and break the circuit.

l. The fuse will break the circuit and prevent the circuit from becoming overloaded. When a fuse breaks the circuit, the appliance has to be fixed before a new fuse is fitted.

2. Do the following demonstration of the heating effect of an electric current. The learners have to make observations and record it in their workbooks. They also have to answer the questions that follow the demonstration. Write the task on the chalkboard (always try to do this before the lesson starts).

   a. You will need three cells, connecting wires, a light bulb and strands of steel wool.

   b. Set up the circuit as below with a strand of steel wool in the place of the metal plate.



   c. Let one of the learners touch the strand of steel wool, or hold a hand over the strand of steel wool, when the current flows through the circuit.

   d. Add more cells to the circuit.

DEMONSTRATION

A current can heat a conductor when it flows through the conductor. Your teacher is going to demonstrate this heating effect. Observe what happens. Record your observations in your workbook and complete the questions that follow.

a. Does the light bulb shine? What does this tell you?
b. What do you feel when you bring your hand closer to the steel wool or when you touch it? The teacher adds cells to the circuit.
c. What do you think happens to the current in the circuit?
d. What happens to the steel wool?
e. What do you predict will happen when even more cells are added to the circuit?
f. Why can we call the steel wool a fuse?

3. Give the learners enough time to complete the task.
4. Model answer

MODEL ANSWER

a. That a current is flowing in the circuit.
b. The steel wool is warm.
c. The current increases.
d. The steel wool becomes hotter.
e. The steel wool will eventually melt or start to burn.
f. The steel wool will break the circuit when it becomes too hot.

Checkpoint 2

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

a. What is the energy change that takes place when a conductor is heated?
b. Which appliances use the heating effect to their advantage?

Answers to the checkpoint questions are as follows:

a. Electrical energy to heat energy
b. Stoves, kettles and heaters

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
Successful Natural Sciences	Energy transfer in electrical systems	112-114
Top Class Natural Sciences	Energy transfer in electrical systems	112-113
Via Africa Natural Sciences	Energy transfer in electrical systems	109-112
Solutions for All Natural Science	Energy transfer in electrical systems	142-144
Spot on Natural Sciences	Energy transfer in electrical systems	112-115
Platinum Natural Sciences	Energy transfer in electrical systems	144
Step-by-step	Energy transfer in electrical systems	88-90
Natural Sciences	Energy transfer in electrical systems	148-152
Sasol Inzalo Bk B	Energy transfer in electrical systems	31-35

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=MO4dY5XWbRQ (4min 56sec) [Completing a circuit using steel wool and a battery]

4 B

Term 3, Week 4, Lesson B
Lesson Title: Effect of an electric current: Magnetic effect
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Effects of an electric current
CAPS Page Number	48

Lesson Objectives

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

- define a magnet
- explain the magnetic effect of an electric current
- describe how an electromagnet works
- provide some applications of electromagnets.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 17: Magnetic effect of an electric current	
Resource 18: Electromagnet	
Resource 19: Electromagnet picking up scrap metal	
Cell, insulated wire, iron nail, objects made from iron, such as paper clips	

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 device can be used to protect a circuit against overheating?

3. Learners should enter the classroom, then discuss the seven life processes with the teacher and then answer the question in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

A fuse.

D ACCESSING INFORMATION

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

MAGNETIC EFFECT OF AN ELECTRIC CURRENT

1. A magnet is a material that has a magnetic field around it. When another magnet is placed in this magnetic field, it experiences a force of attraction or repulsion.
2. A material that contains iron, nickel or cobalt is called a permanent magnet. A bar magnet is permanently magnetic.
3. A magnet has a N-pole and a S-pole.
4. A compass can be used to determine the pole of a magnet. It always points towards the N-pole.
5. A current causes a circular magnetic field around it.
6. A conductor behaves like a magnet when current flows through it. When no current flows through the conductor, it has no magnetic effect. The conductor acts as a temporary magnet.
7. An electromagnet is a temporary magnet that is made up of a soft iron core with a coil of insulated copper wire wound around it.
8. An electromagnet is created and controlled by electricity. It only acts as a magnet when current flows through the copper wire.

2. Explain this to the learners as follows:
    a. A magnet can repel or attract another magnet. Iron, nickel and cobalt are the only materials that are magnetic.
    b. Most magnets, like the ones on refrigerators, cannot be turned off. They are called permanent magnets because they are magnetic all the time.
    c. A magnet has a N-pole and a S-pole that are indicated by a compass.
    d. When current passes through a conductor, a magnetic field is generated. A compass can be used to prove that a magnetic field surrounds the conductor.
    e. Since a current-carrying conductor also produces a magnetic field, it can be used to make a magnet. Such a magnet is called an electromagnet.
    f. An electromagnet is a piece of metal that becomes a magnet when an insulated wire coiled around the metal carries an electric current. When the current is switched off, the magnetism disappears.
    g. An electromagnet is a temporary magnet, because it can be turned on and off.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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 materials are permanent magnets?
b. What do we call a temporary magnet?

Answers to the checkpoint questions are as follows:

a. Iron, nickel and cobalt
b. An electromagnet.

E CONCEPTUAL DEVELOPMENT

1. Show the learners Resource 17. Explain the following to the learners:
    a. When no current is flowing in the circuit, the light bulb will not shine, and the compass needle will not move. This shows that there is no magnetic field.
    b. When an electric current passes through the conductor, the light bulb will shine, and the electric current causes a magnetic field.
    c. This magnetic field deflects the compass. It means that the compass will move so that it points to the N-pole of the magnetic field.
    d. The current controls the magnetic field around the conductor.
    e. An electromagnet is also controlled by the current that flows through the conductor. When the switch in the circuit completes the circuit, the electromagnet acts as a magnet. When the switch breaks the circuit, the magnetism of the electromagnet is switched off.

f. Large electromagnetic cranes are used in scrap yards and are strong enough to lift heavy weights. Show the learners Resource 19. A switch allows current to flow in the forklift so that it attracts the metal objects. When the switch is opened to stop the current flow, the crane loses its magnetism and then the metal objects are released.

g. Electromagnets are used to lock security doors in banks and in circuit breakers in switch boxes in homes. As the current increases, the magnetic field becomes stronger until eventually it causes a switch to be tripped.

2. Show the learners how to make an electromagnet. Then do the demonstration. The learners should make observations and record them in their workbooks. They also must answer the questions that follow the demonstration. Write the task on the chalkboard (always try to do this before the lesson starts). Look at Resource 18.
   a. Wrap insulated copper wire around an iron nail.
   b. Bring the nail near paper clips that are made of iron.
   c. Attach the cell to the wire. Now bring the nail near the paper clips.
3. Give the learners enough time to complete the task.
4. Model answer

MODEL ANSWER

a. Nothing happens.

b. The paper clips are attracted to the nail.

c. If you attach a cell to the wire, an electric charge will flow, and the iron nail will become magnetised. Bring the nail close to the paper clip. The paper clip will be attracted to the nail. Walk carefully to the next desk with the nail and the cell. Disconnect the wire from the cell. The nail loses its magnetism and the paper clip will fall onto the desk.

Checkpoint 2

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

a. How do we know that a magnetic field exists around a current-carrying conductor?
b. What are two applications of electromagnets?

Answers to the checkpoint questions are as follows:

a. It deflects a compass needle.
b. Cranes at scrapyards and circuit breakers in homes

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
Successful Natural Sciences	Energy transfer in electrical systems	114-115
Top Class Natural Sciences	Energy transfer in electrical systems	113
Via Africa Natural Sciences	Energy transfer in electrical systems	112-115
Solutions for All Natural Science	Energy transfer in electrical systems	145-147
Spot on Natural Sciences	Energy transfer in electrical systems	116-117
Platinum Natural Sciences	Energy transfer in electrical systems	145-146
Step-by-step	Energy transfer in electrical systems	93-96
Natural Sciences	Energy transfer in electrical systems	152-154
Sasol Inzalo Bk B	Energy transfer in electrical systems	36-41

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=PwVuLK0Q-po (2min 43sec) [Homemade mini-electromagnet]
2. https://www.youtube.com/watch?v=cxELqN7wjS0 (2min 56sec) [How does an electromagnet work?]

4 C

Term 3, Week 4, Lesson C
Lesson Title: Effect of an electric current: Chemical change
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Effects of an electric current
CAPS Page Number	48

Lesson Objectives

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

- define an electrolyte
- identify an electrolyte
- explain the process of electrolysis
- describe the set-up of an electrolytic cell.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 20: Electrolysis	
Resource 21: Electrolysis of water	
Three cells, two connecting wires, two carbon electrodes, beaker, tap water, sulphuric acid	Pencil leads in the place of carbon electrodes, any sulphate salt that is available, such as sodium sulfate (Na_2SO_4)

C CLASSROOM MANAGEMENT

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

What is a magnet called that can be switched on and off?

3. Learners should enter the classroom, then discuss the seven life processes with the teacher and then answer the question in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

An electromagnet

D ACCESSING INFORMATION

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

THE CHEMICAL EFFECT OF AN ELECTRIC CURRENT

1. If an atom loses electrons it becomes a positively charged ion. If an atom gains electrons, it becomes negatively charged.
2. A salt is a compound that consists of positive ions and negative ions. When the salt dissolves in water the positive ions and negative ions are separated.
3. An **electrolyte** is a solution that contains positive and negative ions.
4. An electric current can cause a chemical reaction when it passes through an ionic solution. The ions change to new substances.
5. **Electrolysis** is the process by which ionic substances are decomposed into simpler substances, when an electric current is passed through them.
6. An electrolytic cell consists of a cell that is connected to two electrodes that are dipped in an electrolyte.
7. Tap water is a conductor of electricity because it contains ions. Distilled water cannot conduct electricity.
8. The energy conversion that takes place during electrolysis consists of chemical energy changing to electrical energy.

2. Explain this to the learners as follows:
    a. An ionic solution has positive and negative ions. A positive ion is an atom that lost electrons, while a negative ion is an atom that gained electrons.
    b. A solution containing free electrons, through which a current can pass, is called an electrolyte.
    c. When electricity is passed through an electrolyte, a chemical reaction occurs.
    d. A chemical reaction occurs when one or more chemicals react to create a different chemical.
    e. Because an ionic solution consists of charged particles, it will allow electricity to flow through it, causing a chemical reaction.
    f. An electric current can cause a chemical reaction in a solution. This process is called electrolysis.
    g. Water can conduct electricity because of the ions that it contains. Pure or distilled water cannot conduct electricity, because water molecules do not contain free electrons.
    h. During electrolysis chemical energy is converted to electrical energy.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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:

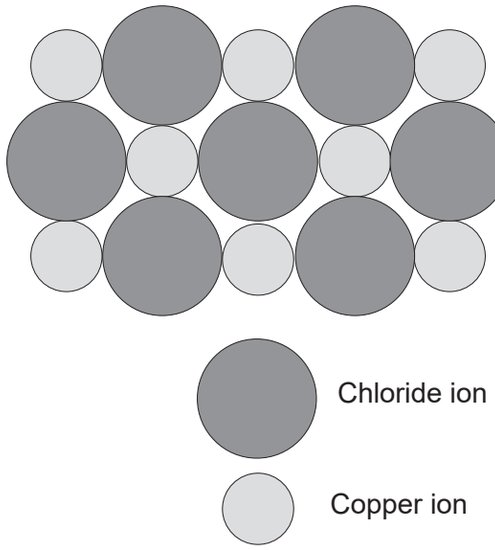
a. What do we call a solution that can conduct electricity?
b. What do we call the process where a compound is decomposed into its elements by means of an electric current?

Answers to the checkpoint questions are as follows:

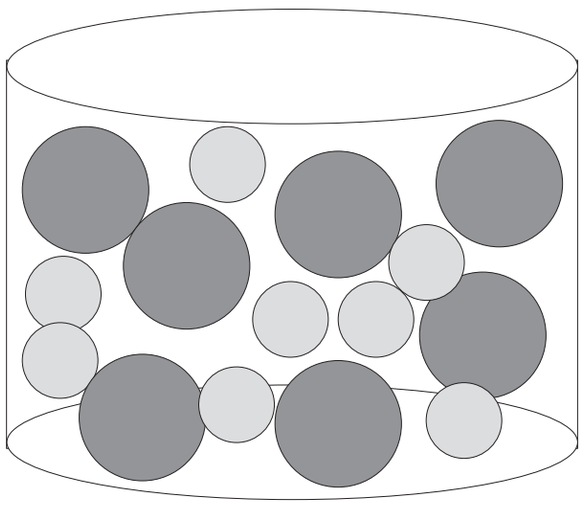
a. Electrolyte
b. Electrolysis

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners. Draw a free-hand sketch of the following (always try to do this before the lesson starts):
   a. If you connect two metals to a cell and then put the two metals into the ionic solution, a chemical reaction occurs in the ionic solution. This process is called electrolysis.
   b. Copper(II) chloride is a green solid that is made up of positive copper ions that lost electrons and negative chloride ions that gained electrons. They attract one another with strong electrostatic forces to form a solid with a fixed pattern.



   c. When the copper(II) chloride dissolves in water, it separates into copper ions and chloride ions that are free to move around in the water. This is called an ionic solution.



   d. Show the learners Resource 20. Electrodes are put in the solution of copper(II) chloride. These electrodes are made of carbon so they do not react with the solution. The one electrode is connected to the positive terminal of the battery and is called the anode. The other electrode is connected to the negative terminal and is called the cathode.

e. When the current flows, the positive copper electrons are attracted to the cathode while the negative chloride ions are attracted to the anode.
f. A chemical reaction takes place at each electrode. The copper ions gain electrons at the cathode to form copper metal that is deposited on the electrode. At the anode the chloride ions give their electrons to the electrode to form chlorine gas, which can be observed as bubbles.
g. The copper(II) chloride solution is an electrolyte. It completes the circuit, which means that it conducts electricity.
h. The copper(II) chloride solution is broken down to copper metal and chlorine gas when an electric current passes through it.

2. Do the following demonstration of the electrolysis of water in the class. The learners should make observations and record them in their workbooks. They should also answer the questions that follow the demonstration.
3. Write the task on the chalkboard (always try to do this before the lesson starts). Look at Resource 21 to set up the following electrolytic cell.
   a. You will need three cells, two connecting wires, two electrodes, a beaker filled with water and a few drops of sulphuric acid.
   b. Add a few drops of sulphuric acid to the water to assist with the electrolysis process. Tell the learners that there are positive hydrogen ions and negative oxygen ions in the water.
   c. Connect the electrodes to the battery and dip the electrodes in the water.

DEMONSTRATION

Water can be broken down by electrolysis to produce oxygen and hydrogen gas. Your teacher is going to demonstrate the electrolysis of water. Observe what happens. Record your observations in your workbooks and complete the questions that follow.

a. What do you observe when the electrodes are connected to the battery and put in the water?
b. Which electrode is the anode?
c. Which electrode is the cathode?
d. What gas is formed at the anode? Why do you say so?
e. What gas is formed at the cathode? Why do you say so?
f. Does the water conduct electricity?
g. What do we call the water?
h. What is happening to the water when an electric current passes through it?
i. What will you observe when this electrolysis process continues for a day?

3. Give the learners enough time to complete the questions.
4. Model answer

MODEL ANSWER

a. *Bubbles are being released at both electrodes. More bubbles are released at the one electrode compared to the other electrode.*
b. *The electrode that is connected to the positive terminal of the battery*
c. *The electrode that is connected to the negative terminal of the battery*
d. *Oxygen gas. The negative oxygen ions are attracted to the positive electrode.*
e. *Hydrogen gas. The positive hydrogen ions are attracted to the negative electrode.*
f. *Yes*
g. *Electrolyte*
h. *It decomposes into its elements, hydrogen and oxygen.*
i. *All the water will be decomposed, and the beaker will be empty.*

Checkpoint 2

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

a. What are the components of an electrolytic cell?
b. What is the positive electrode called?

