Interesting Science fact #15

The air at the summit of Mount Everest, 8851 metres is only a third as thick as the air at sea level.

NATURAL SCIENCES

LESSON PLAN

GRADE 9 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 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 9			
Term 1	**Term 2**	**Term 3**	**Term 4**
NS Strand	**NS Strand**	**NS Strand**	**NS Strand**
Life and Living	**Matter and Materials**	**Energy and Change**	**Planet Earth and Beyond**
Cells as the basic units of life Systems in the human body Human Reproduction Circulatory and respiratory systems Digestive system	Compounds Chemical reactions Reactions of metals with oxygen Reactions of non-metals with oxygen Acids, bases and pH value Reactions of acids with bases Reactions of acids with metals	Forces Electric cells as energy systems Resistance Series and parallel circuits Safety with electricity Energy and the national electricity grid Cost of electrical power	The Earth as a system Mining of mineral resources Atmosphere Birth, life and death of stars
These lesson plans have been designed against the stipulated CAPS requirements with topics being allocated for the time prescribed by CAPS. (Remember that some slight changes have been incorporated to accommodate time for revision, tests and examinations).			

PROGRAMME ORIENTATION

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

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

	GRADE 9		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:
Forces
Term 3, Weeks 1A – 2C

A. TOPIC OVERVIEW

TERM 3, WEEKS 1A – 1C

- This topic runs for 2 weeks.
- It is presented over 6 X 1 hour lessons.
- This topic's position in the term is as follows:

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

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

B. SEQUENTIAL TABLE

GRADE 8	GRADE 9	GRADE 10-12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Gravitational force • A bond is a force that holds atoms together • Particles in gases have weak forces between them	• Types of forces • Contact forces • Field forces (non-contact forces) • Gravitational force • Magnetic force • Electrostatic force	**Grade 10** • Conservation of • mechanical energy (in the absence of dissipative forces) • Force exerted by charges on each other **Grade 11** • Different kinds of forces: weight, normal force, frictional force, applied (push, pull), tension (strings or cables) • Intermolecular forces • Relationship between force and acceleration • Relationship between normal force and maximum static friction

C. SCIENTIFIC VOCABULARY

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

	TERM	EXPLANATION
1.	force	Action that can be described as a push or a pull
2.	exert	To apply by pushing, pulling nd twisting
3.	Newton	Unit of force
4.	balanced forces	Two forces that have no visible effect because they unequal in size and act in opposite directions.
5.	unbalanced forces	Two forces that have a visible effect because they are exactly equal and opposite.
6.	contact force	Force that is exerted when two objects touch each other
7.	non-contact force	Force that is exerted over a distance. Also called a field force
8.	field force	Force that is exerted over a distance. Also called a contact force
9.	friction	Contact force that is created when two objects move over each other; opposes the direction of motion
10.	tension force	Pulling force on a body, causing it to become taut (pulled tight)
11.	compression force	Pushing force on a body that causes it to become squashed
12.	gravitational force	Pulling force that bodies exert on each other over a distance due to their masses
13.	mass	Measure of the amount of matter in an object
14.	weight	Force with which an object near the Earth or another body in space is attracted towards the centre of that body by gravity
15.	magnet	An object that is able to attract certain metals
16.	magnetic force	Force that two magnetic materials exert on each other over a distance
17.	magnetic field	Invisible area of magnetism around a magnet
18.	magnetism	Physical property of a material that causes an object to be attracted to, or repelled by, a magnet
19.	magnetic pole	One of two ends of a magnet
20.	repel	Push away
21.	electrostatic force	Field force that arises through differences in the electric charge of objects
22.	rotate	Turn or spin
23.	force of attraction	A pulling force that two objects exert on each other
24.	force of repulsion	A pushing force that two objects exert on each other
25.	lightning	Electrostatic discharge that occurs during a thunderstorm
26.	potential energy	Energy that is stored in a system

27.	collide	Bump into
28.	force pair	Two forces that act in an equal but opposite directions
29.	friction	A contact force that is created when two objects move over each other

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

We encounter force in our everyday lives. We use force as we walk, lift objects, throw objects, or move a given body in some particular speed or direction. There is also a force which acts on our bodies and prevents us from floating off into space.