Answers to the checkpoint questions are as follows:

a. A cell/battery, two connecting wires, two electrodes and an electrolyte
b. The anode

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
Successful Natural Sciences	Energy transfer in electrical systems	116-117
Top Class Natural Sciences	Energy transfer in electrical systems	114
Via Africa Natural Sciences	Energy transfer in electrical systems	116-117
Solutions for All Natural Science	Energy transfer in electrical systems	148-149
Spot on Natural Sciences	Energy transfer in electrical systems	118-119
Platinum Natural Sciences	Energy transfer in electrical systems	147-148
Step-by-step	Energy transfer in electrical systems	97-98
Natural Sciences	Energy transfer in electrical systems	155-157
Sasol Inzalo Bk B	Energy transfer in electrical systems	41-44

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=HQ9Fhd7P_HA (2min 59sec) [Electrolysis of water]
2. https://www.youtube.com/watch?v=9LNjIjXWjGk (1min) [Electrolysis of copper chloride solution]

TOPIC OVERVIEW:
Series and parallel circuits
Term 3, Weeks 5A – 6C

A. TOPIC OVERVIEW

TERM 3, WEEKS 5A – 6C

- 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 8	GRADE 5
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Electrical wires transfer energy to the electrical appliances and lights	• A series circuit provides only one pathway for the current passing through it. The current is the same everywhere in the circuit but every time a resistor is added in series, the overall current in the circuit decreases • A parallel circuit provides two or more pathways for the current passing through it, but the overall current increases when more resistors are added in parallel	• When cells are connected together in series, the total voltage is the sum of the voltages of individual cells • Resistors can be connected in series in a circuit • The total voltage across the battery is the same as the sum of the voltages across each resistor • When cells are connected in parallel, the voltage across them is the same as for one cell • Resistors can be connected in parallel in a circuit

	• Other complex circuits are used for output devices, such as beepers, buzzers, LEDSs (Light Emitting Diodes), or motors	• The total current through the battery is the same as the sum of the currents through the resistors

C. SCIENTIFIC VOCABULARY

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

	TERM	EXPLANATION
1.	series circuit	A circuit in which the current flows along one path without branching or dividing
2.	parallel circuit	A circuit in which the current divides or branches into alternative paths
3.	output device	A component in an electrical circuit that changes electrical energy into useful forms of energy
4.	resistance	A material's ability to block or oppose the flow of electricity
5.	conductor	A material that allows electric current to pass through it
6.	LED	A light-emitting diode is a device that emits visible light when an electric current passes through it
7.	resistor	A material that opposes the flow of an electric current

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

Learners will understand that circuits can be connected in series or in parallel. In a series circuit, the current can only follow one path, while there are multiple paths that a current can follow in a parallel circuit. The type of circuit influences the current through the circuit, as well as the total resistance. Lastly, learners will learn that output devices are used to change electrical energy to useful energy. These output devices include light bulbs, beepers, buzzers and electric motors.

E. PERSONAL REFLECTION

Reflect on your teaching at the end of each topic:

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

5 A

Term 3, Week 5, Lesson A
Lesson Title: Series circuits 1
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Series and parallel circuits
CAPS Page Number	49

Lesson Objectives

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

- explain what a series circuit is
- explain the effect of resistors in series on the current and resistance of the circuit
- draw circuit diagrams of series circuits
- list the advantages and disadvantages of series circuits.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 13: Circuit with closed switch	
Resource 22: Series and parallel circuits	
Resource 24: Circuit diagram of light bulbs in series	

C CLASSROOM MANAGEMENT

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

What do we call a circuit where there is only one path that the current can follow?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

A series circuit

D ACCESSING INFORMATION

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

SERIES CIRCUITS

1. A **series circui**t is a circuit that provides only one path along which a current can flow.
2. The components are connected one after the other in a series circuit.
3. The amount of current is the same through each part or component in the circuit.
4. Every time a **resistor** is added in series, the overall current in the circuit decreases and the total **resistance** increases.
5. A light bulb is an example of a resistor because it resists the flow of charge.
6. Cells can also be connected in series. The positive terminal of one cell is connected to the negative terminal of the following cell.
7. An advantage of light bulbs in series is that one switch switches on all the light bulbs.
8. A disadvantage is that, if one bulb burns out, all the light bulbs go out. The more light bulbs that are connected in series, the dimmer they all become.

2. Explain this to the learners as follows:
    a. There is more than one way to connect a circuit.
    b. A series circuit provides only one pathway for the current passing through it.
    c. When components are connected one after another in the circuit, the components are connected in series. Show the learners Resource 13. The light bulbs are connected in series. Ask the learners to draw the circuit diagram of the light bulbs in series. *(Answer: Resource 24)*
    d. The current strength is the same everywhere in a series circuit.
    e. If another component is added into a series circuit, the current in the whole circuit is affected.
    f. If more resistors are added to the circuit, the total resistance increases.
    g. When resistors are added in the circuit, they decrease the amount of current that flows in the circuit.
    h. Cells can also be connected in series. We connected the positive terminal of one cell to the negative terminal of another cell.
    i. An advantage of light bulbs in series is that one switch switches on all the light bulbs.
    j. A disadvantage is that, if one bulb burns out, all the light bulbs go out. Also, the more light bulbs that are connected in series, the dimmer they all become.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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 can you say about the current in a series circuit?
b. How do you know that light bulbs are connected in series?

Answers to the checkpoint questions are as follows:

a. The current is the same everywhere.
b. They are connected one after the other. One switch will switch on all the lights at the same time.

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners:
   a. Show the learners the left-hand side of Resource 22. All the current flows through each of the components, without dividing. There is only one path that the current can take. Trace the path with a ruler or pencil.
   b. The light bulbs do not use up the current.
   c. The position of the light bulbs in the series circuit does not influence the amount of resistance. As long as the number of resistors remains the same, the total resistance stays the same.
   d. With one light bulb in the circuit, the total resistance will be small because the current only flows through one resistor.
   e. When more light bulbs are added in series, the current has to flow through each resistor and the resistance to the flow of the current increases. The charges have to work hard to get through each light bulb and energy is used up as they do so.
   f. A resistor is something that opposes the flow of electrons. It therefore reduces the current. The more light bulbs you put in series, the greater the resistance and the smaller the current.
   g. If one of the bulbs burn out, the circuit is broken and the electricity stops flowing.
   h. Christmas lights are often connected in series.
   i. When cells are connected in series, they provide more energy to the electrons. The charged electrons are given more capacity.
2. The learners have to complete the following task in their workbooks. Write the task on the chalkboard (always try to do this before the lesson starts).

TASK

Rewrite the following paragraph and fill in the missing words.

In a series circuit there is _____ path that the current can follow. The current through the cells is _____ as the current that flows through the light bulbs. When more light bulbs are connected in series, the _____ will increase and the _____ will decrease. This is because a light bulb acts as a _____ that _____ the flow of current. When cells are connected in series, the _____ terminal of one cell is connected to the _____ terminal of the _____ cell. More cells connected in series _____ the current in a circuit.

3. Give the learners enough time to complete the task.
4. Model answer

MODEL ANSWER

In a series circuit there is one path that the current can follow. The current through the cells is the same as the current that flows through the light bulbs. When more light bulbs are connected in series, the resistance will increase and the current will decrease. This is because a light bulb acts as a resistor that opposes the flow of current. When cells are connected in series, the positive terminal of one cell is connected to the negative terminal of the next cell. More cells connected in series increase the current in a circuit.

Checkpoint 2

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

a. How does the resistance change when more light bulbs are connected in series in a circuit?
b. How does the current change when more light bulbs are added in series in a circuit?

Answers to the checkpoint questions are as follows:

a. The resistance increases.
b. The current will decrease.

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
Successful Natural Sciences	Series and parallel circuits	118-119
Top Class Natural Sciences	Series and parallel circuits	118-119
Via Africa Natural Sciences	Series and parallel circuits	118-119
Solutions for All Natural Science	Series and parallel circuits	154-155
Spot on Natural Sciences	Series and parallel circuits	122-125
Platinum Natural Sciences	Series and parallel circuits	154-156
Step-by-step	Series and parallel circuits	99
Natural Sciences	Series and parallel circuits	164-168
Sasol Inzalo Bk B	Series and parallel circuits	52-62

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=js7Q-r7G9ug (7min 17sec) [Electrical circuits]

5 B

Term 3, Week 5, Lesson B
Lesson Title: Series circuits 2
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Series and parallel circuits
CAPS Page Number	49

Lesson Objectives

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

- construct series circuits
- apply knowledge of series circuits to real series circuits
- identify metals that are good conductors of electricity.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 12: Circuit with open switch	
Cells, several light bulbs, conducting wire, switch, nichrome, steel wire	

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 happens to the current of a circuit when more resistors are added in series?

3. Learners should enter the classroom, then discuss the seven life processes with the teacher and then answer the question in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

The current will decrease

D ACCESSING INFORMATION

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

SERIES CIRCUITS

1. A series circuit is a circuit that provides only one path for the current to flow.
2. The current is the same throughout a series circuit because all the light bulbs in series will shine with the same brightness.
3. In a simple circuit the brightness of a light bulb is an indication of the magnitude of the current that flows through the light bulb.
4. A light bulb acts as a resistor.
5. The relative brightness of a light bulb is an indication of the total resistance in the circuit.
6. The brighter the light bulb, the lower the resistance, and therefore the higher the current.
7. All metals are **conductors** of electricity, but different metals conduct electricity differently.

2. Explain this to the learners as follows:
    a. We know that the current is the same throughout a series circuit because the current only has one path to take. This means that all the light bulbs in series will shine with the same brightness.
    b. To estimate the amount of resistance, light bulbs can be used as resistors and the relative brightness of the bulbs will give an indication of the amount of current flowing through the circuit.
    c. If more resistors are added to the circuit, the total resistance increases. This means the current is reduced and the effect on the light bulbs is that they become dimmer.
    d. The lower the resistance, the bigger the current and the brighter the light bulb will shine.
    e. Although metals are able to conduct electricity, not all metals conduct electricity equally well.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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:

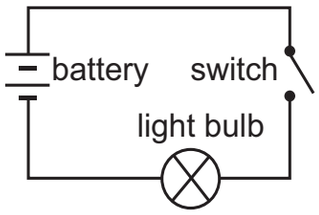
a. What does a bright light bulb indicate regarding the strength of the current?
b. What happens to the brightness of light bulbs when more light bulbs are connected in series?

Answers to the checkpoint questions are as follows:

a. A strong current is flowing through the light bulb.
b. The light bulbs will shine more dimly.

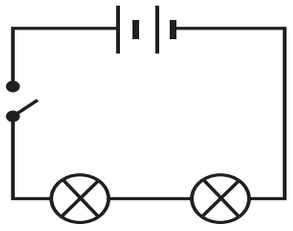
E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners:
   a. We will now draw a circuit diagram of simple series circuit.
   b. Draw a simple series circuit that contains two cells in series, one light bulb, connecting wires and a switch. Label it circuit A.
   [Answer]



Circuit A

   c. Draw similar circuit but add anotherbulb in series. Label circuit B
   [Answer]



Circuit B

   d. Do you think that the two light bulbs in series will shine with the same brightness? Why do you say so?
   [Answer: Yes, because the same current is flowing through both of the light bulbs.]
   e. Do you think that one light bulb in a circuit will shine brighter or dimmer than two light bulbs in series? Why do you say so?
   [Answer: The one light bulb will shine brighter than two light bulbs in series because the current through the one light bulb is greater than the current through the two light bulbs.]
   f. All conductors offer some resistance to electricity.
   g. Some metals are better conductors of electricity than others because of their chemical composition and the density of their particles. The less space there is between the particles of a metal, the greater the resistance there will be to a charge.
   h. We use the difference in resistance of metals to our advantage. Copper is a very good conductor, so we use copper for making electric cables.
   i. The elements of stoves, heaters and toasters are made from nichrome. It becomes red hot when a current flows through it and causes a heating effect.
   j. Tungsten is not a very good conductor. We use tungsten in the filament of light bulbs because tungsten has a high resistance and changes electrical energy to heat and then light.
2. The learners should complete the following practical activity in groups. Write the task on the chalkboard (always try to do this before the lesson starts).
3. Show the learners Resource 12 so that they know how to set up the circuit.

PRACTICAL ACTIVITY

Do the following practical task in groups and write the observations and answers to the questions in your workbooks.

WHAT YOU ARE GOING TO INVESTIGATE

The effect of light bulbs connected in series in a circuit.

The effect of different metals in a series circuit.

WHAT YOU WILL NEED

cells
several light bulbs
conducting wire
switch
nichrome
steel wire.

WHAT YOU WILL DO

- Connect cells in series.
- Use the connecting wires to add a light bulb and switch to the circuit. See the Resource 12.
- Close the circuit. Make a note about the brightness of the light bulb.
- Add more light bulbs in series, one at a time. Record your observations after each light bulb is added.
- Complete the following table:

Number of light bulbs	Brightness of light bulbs

- Keep one light bulb in series and insert steel wire into the circuit. Observe the effect on the brightness of the light bulb.

ANSWER THE FOLLOWING:

a. How did the brightness of the light change with each light bulb you added?
b. Compare the brightness of three light bulbs in series.
c. Give a possible explanation for your observation.
d. What happens when you disconnect one of the light bulbs from the circuit? Why does it happen?
e. Give one advantage and one disadvantage of a series circuit based on your observations.
f. What was the difference between using steel wire and nichrome as a conductor?
g. Which metal was the best conductor of electricity?

4. Give the learners enough time to complete the practical activity.
5. Model answers

MODELS ANSWER

Number of light bulbs	Brightness of light bulbs
1	*Bright*
2	*Less bright*
3	*Even less bright*

a. *The light bulbs became dimmer with each light bulb added.*
b. *They all have the same brightness.*
c. *The light bulbs act as resistors. With more light bulbs in series, the resistance increases and the current decreases.*
d. *All the light bulbs stop shining because the circuit is broken.*
e. *One switch can be used to switch on all the light bulbs, but if one light bulb burns out none of the other bulbs will shine.*
f. *With nichrome the light bulb was dimmer than when the steel wire was connected in the circuit.*
g. *The steel wire*

Checkpoint 2

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

a. Why can the lights in a house not be connected in series?
b. Why is copper considered the best conductor to use in circuits?

Answers to the checkpoint questions are as follows:

a. Lights cannot be connected in series in a house because, if one light is switched off, the other lights will also be switched off.
b. Copper has a very low resistance to electric current

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
Successful Natural Sciences	Series and parallel circuits	118-119
Top Class Natural Sciences	Series and parallel circuits	118-119
Via Africa Natural Sciences	Series and parallel circuits	118-119
Solutions for All Natural Science	Series and parallel circuits	154-155
Spot on Natural Sciences	Series and parallel circuits	122-125
Platinum Natural Sciences	Series and parallel circuits	154-156
Step-by-step	Series and parallel circuits	99
Natural Sciences	Series and parallel circuits	164-168
Sasol Inzalo Bk B	Series and parallel circuits	52-62

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=SFUrIR7txqg (7min 12sec) [Series circuits]

5 C

Term 3, Week 5, Lesson C
Lesson Title: Parallel circuits 1
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Series and parallel circuits
CAPS Page Number	49

Lesson Objectives

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

- explain what a parallel circuit is
- explain the effect of resistors in parallel on the current and resistance of the circuit
- draw circuit diagrams of parallel circuits
- list the advantages and disadvantages of parallel circuits.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 22: Series and parallel circuits	
Resource 23: Light bulbs connected in parallel	
Resource 26.1: Circuit diagram of parallel circuit	
Resource 26.2: Circuit diagram of parallel circuit (answer)	

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 happens to the brightness of light bulbs when they are connected in series?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

The light bulbs become dimmer.

D ACCESSING INFORMATION

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

PARALLEL CIRCUITS

1. A **parallel circuit** provides two or more pathways for the current passing through it.
2. With more paths that the current can take, the total resistance of the circuit will decrease.
3. The overall current increases when more resistors are added in parallel.
4. The total current equals the sum of the currents that flow through each branch of the parallel circuit.
5. There are many advantages of parallel circuits. With light bulbs in parallel, it is possible to switch on one bulb at a time. The brightness of the light bulbs stays the same as more light bulbs are connected in parallel. If one bulb burns out, the remaining bulbs will still shine.
6. A disadvantage of light bulbs in parallel is that the total current produced by the battery increases. The battery will therefore not last as long.

2. Explain this to the learners as follows:
    a. Another way of connecting a circuit is to connect components in parallel. This means that the current branches and has more than one path to follow. Show the learners Resource 23. Show how the path of the current splits.
    b. The resistance of a circuit decreases when more light bulbs are included in parallel. This is because a parallel circuit offers an alternative route for the current to flow through.
    c. The advantages of a parallel circuit are that if one light in the parallel part of the circuit goes out, the rest will continue to work. It is also easy to add resistors to the circuits.
    d. The disadvantage is that it is easy to overload a parallel circuit. Since there are more paths to follow, the current flows faster through the circuit and the resistors heat up more rapidly. This can result in an electrical fire.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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. How do we know that a circuit is connected in parallel?
b. How does the current change when more resistors are connected in parallel?

Answers to the checkpoint questions are as follows:

a. There is more than one path that the current can take.
b. The resistance decreases.

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners:
    a. Show the learners the right-hand side of Resource 22 which shows a parallel circuit. The components of a circuit can be connected so that there is more than one path along which the current can flow. We call this a parallel circuit.
    b. The current reaches a point in the circuit that is similar to a fork in the road. There are two possible paths it can take. When the current rejoins, it will have the same strength as before the split.
    c. When the light bulbs have the same resistance, the current will split evenly and half of the current will flow through each of the bulbs. If the bulbs have a different resistance to each other, then more current will flow through the branch that has the least resistance. The current will prefer the easier path.
    d. Notice that each light bulb has its own connection to the cells in the circuit. This means that each light bulb has its own supply of current, and does not have to share the current with the other light bulbs. If one light bulb burns out, the other light bulbs will still shine.
    e. A parallel circuit lowers the total resistance because the current can take alternative paths. A drop in the total resistance leads to an increase in current. So, the more branches there are in a parallel circuit, the greater the current will be.

2. Ask the learners to complete the following task in their workbooks. Write the task on the chalkboard (always try to do this before the lesson starts).
3. Show the learners Resource 26.1.

TASK

Look at the circuit diagram of a parallel circuit that the teacher is showing you. Answer the following questions in your workbook.

a. Redraw the circuit diagram and show with arrows how the current flows through the circuit.
b. How many light bulbs are connected in parallel?
c. If the light bulbs have the same resistance, what fraction of the current will flow through each branch?
d. How does the current of the circuit in the diagram differ from the current in a circuit with only one light bulb?
e. How does the resistance of the circuit in the diagram differ from the resistance of a circuit with only one light bulb?

4. Give the learners enough time to complete the task.
5. Model answer

MODEL ANSWER

a. See Resource 26.2.
b. Three
c. A third of the current will flow through each light bulb.
d. The current in the parallel circuit is greater than the current in a circuit with only one light bulb.
e. The resistance in the parallel circuit will be less than the resistance of a circuit with only light bulb.

Checkpoint 2

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

a. How does the total resistance of a circuit change when more light bulbs are connected in parallel?
b. What happens when one light bulb in parallel is removed?

Answers to the checkpoint questions are as follows:

a. The total resistance decreases.
b. The other light bulbs in parallel will still shine.

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
Successful Natural Sciences	Series and parallel circuits	120-121
Top Class Natural Sciences	Series and parallel circuits	119-121
Via Africa Natural Sciences	Series and parallel circuits	119-121
Solutions for All Natural Science	Series and parallel circuits	156-157
Spot on Natural Sciences	Series and parallel circuits	122-125
Platinum Natural Sciences	Series and parallel circuits	157-158
Step-by-step	Series and parallel circuits	100
Natural Sciences	Series and parallel circuits	169-172
Sasol Inzalo Bk B	Series and parallel circuits	63-73

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=12BCFvIdVNc (5min 44sec) [Introduction to parallel circuits]

6 A

Term 3, Week 6, Lesson A
Lesson Title: Parallel circuits 2
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Series and parallel circuits
CAPS Page Number	49

Lesson Objectives

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

- construct parallel circuits
- apply knowledge of parallel circuits to real parallel circuits
- distinguish between series circuits and parallel circuits.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 13: Circuit with closed switch	
Resource 23: Light bulbs connected in parallel	
Resource 25: Circuit diagram of light bulbs in series and parallel	
Cells, light bulbs, switch, connecting wires and clips, wire cutter (for each group)	

C CLASSROOM MANAGEMENT

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

How do we know that a circuit is connected in parallel?

3. Learners should enter the classroom, then discuss the seven life processes with the teacher and then answer the question in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

There is more than one path that the current can take.

D ACCESSING INFORMATION

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

PARALLEL CIRCUITS

1. In a simple circuit the brightness of a light bulb is an indication of the magnitude of the current that flows through it.
2. A parallel circuit provides more than one path that a current can follow. The current branches.
3. Light bulbs in parallel shine brighter than light bulbs connected in series.
4. The resistance in a parallel circuit decreases because the current has more paths to flow through.
5. The total current is the sum of the currents passing through each component, so the current increases and causes the light bulbs to shine more brightly.
6. When light bulbs are added in parallel in a circuit, the light bulbs do not dim.
7. When a light bulb burns out, the other light bulbs still shine. The current flows past the broken light bulb to the other light bulbs.
8. Light bulbs in houses and buildings are connected in parallel.

2. Explain this to the learners as follows:
    a. The brightness with which a light bulb shines always shows the magnitude of the current that flows through it.
    b. In a parallel circuit, there is more than one route for the current to flow.
    c. When two or more bulbs or resistors are connected in parallel, the individual bulbs glow much brighter than when the same number of bulbs are connected in series.
    d. Adding light bulbs in parallel will not make them dimmer.
    e. The total current is the sum of the currents through each component.
    f. When a light bulb burns out, the circuit is not broken. The electricity can bypass the socket without a bulb or with a burned-out bulb.
    g. This is the type of circuit used in buildings.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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 will happen to the brightness of light bulbs when more light bulbs are connected in parallel?
b. What happens to the resistance of a circuit when more light bulbs are added in parallel?

Answers to the checkpoint questions are as follows:

a. The light bulbs will shine more brightly.
b. The resistance will decrease.

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners:
    a. Show the learners Resource 25. Ask the learners how many paths there are in the circuit. *(Answer: There are two paths that the current can take.)*
    b. Ask the learners how many light bulbs are in series.
    (Answer: Two light bulbs are in series. Note that the same current flows through the two light bulbs).
    c. Ask the learners what will happen when one of the series light bulbs burns out.
    (Answer: The other light bulb in series will stop shining but the other light bulb in parallel will keep on shining. If the current cannot go through the one branch it can still flow through the other branch.)
    d. Ask the learners which light bulb or light bulbs will be dimmer.
    (Answer: The two light bulbs in series will be dimmer than the light bulbs that are connected in parallel.)
    e. The current always takes the path of least resistance. The resistance of the two light bulbs in series is higher than the one light bulb. Therefore, a smaller current will flow through the two light bulbs and they will be dimmer.

f. Ask the learners if the two light bulbs in series will still shine when the single light bulb in parallel is disconnected.

(Answer: Yes, they will still shine because the current can still flow through them. The current only has one path that it can take.)

2. The learners should complete the following practical activity in their workbooks. Write the activity on the chalkboard (always try to do this before the lesson starts).
3. Show the learners Resources 13 and 23 so that they can see how they should set up the two circuits. Hand out the apparatus to each group.

PRACTICAL ACTIVITY

Do the following practical activity in groups.

AIM

To compare the effects of light bulbs in series and in parallel

WHAT YOU WILL NEED:

cells

several light bulbs

conducting wire and clips

switch

wire cutter.

WHAT YOU WILL DO:

- Connect the cells in series.
- Firstly, use the connecting wires to connect one light bulb in the circuit. Make a note about the brightness of the bulb.
- Connect another light bulb in parallel. Use a wire cutter and clips to create the parallel connection. Notice the brightness of the light bulbs and record your observations.
- Add a third light bulb in parallel. Notice the brightness of the light bulbs and record your observations.
- Repeat these steps but connect the light bulbs in series.

Copy and complete the table to compare the relative brightness of the light bulbs in the series and parallel circuits.

Repeat steps 1-6 but now connect the light bulbs in series.

Copy and complete the table to compare the relative brightness of the light bulbs in the series and parallel circuits.

Brightness of light bulbs		
Number of light bulbs	**Series circuit**	**Parallel circuit**
1	Bright	Bright
2		
3		

Write down your conclusion in terms of:

a. the brightness of the light bulbs in series and parallel.
b. the current through the series circuit and the parallel circuit.
c. the resistance of the light bulbs in series and parallel.

4. Give the learners enough time to complete the task.
5. Model answer

MODEL ANSWER

Brightness of light bulbs		
Number of light bulbs	**Series circuit**	**Parallel circuit**
1	*Bright*	*Bright*
2	*Dimmer*	*Brighter*
3	*Dimmer than two light bulbs*	*As bright as two light bulbs*

a. *When identical light bulbs are connected in a series, the light bulbs are dimmer when more light bulbs are added to the circuit. When identical light bulbs are connected in a parallel circuit, the light bulbs shine just as brightly when more bulbs are added to the circuit.*
b. *A series circuit provides only one pathway for the current passing through it. The current is the same everywhere in the circuit and all the light bulbs shine with the same brightness. In a parallel circuit, the current can follow more than one path. Each light bulb receives the same amount of current as if it was connected on its own to the cells. In a parallel circuit, the current increases as the number of light bulbs connected in parallel increases.*
c. *When resistors are added in series, the total resistance increases. This results in a decrease in the current in the circuit. When resistors are added in parallel, the total resistance decreases. This results in an increase in the current in the circuit.*

Checkpoint 2

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

a. In what type of circuit will light bulbs shine more brightly?
b. How can light bulbs in a series circuit be made to shine more brightly?

Answers to the checkpoint questions are as follows:

a. In a parallel circuit
b. Add more cells or remove light bulbs

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
Successful Natural Sciences	Series and parallel circuits	120-121
Top Class Natural Sciences	Series and parallel circuits	119-121
Via Africa Natural Sciences	Series and parallel circuits	120-121
Solutions for All Natural Science	Series and parallel circuits	156-157
Spot on Natural Sciences	Series and parallel circuits	122-125
Platinum Natural Sciences	Series and parallel circuits	157-158
Step-by-step	Series and parallel circuits	100
Natural Sciences	Series and parallel circuits	169-172
Sasol Inzalo Bk B	Series and parallel circuits	63-73

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=x2EuYqj_0Uk (8min 05sec) [Series and parallel circuits]
2. https://www.youtube.com/watch?v=O8GgRIIB1Yc (5min 47sec) [Series circuits vs parallel circuits]

6 B

Term 3, Week 6, Lesson B
Lesson Title: Output devices
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Series and parallel circuits
CAPS Page Number	49

Lesson Objectives

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

- define an output device
- explain input and output energy of a system
- identify the input and output energy of a system.

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
Old magazines	

C CLASSROOM MANAGEMENT

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

Will three light bulbs shine more brightly when they are connected in series or in parallel?

3. Learners should enter the classroom, then discuss the seven life processes with the teacher and then answer the question in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

In parallel

D ACCESSING INFORMATION

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

OUTPUT DEVICES

1. In an electrical system there needs to be an input, a process that takes place and an output.
2. An **output device** is a component in an electrical circuit that works in a circuit and changes electrical energy into useful forms of energy.
3. The output can be in the form of light, sound, heat or movement.
4. A light bulb is an example of an output device that produces light. It is used in a simple circuit.
5. A light bulb can be used to check whether a current is flowing or not.

2. Explain this to the learners as follows:
   a. There is an input, process and output in every electrical system.
   b. An output device is something that carries out its function because of the way we have controlled an electrical current. Output devices are the reason we have so many appliances that work by electricity.
   c. An output device changes electrical energy into useful forms of energy, such as light, sound or movement.
   d. A light bulb is an output device in a simple electric circuit.
   e. The light energy of a light bulb can be useful in showing when a current is flowing.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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 output device?

b. Can you give an example of an output device in a simple circuit?

Answers to the checkpoint questions are as follows:

a. An output device changes electrical energy to useful energy.

b. A light bulb

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners:

   a. An output device transfers energy in a system to achieve an output.

Input energy	→	Output device	→	Output energy

   b. The filament in a light bulb transfers electrical energy to light energy that lights up the dark.

Electrical energy	→	Light bulb	→	Light energy and heat energy

   c. An electric heater is an output device. A high-resistance material is used to make the bars in the heater. When an electric current is passed through the bars, the high resistance causes a heating effect. We can use a heater to heat our homes.

Electrical energy	→	Bars of a heater	→	Light energy and heat energy

   This is also used in stoves for cooking.

   d. An electrical motor changes electrical energy to kinetic energy because of the magnetic effect of an electric current.

Electrical energy	→	Electric motor	→	Kinetic energy and heat energy

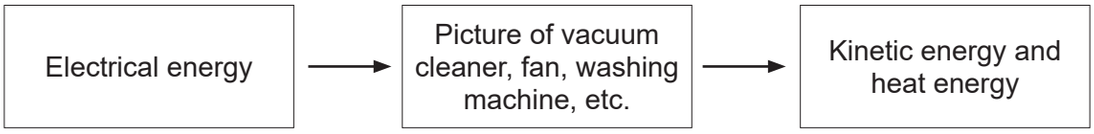
2. The learners should complete the following task in their workbooks. Write the task on the chalkboard (always try to do this before the lesson starts). Give the learners old magazines so that they can look for pictures. Alternatively, learners can make drawings of appliances or other electrical systems.

TASK

Look for pictures in old magazines that are output devices. Use them as part of an input/output flow diagram. Paste them in your workbook and add the arrows for the input energy or output energy. An example is given below.

Electrical energy	→		→	Light energy and sound energy

3. Give the learners enough time to complete the task.
4. Let the learners show their flow diagrams to the class for evaluation. An example is given below:



Checkpoint 2

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

a. Why is a heater an output device?
b. What do we call the energy that an output device needs to produce useful energy?

Answers to the checkpoint questions are as follows:

a. It changes electrical energy to heat energy that is useful.
b. Input 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
Successful Natural Sciences	Series and parallel circuits	124-125
Top Class Natural Sciences	Series and parallel circuits	122-123
Via Africa Natural Sciences	Series and parallel circuits	123
Solutions for All Natural Science	Series and parallel circuits	159-161
Spot on Natural Sciences	Series and parallel circuits	126
Platinum Natural Sciences	Series and parallel circuits	159
Step-by-step	Series and parallel circuits	101
Natural Sciences	Series and parallel circuits	175-176
Sasol Inzalo Bk B	Series and parallel circuits	74-75

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.mstworkbooks.co.za/technology/gr8/gr8-technology-17.html [Input, output and control devices in a circuit

6 C

Term 3, Week 6, Lesson C
Lesson Title: Applications of output devices
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Series and parallel circuits
CAPS Page Number	49

Lesson Objectives

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

- state what a complex circuit is
- explain the basic principles of a buzzer, photocell and electric motor
- explain what a light emitting diode is.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 27: Light emitting diodes	
Resource 28: Electromagnetic door bell	
Resource 29: Photocells	

C CLASSROOM MANAGEMENT

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

What is the input energy and output energy of a stove?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

The input energy is electrical energy and the output energy is heat energy.