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: Types of forces
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Types of forces
CAPS Page Number	71

Lesson Objectives

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

- Explain that a force is a push or pull (or twist) exerted on an object
- Identify the Newton as the unit of measure for force
- Explain that a force can change the shape, direction and speed of an object
- Explain that all forces acting on an object can be placed in two groups - contact forces and non-contact forces
- Explain that forces act in pairs.

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

SCIENCE PROCESS SKILLS

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Poster: Types of forces	
Resource 1: Push force - 1	
Resource 2: Push force - 2	
Resource 3: Friction force	
Resource 4: Gravitational force	
Empty cold drink can, eraser, inflated balloon, magnet, steel pin or paper clip	
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

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

What is the name of the force that acts between the earth and the Sun?

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.

Gravitational force

D ACCESSING INFORMATION

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

TYPES OF FORCES

1. A force is an action that can be described as a push or a pull (or twist).
2. Force is measured in units called Newtons.
3. A force can change the shape, direction and speed of an object. A force can also cause an object to rotate.
4. There are two main types of forces - contact forces and non-contact forces.
5. Forces act in pairs.

2. Display the poster: 'Types of forces in the classroom'. Use Resources 1-4 as you discuss the effects of forces. Use the empty cold drink can, eraser and balloon to demonstrate the effects of force.

3. Explain the following to the learners:
    a. A **force** is an action that can be described as a push or a pull (or twist).
    b. When we measure something, we need to use a unit of measurement. For example, when we measure length, we can use a centimetre or metre as the unit of measurement. Force is measured in units called **Newtons**.
    c. Explain that a force can change the shape, direction and speed of an object. A force can also cause an object to **rotate**.
    d. All forces acting on an object can be placed in two groups - contact forces and non-contact forces.
    e. A contact force is a force that is exerted when two objects touch each other. Ask learners to give examples of contact forces (people pushing a car, kicking a moving ball to change its direction, friction slowing a moving object down).
    f. A non-contact force is a force that is exerted over a distance. It is also called a field force. Ask learners to give examples of non-contact forces (magnetism, gravitational force).
    g. Forces act in pairs. When a force is applied to an object, the object resists the force. If you push against a wall, the wall resists as if it is pushing back. These two forces are known as a **force pair**.
4. Demonstrate the effects of force as follows:
    a. Use the cold drink can. Demonstrate how it can be crushed. Observe a safety precaution – do not crush the can so hard that it breaks or tears as the thin metal can cause nasty cuts.
    b. Use the eraser. Flick the eraser across the desk to demonstrate that force can cause a stationary object to move and accelerate.
    c. Use the eraser. Drop the eraser to demonstrate how all objects are attracted to the earth by a force.
    d. Use the inflated balloon. Throw the balloon into the air and then tap the balloon to demonstrate how force can change the direction of a moving object.
    e. Get a learner to push against a wall. Discuss the concept of a force pair in this demonstration.
    f. Use the magnet and steel pin. Demonstrate the attraction of the pin by the magnet. Remind learners that the objects do not have to be touching for the force to take effect. This is a non-contact or field force.

Checkpoint 1

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

a. What are the two main types of forces?
b. What is the difference between a contact force and a non-contact force?

Answers to the checkpoint questions are as follows:

a. Contact forces and non-contact forces
b. A contact force is exerted when two objects touch each other, while a non-contact force is exerted without the two objects touching each other.

E CONCEPTUAL DEVELOPMENT

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

ACTIVITY

	Type of force	Effect of force
a.		
b.		
c.		
d.		