D ACCESSING INFORMATION

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

APPLICATIONS OF OUTPUT DEVICES

1. Complex circuits contain combined series circuits and parallel circuits. These circuits are used for output devices, such as beepers, buzzers, **LEDs** or motors.
2. A buzzer is used in a door buzzer or microwave timer. A beeper is a device that is used to alert a person. Both types of devices convert electrical energy into sound energy.
3. Electric motors are output devices that provide movement. These motors are used to drive appliances, such as washing machines.
4. An LED (Light Emitting Diode) is an output device that emits light when a current flows through it. LEDs have replaced conventional light bulbs.
5. A photocell is able to convert the light energy of the Sun into electrical energy, which is useful output energy.
6. Photocells are used in solar-powered calculators where the output results in the numbers on the screen.

2. Explain this to the learners as follows:
    a. We have been using an incandescent bulb as an output device.
    b. When other types of output devices are used, more complicated circuits might be needed for their operation. Examples of these output devices are buzzers and beepers.
    c. A buzzer and a beeper are examples of electrical output devices. The output of a buzzer and beeper is sound that can alert a person. These devices are used in door bells, alarm clocks and timers.
    d. Motors are output devices that provide movement. Motors are used to drive appliances, such as microwave ovens, washing machines and air conditioners.
    e. LED lights are output devices that have been replacing traditional light bulbs because they are more efficient.
    f. Photocells use the energy of the Sun and convert it to electrical energy that can be used elsewhere.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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 a complex circuit?
b. What does LED stand for?

Answers to the checkpoint questions are as follows:

a. It is a circuit that consists of series circuits and parallel circuits.
b. Light emitting diode.

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners:
    a. Show the learners Resource 28. A doorbell, like a buzzer, is an example of an electrical output device. The output of a doorbell is sound energy. When the switch is closed, it completes the circuit, which then produces a magnetic field in the coil of the electromagnet. It attracts a metal strip to which a hammer is connected, and the hammer hits the gong. However, this breaks the circuit. No current flows in the circuit, the electromagnet is not magnetised and the hammer falls back. This completes the circuit and the whole process is repeated. Electrical energy is thus changed to sound energy.
    b. A beeper is an electrical device that operates in the same way as a doorbell or buzzer, but it uses a small loudspeaker in place of the metal strip of the doorbell. The term is usually used for a device that receives a radio signal warning that the owner has to respond to a telephone call.
    c. An electric motor is an output device that provides movement so that appliances, such as fans, pumps, washing machines and food mixers can operate. When a current flows through the motor the magnetic effect of the current is used to turn the motor. When the current ceases to flow, the motor will stop moving. A motor changes electrical energy into movement energy.
    d. Show Resource 27 to the learners to indicate what an LED or light emitting diode looks like. A LED light is an output device that emits light when current flows through it. A LED light does not have a filament like a normal light bulb, and therefore it does not become hot or burn out. LEDs use less energy because they are smaller than light bulbs and use a very small amount of current. LEDs are used to indicate when a current flows, especially when the power of electronic devices is on. LED lights have also replaced conventional bulbs in traffic lights because they last much longer. Electrical energy is converted to light energy in a LED light.
    e. Show the learners Resource 29. Photocells are very small. They are found in solar panels and can convert light energy into electrical energy. The electrical energy is useful output energy that can be used in various devices. In very low light conditions, the photocells have a very high resistance which prevents a current from flowing. However, when light is present, the resistance drops greatly and current flows. Photocells are used in automatic lights, which turn on when it gets dark. They are also used in solar-powered calculators where the output energy is used to show the numbers on the screen.
2. The learners should complete the following task orally in pairs. Write the task on the chalkboard (always try to do this before the lesson starts).

TASK

Work in pairs. Each learner should choose two output devices and explain them to the other learner in the pair. Choose from a doorbell, electric motor, photocell or LED. Discuss these output devices in terms of:

- how the output device works.
- the energy conversion that takes place in the output device.
- what the output energy is used for.

3. Give the learners enough time to complete the task.
4. Discuss the answers with the learners as revision.
    a. *The answers appear in the section on conceptual development.*

Checkpoint 2

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

a. What output devices use the magnetic effect of a current?
b. Why are LEDs replacing traditional light bulbs?

Answers to the checkpoint questions are as follows:

a. Beepers, buzzers and electric motors
b. They do not get hot, use less electrical energy and last longer

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
Successful Natural Sciences	Series and parallel circuits	124-125
Top Class Natural Sciences	Series and parallel circuits	122-123
Via Africa Natural Sciences	Series and parallel circuits	123
Solutions for All Natural Science	Series and parallel circuits	159-161
Spot on Natural Sciences	Series and parallel circuits	126
Platinum Natural Sciences	Series and parallel circuits	159
Step-by-step	Series and parallel circuits	101
Natural Sciences	Series and parallel circuits	175-176
Sasol Inzalo Bk B	Series and parallel circuits	74-75

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://youtu.be/5Q9iy152Dg0https://www.youtube.com/watch?v=5wA3senQN5E (6min 57sec) [How to make a simple door alarm]

TOPIC OVERVIEW:
Visible light
Term 3, Weeks 7A – 9C

A. TOPIC OVERVIEW

TERM 3, WEEKS 7A – 9C

- This topic runs for 3 weeks.
- It is presented over 9 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 8	GRADE 5
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Radiation is the transfer of heat and does not require physical contact or movement of particles • The heat from the Sun travels mainly by radiation across empty space to the Earth • Shiny surfaces are good reflectors of radiant heat while dark surfaces absorb heat energy	• Light is emitted from luminous objects • Light travels in straight lines • Light travels through empty space at a speed of 3 x 108 m.s-1 • Visible light consists of a spectrum of different colours, namely violet, blue, green, yellow, orange and red • Light passes through transparent objects but does not pass through opaque objects • Light is absorbed differently by different materials	• N/A

	• Light is reflected off most surfaces • The eye only sees the colours that are reflected off an object • Light can be refracted by transparent substances	

C. SCIENTIFIC VOCABULARY

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

	TERM	EXPLANATION
1.	radiation	The process by which energetic particles spread out from a central source
2.	luminous object	An object that is a source of light
3.	illuminated object	An object that does not have its own light but reflects light from a light source
4.	ray diagram	A diagram that uses lines with arrowheads to show the path of a ray of light
5.	visible light	Part of the electromagnetic spectrum that can be seen by the human eye
6.	vacuum	Empty space without any matter
7.	spectrum	A and of colours
8.	wavelength	The distance between two successive crests or troughs
9.	frequency	The number of wavelengths that pass a point in one second
10.	prism	A block of glass or Perspex that can split light into the different colours of the visible spectrum
11.	dispersion	Dispersion is the splitting of white light into different colours
12.	refraction	The bending of any wave when it passes from one medium to another of different optical densities.
13.	opaque object	An object that does not allow light to pass through it
14.	shadow	An area which direct light from a light source cannot reach, due to obstruction by an opaque object.
15.	transparent object	It is an object that allows light to travel through it
16.	electromagnetic radiation	A form of energy also known as light energy
17.	translucent object	it is an object that allows light to partially pass through
18.	normal	An imaginary line on a reflective surface that is drawn perpendicular to the surface
19.	scattered light	Scattered light reflects in different directions, with no regular pattern apparent in the reflection
20.	retina	The sensory layer at the back of the eye
21.	optic nerve	The optic nerve transmits information about the formed image from the retina to the brain.

22.	photoreceptors	Cells in the eye that are sensitive to light
23.	incident ray	Light ray that strikes the surface of an object
24.	angle of incidence	The angle which an incident ray makes with the normal
25.	relected ray	Light ray that is reflected off the surface of an object

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

It is important to know that light energy is part of the electromagnetic spectrum that is emitted by luminous and illuminated objects. Visible light can be reflected, absorbed, refracted and dispersed into the seven colours of the rainbow. Lastly, learners will learn why one can see through glass but not paper, see different coloured objects and experience the difference in shapes and sizes of object when viewed in the water.

E. PERSONAL REFLECTION

Reflect on your teaching at the end of each topic:

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

7 A

Term 3, Week 7, Lesson A
Lesson Title: Radiation of light
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Radiation of light
CAPS Page Number	49

Lesson Objectives

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

- differentiate between luminous objects and illuminated objects
- explain how light travels from a luminous object
- draw ray diagrams
- state the speed of light.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 30: Pinhole camera	
Torch light, shoebox painted black on the inside, tissue paper, sellotape, candle, matches	

C CLASSROOM MANAGEMENT

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

Can you name two output devices that change electrical energy to light energy?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

Light bulbs and LEDs.

D ACCESSING INFORMATION

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

RADIATION OF LIGHT

1. Light is emitted from **luminous objects**, such as the Sun or light bulbs. A luminous object is a source of light.
2. An object that reflects light is called an **illuminated object**.
3. Light is transferred from luminous objects by **radiation**.
4. Light travels in straight lines.
5. The shadow of an object is proof that light travels in straight lines because it cannot bend around the object.
6. A **ray diagram** is a simple way to show how light is radiated from a luminous object. It represents one ray of light. A beam is a number of light rays together.
7. Light travels very fast. The speed of light in a **vacuum** is 300 000 kilometres per second ($c = 3 \times 10^8$ m.s^{-1}).

2. Explain this to the learners as follows:
    a. Our main source of light on Earth is the Sun. Other objects that give off their own light are candles, light bulbs and television screens.
    b. A luminous object emits light waves whereas an illuminated object reflects light. The Moon is an illuminated object because it does not give off its own light.
    c. The light energy from luminous objects is transferred by radiation.
    d. Light radiates in all directions.
    e. Light travels in a straight line. That is why you cannot see around a corner.
    f. A ray diagram is a straight line that represents the path of a narrow beam of light.
    g. The speed of light is 300 000 kilometres per second ($c = 3 \times 10^8$ $m.s^{-1}$), that is, travelling through a vacuum. This is very fast.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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:

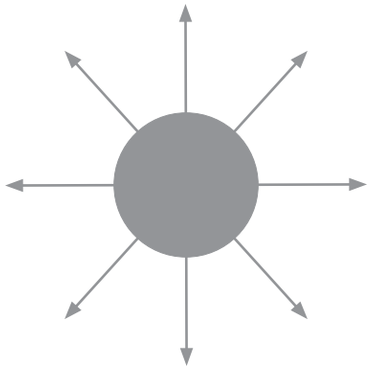
a. Is the Sun a luminous or illuminated object?
b. What is the speed of light?

Answers to the checkpoint questions are as follows:

a. The Sun is a luminous object.
b. 300 000 kilometre per second or 3×10^8 $m.s^{-1}$.

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners:
   a. Switch on the light in the classroom. The light is a luminous object. The whole room becomes illuminated because the light is emitted from the light and radiates in all directions. Can you draw a ray diagram for the light in the classroom?
   [Answer]



   b. Let one of the learners stand outside, around the corner of the door. Ask the learner if he/she can see any object in the classroom. The answer should be no because light cannot travel around corners. It can only travel in a straight line.
   c. The Moon looks like a luminous object, but it is not. It is illuminated by the Sun. There are times when we can only see part of the Moon. This happens when only part of the Moon is illuminated by the Sun.
   d. The Sun is 150 million kilometres from the Earth. Ask the learners to calculate how long it takes for Sun rays to reach the Earth. The speed of light is 300 000 km/s.
   [Answer: 150 000 000 km ÷ 300 000 km/s = 500 s ÷ 60 seconds = 8,3 minutes]
   e. Shine with the torch light on an object, such as a pencil, so that it casts a shadow on the desk. The light rays cannot bend around the pencil and therefore there will be no light rays behind the pencil. This is a darker shadow.
2. The learners should make a pinhole camera in groups and form an image of an object in the pinhole camera. Then they must answer the questions in their workbooks. Write the task on the chalkboard (always try to do this before the lesson starts). Show the learners Resource 30 so that they can see how to construct the pinhole camera.

TASK

Work in pairs. Each learner should choose two output devices and explain them to the other learner in the pair. Choose from a doorbell, electric motor, photocell or LED. Discuss these output devices in terms of:

- how the output device works.
- the energy conversion that takes place in the output device.
- what the output energy is used for.

TOPIC: Visible light

TASK

A pinhole camera is used to form an image of a luminous object on a screen.

WHAT YOU WILL NEED:

shoebox painted black on the inside

tissue paper

sellotape

candle

matches.

WHAT YOU NEED TO DO:

- Work in groups.
- Construct the pinhole camera as shown on the Resource that the teacher is showing you.
- Make a small hole at the one end of the shoebox. At the other end, remove the side of the shoebox and cover with tissue paper. Use sellotape to stick the tissue paper to the box.
- Light a candle and put it in front of the hole of the shoebox.
- Observe the image formed on the tissue paper and record your observation.

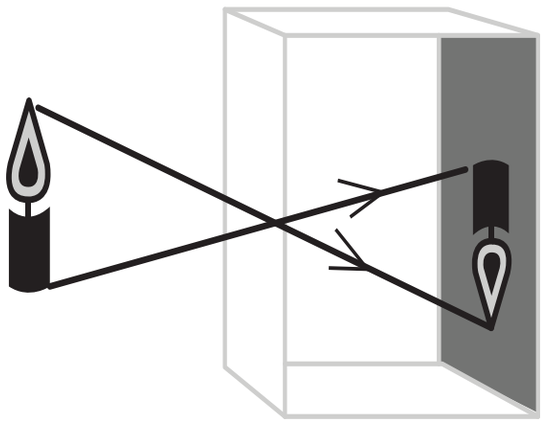
QUESTIONS AND INSTRUCTIONS

a. Why is the candle a luminous object?
b. Can you describe the image that is formed?
c. Draw a ray diagram to explain why the image is formed as stated in b.

3. Give the learners enough time to complete the task.
4. Model answer

MODEL ANSWER

a. The candle creates its own light.
b. The image is an upside-down candle.
c.



Checkpoint 2

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

a. How is light transferred from a luminous object?
b. How does light move from a luminous object?

Answers to the checkpoint questions are as follows:

a. By means of radiation
b. In a straight line

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
Successful Natural Sciences	Visible light	130-131
Top Class Natural Sciences	Visible light	125
Via Africa Natural Sciences	Visible light	126-127
Solutions for All Natural Science	Visible light	168-172
Spot on Natural Sciences	Visible light	130-133
Platinum Natural Sciences	Visible light	164-165
Step-by-step	Visible light	105
Natural Sciences	Visible light	185-187
Sasol Inzalo Bk B	Visible light	84-88

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=NnOTtfkilLc (4min 33sec) [How to make a pinhole camera]
2. https://www.youtube.com/watch?v=fm__GAlrBuQ (7min 06sec) [How does light travel?]

7 B

Term 3, Week 7, Lesson B
Lesson Title: Spectrum of visible light
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Spectrum of visible light
CAPS Page Number	50

Lesson Objectives

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

- describe what visible light is
- list the seven colours of the visible spectrum
- explain how a triangular prism disperses white light
- explain how a rainbow is made.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 31: Visible spectrum of light	
Resource 32: Dispersion of light	
Light source, piece of cardboard with a thin slit (1mm) cut into it, triangular Perspex or glass prism, sheet of white paper	

C CLASSROOM MANAGEMENT

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

What do we call an object that is a source of light?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

A luminous object

D ACCESSING INFORMATION

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

SPECTRUM OF VISIBLE LIGHT

1. **Visible light** is the part of the electromagnetic spectrum that is visible to the human eye.
2. White light consists of a **spectrum** of different colours. These colours are violet, indigo, blue, green, yellow, orange and red.
3. Each colour of the spectrum has its own **frequency** and **wavelength**. Red light has the longest wavelength and lowest frequency. Violet light has the shortest wavelength and the highest frequency.
4. A triangular **prism** can break white light up into its different colours. This is called **dispersion** and **refraction**.
5. Red light is refracted the most and violet light is refracted the least.
6. A rainbow is seen when white light is dispersed and refracted by water droplets in the air into the different colours of the spectrum.

2. Explain this to the learners as follows:
    a. Visible light refers to the range of **electromagnetic radiation** that the human eye can see.
    b. Visible light is made up of different colours. These colours are violet, indigo, blue, green, yellow, orange and red.
    c. Each colour has a different frequency and wavelength.
    d. If you shine a beam of white light at a triangular prism at an angle, the beam will be dispersed into the different colours of the spectrum of visible light.
    e. A spectrum is a band of light in which all the colours of the rainbow are visible.
    f. Water droplets in the air act like tiny prisms, refracting the light and dispersing or separating the colours.
    g. The colours that make up the rainbow always appear in the same order.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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 do we call the part of the electromagnetic spectrum that we can see with our eyes?
b. What can be used to break white light into the spectrum of colours?

Answers to the checkpoint questions are as follows:

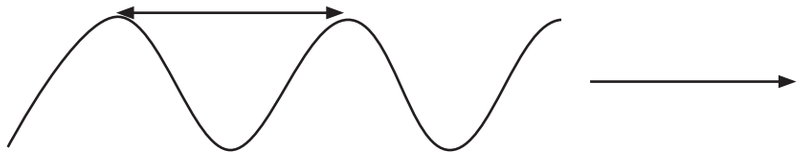
a. Visible light
b. A triangular prism

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners:
   a. Light is a form of energy known as electromagnetic radiation. Light can travel through solids, liquids and gases.
   b. Light travels through space as waves, which resembles waves of water. It is called a wave because it moves in a repetitive up and down motion.

Wavelength

A



B Wavelength

   c. Show the learners Resource 31. We see colour because each colour has its own wavelength and frequency. Red light has the longest wavelength and the lowest frequency. Wavelength is the length of each wave. Frequency is the number of waves that pass a point in one second. Violet light has the highest frequency and the shortest wavelength. Diagram A shows red light waves and diagram B shows violet light waves.
   d. Show the learners Resource 32. A triangular prism is a triangular piece of glass, which is denser than air, so light is slowed down as it passes through it. When light enters a triangular prism at an angle, the white light is split into different colours. The different colours move at different speeds through the prism because of their different wavelengths and frequencies.
   e. The different colours of light bend at different angles and that is why we see these colours. Red light is bent the most and violet light the least.
   f. A rainbow forms after a storm because tiny drops of water in the air act as tiny prisms. They refract and disperse the sunlight into the colours of the rainbow.
   g. The colours that make up the rainbow always appear in the same order.
   h. A rainbow is only visible when white light passes through water droplets.
2. Do a demonstration to show learners how a prism disperses light into different colours. Use a light source such as a torch, a triangular prism, a cardboard with a slit and white paper. The learners should complete the questions in their workbooks. Write the task on the chalkboard (always try to do this before the lesson starts).
3. <u>DEMONSTRATION: To show how a prism disperses light into different colours</u>.

<u>METHOD</u>

   a. Place a prism on the sheet of white paper
   b. Direct a thin beam of light through the slit in the cardboard so that it strikes the prism at an angle.

4. Using a prism shows that white light is made up of different colours. A prism is a block of glass or Perspex that can split white light into the different colours of the visible spectrum. The prism bends or refracts the white light. We say that the light is dispersed. It is easier to see how white light can be split into its different colours, if we work with thin beams of light.
   Darken the classroom as much as you can.

TASK

White light is made up of a mixture of various wavelengths of light. A triangular prism can be used to separate these colours by using these various wavelengths. Observe what happened during the demonstration and answer the following questions.

QUESTIONS

a. What was the colour of the light before it went through the prism?
b. What did you observe when a thin beam of light went through the slit in the cardboard and struck the prism at an angle?
c. How many different colours could you see on the paper, after it had gone through the prism?
d. Can you record the sequence of colours in the visible spectrum, when light is shone through the triangular prism?
e. Which colour was most bent?
f. Which colour was least bent?

5. Give the learners enough time to complete the task.
6. Model answer

MODEL ANSWER

a. White
b. It changed into different colours.
c. Seven colours.
d. Violet, indigo, blue, green, yellow, orange, red
e. Red
f. Violet

Checkpoint 2

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

a. What are the colours of the rainbow in decreasing order of frequency?
b. What do we call it when white light is separated into the different colours of the rainbow?

Answers to the checkpoint questions are as follows:

a. Violet, indigo, blue, green, yellow, orange and red
b. Dispersion and refraction

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
Successful Natural Sciences	Visible light	134-137
Top Class Natural Sciences	Visible light	126-127
Via Africa Natural Sciences	Visible light	128-129
Solutions for All Natural Science	Visible light	173-176
Spot on Natural Sciences	Visible light	134-136
Platinum Natural Sciences	Visible light	166-167
Step-by-step	Visible light	106-107
Natural Sciences	Visible light	187-188
Sasol Inzalo Bk B	Visible light	89-93

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=Wx0GIDvyMIY (2min 48sec) [Dispersion of light]
2. https://www.youtube.com/watch?v=7FI0GZsBhGo (1min 58sec) [Dispersion of light]

7 C

Term 3, Week 7, Lesson C
Lesson Title: Opaque substances
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Opaque and transparent substances
CAPS Page Number	50

Lesson Objectives

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

- describe an opaque object
- explain how a shadow is formed by an opaque object
- draw a diagram of the shadow of an opaque object
- relate the distance of an opaque object from the light source to the size of the shadow.

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
Opaque materials, such as wood, paper, metal, plastic	
Cardboard, pair of scissors, torch, white paper, ball such as a tennis ball, sellotape	

C CLASSROOM MANAGEMENT

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

What do we call the seven colours of the rainbow?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

The visible spectrum of light

D ACCESSING INFORMATION

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

OPAQUE SUBSTANCES

1. Materials that do not allow light to pass through them are called **opaque objects**.
2. Light that cannot pass through opaque surfaces is either absorbed or reflected.
3. Light travels in straight lines.
4. **Shadows** are darker areas that form behind opaque objects because the light is unable to travel through the object.
5. A shadow is always cast on the side of the object that faces away from the light source.
6. The area where light is absent appears black to the eye.
7. The shape of the shadow is the same as the shape of the object.
8. The length of the shadow depends on the distance of light from the object.

2. Explain this to the learners as follows:
    a. Light cannot pass through some objects. These objects are called opaque objects.
    b. An opaque object does not allow any light to travel through it.
    c. Light is either absorbed or reflected by an opaque object.
    d. A shadow is an area where direct light from a light source cannot reach due to the obstruction by an opaque object.
    e. Since light cannot pass through an opaque object, it will form a shadow on the side facing away from the light source.
    f. A shadow is the area that receives no light behind the opaque object because the light travels in straight lines.
    g. An opaque object casts a shadow that has the same shape as the object.
    h. The size of the shadow is determined by the distance of the opaque object from the light source.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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 do we call an object that does not allow light through it?
b. Why is a shadow cast behind an opaque object?

Answers to the checkpoint questions are as follows:

a. An opaque object
b. The object does not allow light to pass through it, and light travels in straight lines

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners:
   a. What prevents us from seeing through a wall?
   (Answer: The wall is an opaque object that prevents the light from passing through it.)
   b. So, what happens to the light if it cannot pass through the wall?
   (Answer: It is absorbed by the wall or reflected off the wall. Absorption and reflection are done in the next lessons.)
   c. Examples of opaque objects are wood, paper, some plastics, metals and clothes. Show the learners the opaque objects that you brought to the class.
   d. Let each learner draw a shape on cardboard and cut it out. Give each learner the chance to shine a torch on the shape so that it makes a shadow on a white paper. They then must draw the shape of the shadow on the white paper.
   e. Is the shape of the shadow the same as the shape of the cardboard shape?
   (Answer: Yes)
   f. All the light rays from the torch that hit the cardboard shape are blocked by the object. No image can be seen behind it. Light rays that are wider than the opaque object will carry on past the object. The shadow takes on the shape of the opaque object.
   g. The fact that the shape of the shadow is the same as the shape of the object tells us that light travels in straight lines.
   h. Demonstrate the following with a ball and torch. Let the ball represent the Moon and the learners represent the Earth. Use the information below to do the demonstration.
   i. The phases of the Moon are due to shadows that are formed. When the Moon is directly between the Sun and Earth, we can see only the dark side of the Moon. The illuminated side is facing away from us. This is called New Moon.
   j. When the Earth is directly between the Sun and the Moon, we can see the whole surface of the Moon that is lit. The shadow side is facing away from us. This is called Full Moon.
   k. You can also create shadow shapes with your hands.
2. The learners must complete the following practical activity in their workbooks. Write the task on the chalkboard (always try to do this before the lesson starts).

PRACTICAL ACTIVITY

You will work in pairs.

AIM:

To find out whether the shadow of an object is dependent on the distance between the object and the light source.

WHAT YOU WILL NEED:

a torch

cardboard in the shape of a rectangle

a clean white page

ruler.

WHAT YOU WILL DO:

- Stick the white paper onto the wall. Place the rectangle on a flat surface in front of the white paper.
- Shine the torch on the cardboard rectangle so that it casts a shadow on the white paper.
- Let the other learner measure the distance between the shape and the torch, as well as the length of the shadow on the paper.
- Keep the torch the same distance from the wall. Move the shape further away from the torch and closer to the wall.
- Measure the distance between the rectangle and the torch, as well as the length of the shadow on the paper. Observe what happens.
- Repeat the previous two steps above but move the shape closer to the torch.

a. Record the information in the following table:

Distance of rectangle from torch (in cm)	Length of shadow (in cm)	Description of shape

b. What happens to the size of the shadow, if the rectangle is moved further away from the torch?

c. What happens to the size of the shadow, if the rectangle is moved closer to the torch?

d. Explain why this happens.

e. Draw a ray diagram for the rectangle close to the torch, as well as for the rectangle further away from the torch.

f. What is your conclusion?

A ray diagram can be used to show the distance of the object from the light source. It can also be used to show how the size of a shadow depends on the size of the object blocking the light source. Ray diagrams are drawn with straight lines using an arrow to show the direction.

3. Give the learners enough time to complete the practical activity.

4. Model answers

MODEL ANSWER

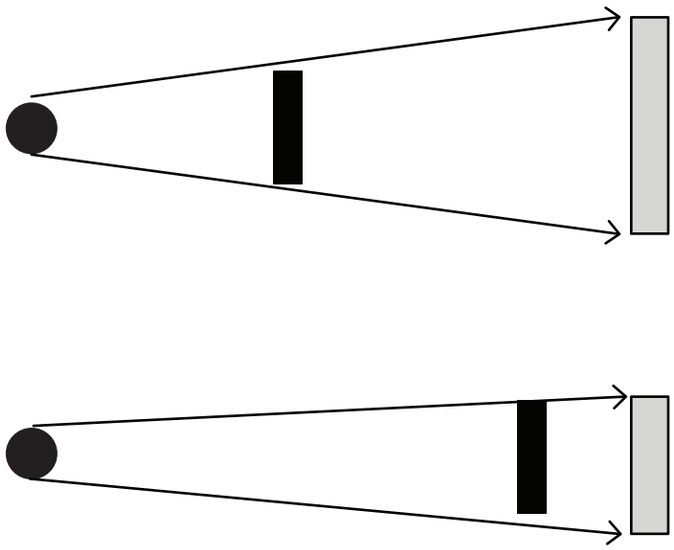
Distance of rectangle from torch (in cm)	Length of shadow (in cm)	Description of shape of shadow
30 cm	*20 cm*	*Rectangular shape*
45 cm	*15 cm*	*Rectangular shape of shadow is smaller*
20 cm	*35 cm*	*Rectangular shape of shadow is bigger*

b. The size of the shadow of the rectangle is smaller.

c. The size of the shadow of the rectangle is bigger.

d. When the object is far away from the light source, a smaller amount of light is source, more light is blocked and therefore the shadow is larger.

e.



f. The length of the shadow depends on the distance of light from the object.

Checkpoint 2

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

a. What is the similarity between an object and its shadow?

b. What is the difference between an object and its shadow?

Answers to the checkpoint questions are as follows:

a. The shape

b. The size

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
Successful Natural Sciences	Visible light	138-139
Top Class Natural Sciences	Visible light	127-128
Via Africa Natural Sciences	Visible light	130
Solutions for All Natural Science	Visible light	177-179
Spot on Natural Sciences	Visible light	137-139
Platinum Natural Sciences	Visible light	168-170
Step-by-step	Visible light	110-113
Natural Sciences	Visible light	188-190
Sasol Inzalo Bk B	Visible light	94-97

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=Kz8wP2RYy64 (2min 42sec) [How to make shadow puppets with your hands]
2. https://www.youtube.com/watch?v=Uv-MdaBfk8U (2min 02sec) [How to make shadow puppets with your hands]
3. https://www.youtube.com/watch?v=xIEiTqq8FiI (2min 17sec) [How to make shadow puppets with your hands]

8 A

Term 3, Week 8, Lesson A
Lesson Title: Transparent substances
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Opaque and transparent substances
CAPS Page Number	50

Lesson Objectives

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

- describe a transparent object
- describe a translucent object
- explain what happens to light that falls onto a transparent and a translucent object
- classify objects as transparent or translucent.

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
Examples of transparent objects, such as glass, clean water, and clear plastics; examples of translucent objects, such as tissue paper, frosted glass and certain plastics; a torch	
Cardboard, pair of scissors, torch, white paper, ball such as a tennis ball, sellotape	

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 happens to the shadow of an object that is moved away from the light source?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

The shadow becomes bigger.

D ACCESSING INFORMATION

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

TRANSPARENT SUBSTANCES

1. A **transparent object** is any object that allows light to travel through it.
2. When light strikes a transparent object, some of the light is absorbed and reflected but most of the light passes through the object.
3. Transparent objects do not cast shadows.
4. When a clear image can be seen through an object, it means that all light has passed through.
5. A **translucent object** allows light to pass through it, but this light is **scattered** in many directions and does not form a clear image.

2. Explain this to the learners as follows:
    a. Objects that allow light to pass through them are called transparent objects.
    b. A transparent object absorbs and reflects some of the light while most of the light passes through the object.
    c. Transparent objects do not form shadows.
    d. A clear image can be seen through a transparent object.
    e. A translucent object also allows light to pass through it. A clear image is not formed because the light is scattered by a translucent object.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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 a transparent object?
b. Does a transparent object form a shadow?

Answers to the checkpoint questions are as follows:

a. It is an object that lets light travel through it.
b. No, the object does not block the light.

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners:
    a. Show the learners transparent substances, such as glass, clear plastic, cellophane and clean water. Air is also transparent.
    b. Ask the learners if they can see you behind a transparent object.
    c. The light travels straight from you to the learners and they can see a clear image. This is because the surfaces are smooth and all the light is let through.
    d. Show the learners the translucent objects, such as tissue paper, frosted glass and certain plastics. Hold these objects up to the window and ask the learners whether they can see a clear image. The answer should be no.
    e. Some light passes through the translucent objects but you cannot see a clear image.
    f. Shine a torch on the transparent object and translucent objects. See which objects cast a shadow.
    g. The translucent objects will make a shadow but the transparent objects do not make any shadows
    h. Bathroom windows are often made from translucent glass, such as frosted glass. The light is scattered in different directions by the frosted glass, which results in a cloudy, blurred or distorted image.
2. The learners must complete the following practical activity in their workbooks. Write the task on the chalkboard (always try to do this before the lesson starts).

TASK

Draw a table as shown below and compare transparent and translucent objects.

Transparent object	Translucent object

3. Give the learners enough time to complete the task.
4. Model answer

MODEL ANSWER

Transparent object	**Translucent object**
Allows light to pass through it.	Allows light to pass through it.
Produces a clear image	Does not produce a clear image
The light passes in straight lines through the object.	Light is scattered.
A transparent object does not cast a shadow.	A translucent object casts a shadow.

Checkpoint 2

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

a. What is a difference between a transparent object and a translucent object?
b. What is a similarity between a transparent object and a translucent object?

Answers to the checkpoint questions are as follows:

a. A transparent object produces a clear image, while a translucent object does not produce a clear image.
b. Both transparent and translucent objects allow light to pass through the objects.

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
Successful Natural Sciences	Visible light	140
Top Class Natural Sciences	Visible light	127-128
Via Africa Natural Sciences	Visible light	130
Solutions for All Natural Science	Visible light	177-179
Spot on Natural Sciences	Visible light	137-139
Platinum Natural Sciences	Visible light	168-170
Step-by-step	Visible light	111-113
Natural Sciences	Visible light	188-190
Sasol Inzalo Bk B	Visible light	94-97

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=P6Uihn8V3h4 (1min 17sec) [Transparent, translucent and opaque objects]

8 B

Term 3, Week 8, Lesson B
Lesson Title: Absorption of light
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Absorption of light
CAPS Page Number	50

Lesson Objectives

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

- describe the absorption of colours
- explain why an object has a certain colour
- explain why a black object appears black
- explain why a white object appears white.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 33: Absorption and reflection of light	

C CLASSROOM MANAGEMENT

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

What is a translucent object?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

It is an object that allows light to pass through it but it scatters the light so that no clear image is formed.

D ACCESSING INFORMATION

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

ABSORPTION OF LIGHT

1. White light is made up of seven different colours that correspond to different frequencies of light.
2. Light is absorbed by the surfaces of some materials.
3. Different materials absorb light differently. An opaque object absorbs all the light that falls on it, while a mirror does not absorb any light.
4. A material has colour because it absorbs some of the colours in the spectrum, while reflecting other colours.
5. When light shines on a coloured object, the object absorbs all the colours but reflects the colour of the object.
6. When all light is completely absorbed by an object, the surface of the object appears black.
7. A white object does not absorb any colours and all the colours are reflected as white light.
8. The frequencies that are absorbed do not reach the eye. We can only see those colours that are reflected and enter our eyes.

2. Explain this to the learners as follows:
    a. The surfaces of most materials will absorb light, but not all meterials absorb light in the same way.
    b. Some of the colours of the light spectrum are absorbed and some of the colours are reflected, depending on the material.
    c. An object appears to be the colour of the light rays that it reflects. The other colours are absorbed.
    d. A black object absorbs all of the frequencies or colours of white light, and no light is reflected.
    e. A white object reflects all the frequencies or colours of white light.
    f. The colours that are absorbed do not reach the eye. The frequencies that have been reflected will reach the eye and will give colour to the object.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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. Why does a material have a particular colour?
b. How does an object appear that reflects all light?

Answers to the checkpoint questions are as follows:

a. It reflects some colours and absorbs other colours.
b. The object will appear white.

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners:
    a. Albert Einstein said that colour is how we perceive the energy of light. We see colours that are associated with specific frequencies.
    b. A material has a specific colour because it absorbs some of the frequencies in the spectrum and reflects other frequencies. We call this selective absorption.
    c. When an object has a specific colour, it is because it reflects only that colour of light and absorbs all the other colours of the visible spectrum.
    d. Show the learners Resource 33. The flowers appear red because they have absorbed all the frequencies of violet, indigo, blue, green, yellow and orange of the sunlight, and only reflected the frequency of red light. Since red light is the only light that reaches the eye, the flowers appear to be red.
    e. Ask the learners if they can explain why the leaves appear green.
    (Answer: The leaves appear green because the leaves have absorbed all the frequencies of violet, indigo, blue, yellow, orange and red of the sunlight, and only reflected the frequency of green light. Since green light is the only light that reaches the eye, the leaves appear to be green.)
    f. The black surface absorbs all the frequencies of white light and does not reflect any light. The surface appears black to the eye.

g. The white surface reflects all the frequencies of white light and therefore looks white.

h. You learned in GRADE 8 that black, dull surfaces are good absorbers of heat energy while shiny, white surfaces are good reflectors of heat. Black surfaces get hotter than white surfaces because they absorb the heat, which falls onto them, far better than white surfaces.

i. This same principle that applies to heat also applies to light. White surfaces are good reflectors of light while black surfaces are good absorbers of light.

2. The learners should complete the following task orally in pairs. Write the task on the chalkboard (always try to do this before the lesson starts).

TASK

Copy the checklist below into your workbook. Work in pairs. Each learner must take an object with a certain colour. Take turns to explain orally why the object has the specific colour. Assess the learners by using the checklist.

Information	**Yes**	**No**
What the object is		
The colour light that shines on the object		
The colour(s) that were absorbed		
The colour(s) that were reflected		
The colour(s) that reached the eyes		

3. Remind the learners that the colour frequencies of the spectrum are violet, indigo, blue, yellow, orange, green and red.
4. Give the learners enough time to complete the task.
5. Let the learners show the checklist that they gave to the other learner in the pair.
6. Discuss the answers with the learners.

Checkpoint 2

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

a. Why does a red object appear red?

b. How will an object appear when it absorbs all light?

Answers to the checkpoint questions are as follows:

a. The red object absorbs all the colours and only reflects red light.

b. The object will appear black.

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
Successful Natural Sciences	Visible light	141
Top Class Natural Sciences	Visible light	128-129
Via Africa Natural Sciences	Visible light	131-132
Solutions for All Natural Science	Visible light	180-181
Spot on Natural Sciences	Visible light	140
Platinum Natural Sciences	Visible light	171-172
Step-by-step	Visible light	114
Natural Sciences	Visible light	191-192
Sasol Inzalo Bk B	Visible light	98-100

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=ol529s_gUIc (1min 54sec) [Reflected colour and colour subtraction]
2. https://www.youtube.com/watch?v=0PyxLVXDkeY (1min 45sec) [Colour filters and white light]

8 C

Term 3, Week 8, Lesson C
Lesson Title: Reflection of light
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Reflection of light
CAPS Page Number	51

Lesson Objectives

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

- describe the reflection of light from a smooth and rough surface
- draw a ray diagram to explain the reflection of light
- draw a ray diagram to show the incident ray, reflected ray, incident angles and reflected angle of light..

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 34: Reflection of light	
Mirror, light source (ray box), protractor, tinfoil, pencil, ruler	A laser can be used in the place of a ray box

C CLASSROOM MANAGEMENT

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

What is a transparent object?

3. Learners should enter the classroom, then discuss the seven life processes with the teacher and then answer the question in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

It is an object that allows all the light to pass through and then produce a clear image.

D ACCESSING INFORMATION

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

REFLECTION OF LIGHT

1. Light is reflected off most surfaces, such as mirrors. This enables us to see objects.
2. Light can change direction when it is reflected.
3. The law of reflection states:
   a. The **angle of incidence** and the angle of reflection are equal.
   b. The **incident ray**, **reflected ray**, and the **normal** lie on the same side of the
3. reflected surface.
4. The incident ray is the light ray that strikes the surface of an object.
5. The reflected ray is the light ray that is reflected off the surface of an object.
6. The normal is a line drawn at right angles to the surface of an object.
7. The angles of incidence and reflection are measured from the normal.
8. All the light is reflected in the same direction on a smooth surface.
9. On rough surfaces, reflected light is scattered, which means that it reflects in different directions with no regular pattern in the reflection.

2. Explain this to the learners as follows:
    a. When light cannot travel through a substance, it is either absorbed or reflected.
    b. A reflection occurs when light bounces off an object. The light changes direction when it is reflected off an object.
    c. Show the learners Resource 34 and indicate the different angles and rays on the first diagram.
    d. The light ray from a light source towards a smooth reflecting surface, such as a mirror, is called an incident ray. The ray that is reflected from the mirror surface is the reflected ray.
    e. The angle of incidence is between the incidence ray and the normal. The angle of reflection is between the reflecting ray and the normal.
    f. According to the law of reflection, the angle of incidence is equal to the angle of reflection. Light rays reflect from a mirror at the same angle at which they arrive. The incident ray, reflection ray and normal lie in the same plane on the same side of the reflective object.
    g. Show the learners the second and third diagrams on Resource 34. The smoother the surface, the more the light is reflected in the same direction and, therefore, the clearer the image that forms.
    h. When light falls on a rough surface, the light scatters into many directions. Light reflects at all sorts of different angles, because the surface is uneven.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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 do we call the angle between the reflected ray and the normal?
b. Why can we see a reflected image when a surface is smooth and shiny?

Answers to the checkpoint questions are as follows:

a. The reflected angle
b. All the light rays travel in the same direction.

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners:
    a. Choose learners to come to the front and demonstrate the following with a mirror:
        - Describe what happens to your reflection when you move towards the mirror.
          (Answer: The closer you move towards the mirror, the closer your image gets.)
        - Describe what happens to your reflection when you move to the right.
          (Answer: Your image also moves to the right.)
        - Is your image the same size as you?
          (Answer: Yes, the image you see is the same size.)

- When you look in the mirror, does your image seem behind, in front or on the mirror?
  (Answer: When you look in a mirror your image seems to be behind the surface of the mirror.)
- Write your name on a piece of paper and show it to the mirror. Can you read your name?
  (Answer: Yes, but the left and right side of the name are the wrong way around. The name looks as if it was spelt backwards in the mirror.)

b. Try to see your reflection in the window. When a surface has a perfect reflection, where each ray of light is reflected in a single direction, the surface will actually be invisible. If you look at that surface, you will only see the reflection of the object, but you will not see the surface itself.

c. When light strikes a mirror at 90°, it comes straight back. The incident angle and reflected angle are both 0°.

d. Not all surfaces form images when light is reflected off them. Take a sheet of aluminium and ask the learners if they can see their reflection in the aluminium.
(Answer: They will not be able to see a clear reflection of themselves.)

e. The aluminium has a rough surface even if it is shiny and looks smooth. The light is scattered but still obeys the laws of reflection.

f. There is a difference between the reflection off white paper and the reflection off a mirror.

2. The learners should complete the following practical activity in their workbooks. The activity can either be a demonstration or group work, depending on the apparatus that is available. Write the task on the chalkboard (always try to do this before the lesson starts) and hand out the ray box.

PRACTICAL ACTIVITY

Do the following practical activity in a group.

AIM

To prove that the angle of incidence is equal to the angle of reflection.

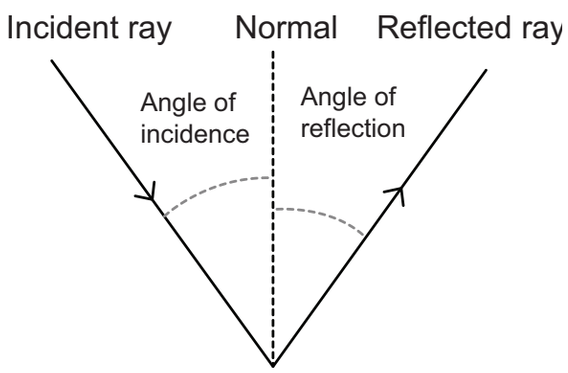
WHAT YOU NEED:

a pencil
a ruler
a protractor
a ray box
a white sheet
mirror.

WHAT YOU NEED TO DO:

- Look at ‘Mirror Reflection’ that your teacher will show you. It will act as a guideline while you do this activity.

Mirror reflection



- Stand the mirror vertically on the paper and let someone hold it upright.
- Draw a solid line along the front of the mirror.
- Shine a ray from the ray box at an angle towards the mirror so that you can see the incident ray and the reflected ray.
- Draw these rays on the paper with a ruler. Add arrows to the lines to show the direction of the rays.
- Draw a dotted or broken line perpendicular to the mirror surface where the incident ray strikes the mirror. This is the normal.
- Take away the mirror. You are left with the ray diagram on the white paper.
- Add labels to the ray diagram. Indicate the incident ray, reflected ray, normal, angle of incidence and angle of reflection.
- Use the protractor to measure the angle of incidence and angle of reflection.

a. Can you write down the values of the angle for incidence and angle of reflection in your work book?

b. What is your conclusion?

3. Give the learners enough time to complete the practical activity.
4. Model answer

MODEL ANSWER

a. The values will differ from group to group. However, the values of both angles should be the same.

b. The angle of incidence is equal to the angle of reflection. Light bounces off the mirror at the same angle but in the opposite direction to which it came in.

Checkpoint 2

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

a. What is the angle of incidence?
b. What is the size of the angle of reflection when the angle of incidence is 25°?

Answers to the checkpoint questions are as follows:

a. It is the angle between the incidence ray and the reflected ray.
b. The size of the angle of reflection will also be 25°.

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Successful Natural Sciences	Visible light	141-145
Top Class Natural Sciences	Visible light	129-132
Via Africa Natural Sciences	Visible light	132-134
Solutions for All Natural Science	Visible light	182-183
Spot on Natural Sciences	Visible light	141-142
Platinum Natural Sciences	Visible light	173-176
Step-by-step	Visible light	115-116
Natural Sciences	Visible light	192-195
Sasol Inzalo Bk B	Visible light	101-107

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=vt-SG7Pn8UU (5min 21sec) [Laws of reflection]

9 A

Term 3, Week 9, Lesson A
Lesson Title: Light and the eye
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Seeing light
CAPS Page Number	51

Lesson Objectives

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

- describe the parts of the eye that are responsible for seeing light
- explain how the eye distinguishes between different colours
- describe the image that is formed by the eye and the brain.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 35: Structure of the human eye	

C CLASSROOM MANAGEMENT

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

What is the angle of reflection?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

It is the angle between the normal and the reflected ray.

D ACCESSING INFORMATION

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

LIGHT AND THE EYE

1. When light shines on coloured objects, some of the light is absorbed and some of the light is reflected by the object.
2. The frequencies of the colours that are reflected enter the eye.
3. We can only see the colours of light that are part of the visible spectrum. They are violet, blue, green, yellow, orange and red.
4. Light enters the eye at the pupil and is focused to form an image on the retina at the back of the eye.
5. The image that is formed on the retina is upside down.
6. The light energy of the image is converted to electrical nerve impulses that are sent to the **optic nerve** of the brain.
7. The brain interprets the impulses to form a picture. It turns the image around so that we see objects upright.

2. Explain this to the learners as follows:
    a. We see objects because different frequencies of light are reflected off the surfaces of objects.
    b. Only the frequencies that are reflected from an object enter the eye through the pupil. Show the learners Resource 35 and point out the different parts of the eye that are used to form an image.
    c. The light is focused and falls on the retina, which is at the back of the eye.
    d. On the surface of the retina are light-sensitive cells that are stimulated by specific frequencies.
    e. These cells can sense only wavelengths of light in the visible spectrum.
    f. The image that is formed on the retina is upside down.
    g. The light-sensitive cells come together at the back of the eye to form the optic nerve.
    h. The light energy that strikes a cell in the retina is converted to electrical nerve impulses. These impulses pass along the optic nerve to the visual centre at the back of the brain where the brain interprets the signals and provides us with an upright image.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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. Where does light enter the eye?
b. Where does the image form in the eye?

Answers to the checkpoint questions are as follows:

a. At the pupil
b. On the retina at the back of the eye.

E CONCEPTUAL DEVELOPMENT

1. Show the learners Resource 35. Explain the following to the learners:
    a. Let us explain step by step what happens when we see a red lollipop.
    b. When light shines on the lollipop, it absorbs all the frequencies of visible light except the frequency that is associated with the colour red. Red light is reflected.
    c. The absorbed frequencies of visible light do not reach the eye.
    d. The only colour that reaches the eye is the red light. It passes through the pupil of the eye and is focused on the retina at the back of the eye.
    e. The retina contains special cells that are sensitive to light. They are called photoreceptors. Photoreceptors are either cones or rods. The rods are sensitive to the brightness of light, while the cones are stimulated by the frequencies of colours.
    f. Different cones detect red light, blue light and green light.
    g. An upside-down image is formed on the retina.

h. The brain interprets the impulses to form a picture and our perception of light.

i. We see with our eyes, but we also need our brain to be able to see things. The brain also needs light from both eyes to be able to pinpoint the position of objects accurately.

j. So how do we see a pink lollipop? Pink is not one of the colours of the rainbow. The pink lollipop reflects all the colours but absorbs green light. You can also see different shades of pink. If more blue light and less yellow light shine on the retina, the brain will interpret a darker shade of pink. If less blue light and more yellow light shine on the retina, the brain will interpret a lighter shade of pink..

2. The learners must complete the following task in their workbooks. Write the task on the chalkboard (always try to do this before the lesson starts).

TASK

Draw a flow diagram to show how you are able to see a green leaf. Use the following words to help you:

retina, leave, optical nerve, pupil, upright image, brain, sunlight, light energy, green light, reflect, photoreceptors, electrical impulses

3. Give the learners enough time to complete the task.

4. Model answer:

MODEL ANSWER

sunlight —*shines on*→ *green leaf* —*reflects*→ *green light* —*enters*→ *pupil* —*stimulates*→

photoreceptors —*on*→ *retina* —*changes*→ *light energy* —*to*→ *electrical impulses* —*moves down*→

optical nerve —*to*→ *brain* —*that forms*→ *upright image*

Checkpoint 2

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

a. Why is the image that forms on our retina not a true image of what is in front of us?

b. How do we see objects as upright objects?

Answers to the checkpoint questions are as follows:

a. The image is upside down.

b. The brain turns the upside-down image upright.

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
Successful Natural Sciences	Visible light	146-147
Top Class Natural Sciences	Visible light	133-134
Via Africa Natural Sciences	Visible light	134-135
Solutions for All Natural Science	Visible light	184-186
Spot on Natural Sciences	Visible light	143
Platinum Natural Sciences	Visible light	177-180
Step-by-step	Visible light	117
Natural Sciences	Visible light	195-197
Sasol Inzalo Bk B	Visible light	107-110

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.vischeck.com/ [Colour blindness simulator]
2. https://www.compadre.org/portal/items/detail.cfm?ID=4592 [Colour vision simulator]
3. https://www.optics4kids.org › Home › Content [Optical illusions]

9 B

Term 3, Week 9, Lesson B
Lesson Title: Refraction of light
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Refraction of light
CAPS Page Number	51

Lesson Objectives

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

- Define refraction
- State the conditions for refraction
- Explain why light is refracted
- Draw a ray diagram to show the refraction of a light ray.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 36: Refraction of a pencil	
Resource 37: Ray diagram of refraction	
Pencil, glass of water	

C CLASSROOM MANAGEMENT

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

Where in the eye is an upside-down image formed?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

On the retina at the back of the eye

D ACCESSING INFORMATION

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

REFRACTION OF LIGHT

1. **Refraction** is the bending of light waves.
2. Refraction occurs when the speed of light is increased or decreased.
3. Light travels at different speeds through transparent mediums with different optical densities. Glass has a higher optical density than water, while air has the lowest optical density.
4. Refraction of light occurs at the boundary between two transparent mediums with different optical densities.
5. Light must enter a transparent medium at an angle to be refracted.
6. When a light ray enters an optically dense medium, the speed of light will decrease, and the light ray will bend towards the normal in that medium.
7. When a light ray enters a less optically dense medium, the speed of light will increase, and the light ray will bend away from the normal in the medium.

2. Explain this to the learners as follows:
    a. Although light travels in straight lines, the direction of light can be changed when it is reflected or refracted.
    b. Different transparent mediums have different optical densities.
    c. The speed of a wave depends on what medium it is travelling through. A light wave travels at different speeds through mediums of different optical densities.
    d. Refraction occurs when a ray of light passes from one transparent medium to another transparent medium with a different optical density. Show the learners Resource 37.
    e. When this happens, the speed of light changes and the light ray bends as it crosses the boundary from one medium to another. The light changes direction.
    f. Light travels more slowly in a denser medium, and changes direction towards the normal in such a medium.
    g. Light travels faster in a less dense medium, and changes direction away from the normal in such a medium.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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:

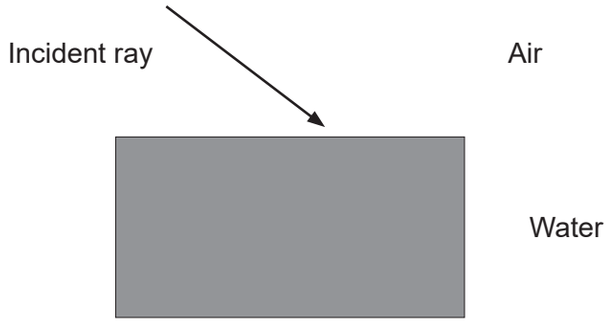
a. What is refraction?
b. What are the two conditions for the refraction of light?

Answers to the checkpoint questions are as follows:

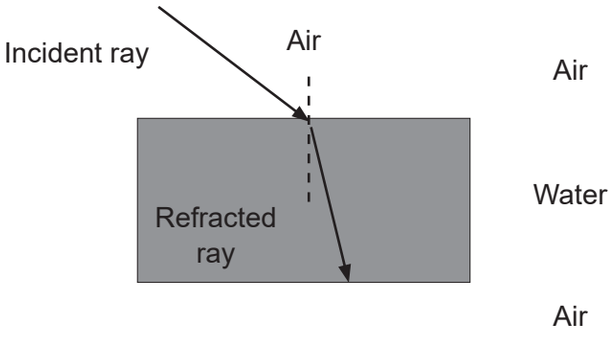
a. It is the bending of light in a transparent medium.
b. Light must travel through a transparent medium with a different optical density, and must enter the medium at an angle.

E CONCEPTUAL DEVELOPMENT

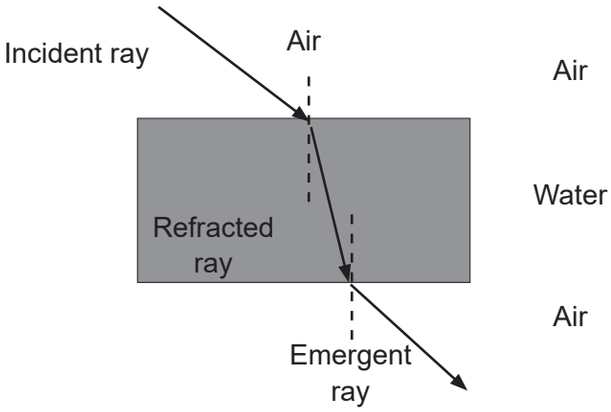
1. Explain the following to the learners:
   a. We will explain the refraction of light as it travels from air to water and back into the air.
   b. Let us draw a ray diagram to show the incident ray that enters water at an angle.



   c. Water is optically denser than air. The light slows down as it enters the water and at the boundary between the air and the water is bend closer to the normal. This is called the refracted ray. Remember that the normal is a line perpendicular to the surface of a medium and we draw it as a broken line.



   d. As the light leaves the water, it travels back into the air, which is less optical dense than water. The light speeds up and changes direction away from the normal. This is called the emergent ray. The emergent ray is parallel to incident ray.



2. The learners must complete the following task in their workbooks. Write the task on the chalkboard (always try to do this before the lesson starts). Show the learners Resource 36.

TASK

Insert a pencil in a glass of clean water and observe the apparent change in position of the pencil below the surface of the water. Alternatively, look at the pencil in the water on the page that the teacher is showing you. Answer the following questions.

a. Why does the pencil look broken?
b. What do we call this phenomenon?
c. What are the two optical mediums?
d. Which medium is optically denser?
e. Where does the bending of light take place?
f. Explain why the part of the pencil in the water looks misplaced.

3. Give the learners enough time to complete the task.
4. Model answer

MODEL ANSWER

a. The light that is reflected off the pencil is bent.
b. Refraction
c. Water and air
d. Water
e. At the water-air boundary
f. The glass that contains the pencil and water is too thin to show a lot of refraction. The light from the part of the pencil above the water travels straight to our eyes. The light from the part of the pencil in the water is bent as it leaves the water and enters the air. The light speeds up in the air and changes direction away from the normal.

Checkpoint 2

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

a. Why do light waves change direction when they go from air to glass?
b. What happens to the speed of light waves when it travels from water to air?

Answers to the checkpoint questions are as follows:

a. The speed of the light waves changes.
b. The speed of the light waves increases, and it bends towards the normal.

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
Successful Natural Sciences	Visible light	148-150
Top Class Natural Sciences	Visible light	134-135
Via Africa Natural Sciences	Visible light	135-136
Solutions for All Natural Science	Visible light	186-187
Spot on Natural Sciences	Visible light	144-145
Platinum Natural Sciences	Visible light	181-183
Step-by-step	Visible light	118-119
Natural Sciences	Visible light	198-199
Sasol Inzalo Bk B	Visible light	111-117

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.physicsclassroom.com ›Physics Interactives › Refraction and Lenses › Refraction [Interactive refraction - simulations]
2. https://www.youtube.com/watch?v=nJSELNYvH6E (35sec) [Disappearing coin trick]

9 C

Term 3, Week 9, Lesson C
Lesson Title: Applications of the refraction of light
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Refraction of light
CAPS Page Number	51

Lesson Objectives

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

- Define a lens
- Apply the refraction of light to everyday situations
- Explain how a lens, prism and magnifying glass refracts light
- Investigate the images where light is refracted.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 32: Dispersion of light	
Resource 38: Glass refracting light	
Resource 39: Magnifying glass refracting light	
Lenses such as reading glasses, a magnifying glass, a triangular prism; glass of water, pebbles or marbles	

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 is light bent when it travels from glass to air?

3. Learners should enter the classroom, then discuss the question with the teacher and then answer it in their workbooks.
4. Discuss their answers with the learners.
5. Write the model answer onto the chalkboard.

The light is bent away from the normal.

D ACCESSING INFORMATION

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

APPLICATIONS OF THE REFRACTION OF LIGHT

1. An object in water always looks shallower than it really is. The light that is reflected off the object in the water is refracted at the water-air boundary.
2. To refract means to make a ray of light change direction when it enters at an angle.
3. A lens is a curved transparent object that is made of glass or moulded plastic.
4. A lens is able to refract and focus light.
5. A magnifying glass is also a type of lens that is able to refract and focus light.
6. A triangular prism is a transparent medium that is able to refract and disperse white light into the different colours of the visible spectrum. The light is refracted at the boundary between the prism and the air.

2. Explain this to the learners as follows:
    a. Whenever you use eyeglasses, a telescope, binoculars or fibre optics technology, you are using the refraction of light. Show the learners Resource 38.
    b. An object in the water appears to be closer to the surface than it really is. This illusion is caused by the refraction of light rays. The light rays from the object are refracted when they cross from the water into the air before reaching your eyes.
    c. Lenses are able to refract and focus light.
    d. Magnifying glasses are used to focus light and heat energy onto a point. Show the learners Resource 39.
    e. A triangular prism is able to break up white light into the different colours of the visible spectrum because each colour is refracted differently. Show the learners Resource 32.
3. Read through the information written on the chalkboard with the learners.
4. Ask the learners if they have any questions.
5. Tell the learners 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:

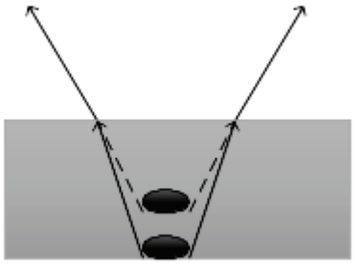
a. What type of object can refract light?
b. Does an object in water look deeper or shallower than it really is?

Answers to the checkpoint questions are as follows:

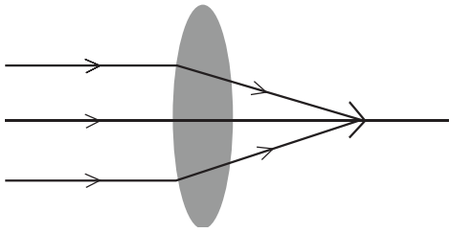
a. Lens/ prism/ magnifying glass
b. It looks shallower.

E CONCEPTUAL DEVELOPMENT

1. Explain the following to the learners:
   a. When an object is in water, its image appears to be shallower. This is the result of the refraction of light rays. We can explain it with a ray diagram. Air is less dense than water. As the light rays leave the water, they speed up and bends away from the normal. Our eyes can only see in straight lines, so our brains extend the paths of the light rays to where they expect the object to be.



   b. People who catch fish with a sharp stick or spear have learned that they must aim below where they see the fish. The fish is actually deeper in the water.
   c. A triangular prism refracts white light and splits it into its spectrum of colours. Each colour has its own frequency and wavelength. As a result, the colours move at different speeds through optical dense mediums and are refracted differently.
   d. A lens is made of a transparent material with a different optical density than air. A lens is able to refract and focus light, because its surface is curved to refract light in a specific way. Look at the ray diagram below. The light is refracted at each boundary.



   e. A magnifying glass enlarges an object. It creates an image that is virtual and larger than the object. The light is bent by the lens so that it appears to come from a much larger object.
   f. Lenses are used in reading glasses to correct a person's vision or enhance it by making distant objects appear closer or small objects appear bigger.
2. The learners should complete the following investigation in their workbooks. Write the task on the chalkboard (always try to do this before the lesson starts). Provide the learners with a magnifying glass, pair of reading glasses, a triangular prism, a glass of water, and pebbles/ marbles. Let them take turns to use these objects to investigate their refraction properties.

INVESTIGATION

- Take a pebble or marble. Look at the pebble with the naked eye.
- Compare its shape and size with the image that you see when you look at the pebble through a magnifying glass, pair of reading glasses and triangular prism.
- Put the pebble in the glass of water and observe the pebble.
- Record your observations with respect to the original pebble seen with the naked eye. Write your observations in the table below.
- Write down a conclusion.

Object	**Size of pebble**	**Shape of pebble**
Magnifying glass		
Pair of reading glasses		
Triangular prism		
Glass of water		
Conclusion:		

3. Give the learners enough time to complete the task.
4. Model answer

Object	***Size of pebble***	***Shape of pebble***
Magnifying glass	*Bigger*	*Same shape*
Pair of reading glasses	*Different size depending on the lenses of the pair of glasses*	*Same shape*
Triangular prism	*Different size*	*Different shape*
Glass of water	*Bigger*	*Same shape but pebble appears to be in a different place*
Conclusion: In each case the light rays have been changed and a different image from the original pebble is observed.		

Checkpoint 2

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

a. Where should a person aim to spear a fish?
b. How does a lens change a light ray?

Answers to the checkpoint questions are as follows:

a. The person should aim deeper than the fish appears.
b. A lens bends and focuses the light ray.

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
Successful Natural Sciences	Visible light	151-153
Top Class Natural Sciences	Visible light	134
Via Africa Natural Sciences	Visible light	137
Solutions for All Natural Science	Visible light	187
Spot on Natural Sciences	Visible light	145
Platinum Natural Sciences	Visible light	184-186
Step-by-step	Visible light	120
Natural Sciences	Visible light	200-201
Sasol Inzalo Bk B	Visible light	118-128

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.explainthatstuff.com/lenses.html [How do lenses work?]
2. https://www.youtube.com/watch?v=qbPfzOuIeSM (1min 38sec) [How do lenses work?]

NATURAL SCIENCES

ASSESSMENT
GRADE 8 TERM 3

GRADE 8 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 8 ASSESSMENT

Grade 8					
Programme of Formal Assessment					
Formal Assessments	**TERM 1**	**TERM 2**	**TERM 3**	**TERM 4**	**TOTAL % FOR THE YEAR**
School-based assessments	Test 1 [35 marks] Practical task/ investigation 1 [20 marks]	Test 2 [35 marks] Practical task/ investigation 2 [20 marks]	Test 3 [35 marks] Practical task/ investigation 3 [20 marks]	Practical task/ investigation 4 [20 marks] Project [30 marks]	40%
Exams [60 minutes]		Exam 1 on work from terms 1 and 2 [70 marks]		Exam 2 on work from terms 3 and 4 [70 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:

1. 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.

2. A Test

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

3. A Project

The project will be completed in Term 3, but the marks will be used in Term 4. The project focuses on Term 3 work. There are instructions for learners and a memorandum is included to assist you with marking the completed projects.

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

Natural Sciences
Grade 8
Project

Information and instructions for the teacher

NOTE TO THE TEACHER:

If possible, photocopy this test for each learner. If this is not possible, write the test on the chalkboard.

INSTRUCTIONS TO THE LEARNERS

1. If possible, photocopy the project information for each learner. If this is not possible, write the information on the chalkboard and have the learners copy it down.
2. This project will focus on OPAQUE AND TRANSPARENT SUBSTANCES.
3. Time needs to be taken to explain the project at the beginning of term 3.
4. A due date needs to be set for submission at the end of Term 3 or early in Term 4.
5. The project mark is to be used in Term 4.
6. This project is out of 30 marks.
7. The rubric for assessing the project is provided.
8. Ongoing support, encouragement and reminders should be provided for the learners.
9. The due date should be visibly displayed in the classroom.

Grade 8
Natural Sciences
Project

Topic: Opaque and Transparent Substances

30 Marks

Name or learner: _____

Due date: _____

INSTRUCTIONS TO THE LEARNERS

1. This project will be done individually.
2. Pay attention to the mark allocations.
3. The marks for this project count towards term 4 assessment.
4. Read through the entire project to ensure you understand the tasks.
5. Plan your time carefully.
6. NO LATE projects will be accepted.
7. Work neatly and pay attention to your presentation.

THE PROJECT CRITERIA:

You are going to conduct tests on the differences between transparent, opaque and translucent materials.

- To conduct the tests, you will need a light source (cell phone torch, electric lamp, paraffin lamp, torch), cardboard, clear plastic, plastic shopping bag, scissors, ruler.
- All answers must be recorded in your workbook.
- The shapes used to test the materials must be handed in for assessment.

Step-by-step:

- Cut your cardboard into three different sized squares:
  - 15cm x 15cm
  - 10cm x 10cm
  - 5cm x 5cm
- Cut the clear plastic and the plastic shopping bag into the same shapes.
- You should now have 9 squares.
- Write the heading “Opaque, transparent and translucent materials project” in your workbook.
- Complete the tasks and questions below:

GRADE 8 ASSESSMENT – PROJECT TERM 3

THE QUESTIONS AND INSTRUCTIONS:

Question1:

1. Define the following terms:

   1.1. Opaque

   1.2. Translucent

   1.3. Transparent

Question 2:

- Switch on your light source. Make sure it is shining onto a wall.
- Hold your largest cardboard square between the light source and the wall.

2.1. What do you observe?

- Now do the same with the second cardboard square.

2.2. What do you observe?

- Now do the same with the third cardboard square.

2.3. What do you observe?

2.4. What differences do you observe between the shadows of the three shapes?

Question 3:

- Switch on your light source. Make sure it is shining onto a wall.
- Hold your largest plastic shopping bag square between the light source and the wall.

3.1. What do you observe?

- Now do the same with the second plastic shopping bag square.

3.2. What do you observe?

- Now do the same with the third plastic shopping bag square.

3.3. What do you observe?

3.4. What differences do you observe between the shadows of the three shapes?

Question 4:

- Switch on your light source. Make sure it is shining onto a wall.
- Hold your largest clear plastic square between the light source and the wall.

4.1. What do you observe?

- Now do the same with the second clear plastic square.

4.2. What do you observe?

- Now do the same with the third clear plastic square.

4.3. What do you observe?

4.4. What differences do you observe between the shadows of the three shapes?

Question 5:

- Using only the cardboard shapes, answer these questions:

5.1. Is the cardboard transparent, translucent or opaque? How do you know?

5.2. What do you predict will happen if you move the cardboard shapes closer or further away from the light source?

- Test your prediction by moving the shapes closer and further away from the light source.

5.3. Was your prediction correct? If not, what happened when you moved the shapes closer or further away?

Question 6:

- Using the plastic shopping bag and clear plastic shapes:

6.1. Explain if the plastic shopping bag transparent or opaque?

6.2. Did the plastic shopping bag cast a shadow?

6.3. Explain why the plastic shopping casts a lighter shadow than the cardboard shapes.

6.4. Did the clear plastic shape cast a shadow?

6.5. Explain why the cardboard and the plastic shopping bag cast shadows but the clear plastic does not.

Project assessment rubric
Grade 8

Name of learner/s: _____

Date: _____

	Excellence achieved	Achieved	Mostly achieved	Was not submitted	Total
Score	5	4-3	2-1	0	
Question 1	Definitions are detailed and accurate with examples	Definitions are correct but lack details or examples	Definitions are incorrect, contain errors or are incomplete	Work not submitted	
Question 2	The 3 cardboard shapes have been submitted and are accurately prepared The 3 observations have been recorded and are clear and show critical thinking The comparison has been recorded and reflects accurate observation	The 3 cardboard shapes have been submitted but are not accurately prepared The 3 observations have been recorded The comparison has been recorded and shows some critical thinking	The shapes may or may have been submitted At least 2 observations are recorded The comparison shows little critical thinking	Work was not submitted	
Question 3	The 3 plastic shopping bag shapes have been submitted and are accurately prepared The 3 observations have been recorded and are clear and show critical thinking The comparison has been recorded and reflects accurate observation	The 3 plastic shopping bag shapes have been submitted but are not accurately prepared The 3 observations have been recorded The comparison has been recorded and shows some critical thinking	The shapes may or may have been submitted At least 2 observations are recorded The comparison shows little critical thinking	Work was not submitted	

GRADE 8 ASSESSMENT – PROJECT TERM 3 MEMO

	Excellence achieved	Achieved	Mostly achieved	Was not submitted	Total
Score	5	4-3	2-1	0	
Question 4	The 3 clear plastic shapes have been submitted and are accurately prepared The 3 observations have been recorded and are clear and show critical thinking The comparison has been recorded and reflects accurate observation	The 3 clear plastic shapes have been submitted but are not accurately prepared The 3 observations have been recorded The comparison has been recorded and shows some critical thinking	The shapes may or may have been submitted At least 2 observations are recorded The comparison shows little critical thinking	Work was not submitted	
Question 5	All questions are answered with accurate reasoning Clear prediction is made before testing the hypothesis and answered after testing	All questions are answered with some reasoning present Prediction is made before testing the hypothesis. Clear finding may or may not be evident	All questions are answered but with flawed or no reasoning Prediction is made before testing the hypothesis. Clear finding is not made	Work was not submitted	
Question 6	All questions are answered with detailed and accurate explanations	All questions are answered with some explanation	All questions are answered but explanations contain errors	Work was not submitted	
					30 marks

Natural Sciences
Grade 8
Practical Task
Term 3

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 1B.
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. This will be a pair-work or small-group work lesson.
8. The following equipment will need to be collected before the lesson:
    - two balloons or latex gloves
    - a few sheets of tissue or toilet paper
    - an empty coke can
    - a woolen jersey/ sock or similar
    - a ruler
    - a marker pen
9. Ensure that all the materials have been collected before the practical lesson. This may take a few days. Allow enough time for this.
10. The learners should complete the drawings/ graphs with a sharp pencil and the written answers should be completed in pen.

Grade 8
Natural Sciences & Technology
Term 3
Practical

Memorandum

CAPS Topic	Task	Expected answer(s)	Marks
	1		
Static electricity	1.1	(Answers may vary) ✓ The tissue won't stick.	½
Static electricity	1.2	(Answers may vary) ✓ The tissue will stick.	½
Static electricity	1.3	• Balloon "A" did not attract the toilet tissue. ✓ • Balloon" B" attracted the toilet tissue ✓	2
Static electricity	1.4	(Any 3) ✓ ✓ ✓ • Balloon "B" was charged through friction with the jersey. • A charged object has an effect on neutral objects • The toilet tissue is neutral • Objects with different electric charges attract each other • A charged object can attract a neutral object	3
	2.		
Static electricity	2.1	(Answers may vary) The balloons will repel each other. ✓	1
Static electricity	2.2	The balloons repelled each other. ✓	1
Static electricity	2.3	(Answers may vary) • Both balloons were charged ✓ • Objects with the same electric charge move away from each other ✓ • Both balloons have been charged negatively ✓ • The electrons have been transferred to the jersey ✓	4

	3		
	Aim	To make a can move using static electricity. ✓	1
	Method	(Answers may vary) ✓ ✓ ✓ • Charge the balloon/s by rubbing them against a jersey • Place the can on its side on a flat surface. • Hold the balloon close to the can. • The can should start to move towards the balloon.	3
	Conclusion	(Answer may vary) • The balloon was charged through friction on the jersey. ✓ • The balloon has been charged negatively ✓ • The can is neutral ✓ • The balloon (which is charged) attracted the can (which is neutral) causing the can to move ✓	4
			TOTAL 20

Grade 8
Natural Sciences
Term 3
Test

35 Marks
70 Minutes

NOTE TO THE TEACHER:

If possible, photocopy this test for each learner. If this is not possible, write the test on the chalkboard.

INSTRUCTIONS TO THE LEARNERS

1. Answer all questions in blue or black ink.
2. Read each question carefully before answering it.
3. Pay attention to the mark allocations.
4. Plan your time carefully.
5. Write your answers in the spaces provided.
6. Write neatly.

PRACTICE QUESTION

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

1.1. Where can resistors be found?

a. bathroom taps

b. televisions

c. gas heaters

d. paraffin lamps

You have answered correctly if you have circled (B)

GRADE 8 ASSESSMENT – TEST TERM 3

QUESTION 1: MULTIPLE CHOICE [4]

1.1. Which one of these is NOT an example of output energy?

a. light

b. sound

c. movement

d. electricity

1.2. Which of these statements is false?

a. A circuit is a system that transfers electrical energy to a device.

b. An input energy is needed for a system to work.

c. An output energy is needed for a system to work.

d. A circuit provides a complete conducting pathway for electricity to move.

1.3. Which of these statements is true?

a. Light is reflected from luminous objects.

b. An object that emits light is called an illuminated object.

c. Light is transmitted from luminous objects by radiation.

d. Light travels in straight lines.

1.4. Which one of these is the output energy of an electric motor?

a. Kinetic energy and heat energy

b. Light energy and heat energy

c. Light energy and kinetic energy

d. Kinetic energy only

QUESTION 2: MATCH THE COLUMNS [4]

- Match the sentences in COLUMN A with the words in COLUMN B.
- Draw a line to join the sentence in COLUMN A with the correct word in COLUMN B. Do this as shown in the example below.

COLUMN A	
example	Needed by all living things to survive
2.1.	A material that allows electrical current to pass through it.
2.2.	An object that is a source of light.
2.3.	The sensory layer at the back of the eye.
2.4.	A chemical system that stores electrical potential energy.

COLUMN B	
A.	Particle
B.	Element
C.	Biofuel
D.	Vacuum
E.	Air

QUESTION 3 [5]

Write the word or words that is/are being described in the sentences below.

Only write the answer.

3.1. The number of wavelengths that pass a point in one second.

_____

3.2. A material that does not allow charge to run through it.

_____

3.3. Two or more cells forming a chemical system that stores electrical potential energy.

_____

3.4. An object that allows light to travel through it.

_____

3.5. The splitting of white light into different colours.

_____

QUESTION 4 [11]

(Note to educator: This drawing can be replicated, (or Resource 2 can be used.)

Look at the drawing below.

4.1. What form of electricity is being demonstrated in this drawing?

_____

4.2. Explain how this form of electricity is generated using the words in the box below:

Atoms, protons, neutrons, electrons, nucleus, negative, positive, particles, friction, charge, separation

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

4.3. Explain why the balloon sticks to your head when you rub it on your hair.

_____

_____

QUESTION 5 [5]

5.1. In the space below, draw an electrical open electrical circuit diagram with the following components:

- two cells
- two bulbs in series
- a switch

5.2. As the circuit is now, will the bulbs shine? Give a reason for your answer.

_____

_____

5.3. Once the switch is closed, will both bulbs shine at equal brightness? Give a reason or your answer.

_____

_____

_____

QUESTION 6 [3]

Say if the following sentences are TRUE or FALSE:

6.1. Refraction is the bending of light waves.

_____

6.2. All light is reflected by coloured objects.

_____

6.3. White light consists of a spectrum of different colours.

_____

QUESTION 7 [3]

Many people need spectacles (glasses) to be able to see more clearly. Explain how you think glasses help people see more clearly?

_____

_____

_____

_____

_____

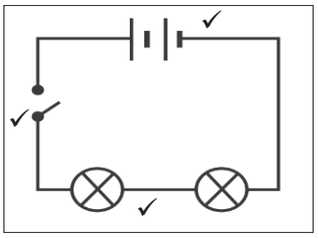
_____

Total: 30 marks

GRADE 8
NATURAL SCIENCES
TERM 3

TEST
MEMORANDUM

CAPS Topic	Questions	Expected answer(s)	Marks
	1		
Energy transfer in electrical systems	1.1	C ✓	1
Series and parallel circuits	1.2	C ✓	1
Visible light	1.3	D ✓	1
Series and parallel circuits	1.4	A ✓	1
	2.		
Series and parallel circuits	2.1	B ✓	1
Visible light	2.2	A ✓	1
Visible light	2.3	C ✓	1
Energy transfer in electrical systems	2.4	D ✓	1
	3.		
Visible light	3.1	frequency ✓	1
Static electricity	3.2	isolator ✓	1
Energy transfer in electrical systems	3.3	battery ✓	1
Visible light	3.4	transparent ✓	1
Visible light	3.5	dispersion ✓	1

	4.		
Static electricity	4.1	Static electricity ✓	1
Static electricity	4.2	• Atoms are made up of positively charged protons and neutral neutrons that are packed into the nucleus. ✓ • Negatively charged electrons move freely around the nucleus. ✓ • A neutral atom has an equal number of negatively and positively charged particles. ✓ • Friction between objects causes electrons to move from one object to another. ✓ • The object that gains electrons becomes negatively charged because it has more electrons than protons. ✓ • The object that loses electrons becomes positively charged because it has fewer electrons than protons. ✓ • This separation of charges is called static electricity. ✓	7
Static electricity	4.3	• The balloon obtained electrical charge through friction against the hair. ✓ • A charged object has an affect on other charged or neutral objects. ✓ • Objects with different electric charges (the hair and the balloon) attract each other. ✓	3
	5.		
Series and parallel circuits	5.1		3
Series and parallel circuits	5.2	No, because the circuit is open and the current cannot flow continuously. ✓	1
Series and parallel circuits	5.2	Yes, because the current is the same throughout a series circuit. ✓	1

	6		
Visible light	6.1	True ✓	1
Visible light	6.2	False ✓	1
Visible light	6.3	True ✓	1
	7		
Visible light	7	Answers will vary, but may include: • To see properly the light that enters the eyeball needs to enter on an exact spot on the retina. • Some people may have eyes where the light entering the eyeball is not reaching the exact spot for clear vision. • The lenses of the glasses have different thicknesses and so the light will bend to find the exact spot on the retina. • This bending of light is called refraction. (Any 3) ✓ ✓ ✓	3
			TOTAL 35