TASK 1

1. Complete Column A

TASK 2

1. Complete Column B.

2. Explain Task 1 to the learners as follows:
   a. Learners work with a partner.
   b. Remind learners to refer to the notes they wrote in their exercise books and the poster as they complete Task 1.
   c. Complete Column A. Column A has not been filled in. Look at each diagram, discuss it with your partner and classify the force. Write the type of force in Column A. Hint: If you cannot remember the types of forces, read your notes again.
3. Ask learners to share their answers to Task 1 with the class.
4. *Model answer: Task 1*

	Type of force	Effect of force
a.	*non-contact*	
b.	*contact*	
c.	*contact*	
d.	*non-contact*	

5. When the learners have completed Task 1, hold a short class discussion on contact and non-contact forces.
6. Next, get the learners to do Task 2:
   a. Column B has not been filled in. Look at each diagram, discuss it with your partner and complete Column B.
   Hint: If you cannot remember the effects of forces, read your notes again.
7. *Model answer: Task 2*

	Type of force	**Effect of force**
a.	*non-contact*	*Change the direction and speed of an object*
b.	*contact*	*Change the direction and speed of an object*
c.	*contact*	*Change the shape of an object*
d.	*non-contact*	*Change the direction and speed of an object*

Checkpoint 2

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

a. What is another name for a non-contact force?
b. What is a force pair?

Answers to the checkpoint questions are as follows:

a. Field force
b. A force pair is two forces that act in an equal but opposite direction.

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Forces	145
Solutions for all	Forces	160
Spot On	Forces	95
Top Class	Forces	132
Via Afrika	Forces	118
Platinum	Forces	129
Oxford Successful	Forces	110
Pelican Natural Sciences	Forces	207
Sasol Inzalo Bk B	Forces	4

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=FVLAyphuZOU (10min 38sec) [Forces/ Types of forces/ Contact forces/ Non-contact force]

1 B

Term 3, Week 1, Lesson B
Lesson Title: Contact forces and field forces
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Contact forces and field forces
CAPS Page Number	71

Lesson Objectives

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

- Describe contact forces and field forces
- Give examples of contact forces and field forces
- Give one difference between contact forces and field forces
- Differentiate between a tension force and a compression force
- Explain that a field force results from action-at-a-distance between two bodies.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Poster: Types of forces	
Resource 5: Pull or tension force	
Resource 6: Compression force	
Rope, spring, solid object – for example a wooden block, toy car, piece of sandpaper	Belt or cord to replace rope. If no spring is available, use Resource 2 – picture of hand crushing a can
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

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

What is the unit of measurement of force?

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.

Newton

D ACCESSING INFORMATION

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

CONTACT FORCES AND FIELD FORCES

1. Contact forces are forces where the bodies that are exerting a force on each other are in direct contact with each other.
2. Examples of contact forces are: a person pushing a wheelbarrow, two people pulling on a rope, a compressed spring.
3. A tension force is a pulling force on a body, causing it to become taut.
4. A compression force is a pushing force on a body that causes it to become squashed.
5. Friction is a contact force that is created when two objects move over each other.
6. The direction of friction force is always against the direction of movement.
7. Field forces are the result of an attracting or repelling force of one object on another object, without the objects touching each other.
8. Examples of field forces are: gravitational force, magnetic force, electrostatic force.

2. Display the poster: Types of forces in the classroom.
3. Make sure Resources 5 and 6 are on display on the chalkboard.

4. Explain the following to the learners:
    a. Contact can mean to physically touch. Contact forces are forces where the bodies that are exerting a force on each other are in direct contact with each other.
    b. Examples of contact forces are a person pushing a wheelbarrow, two people pulling on a rope, and a compressed spring. For each example, discuss the two objects that are touching.
    c. Taut means stretched or pulled, not slack. A **tension force** is a pulling force on a body, causing it to become taut.
    d. A **compression force** is a pushing force on a body that causes it to become squashed.
    e. Friction is a contact force that is created when two objects move over each other.
    f. The direction of a friction force is always against the direction of movement.
    g. Friction can be an advantage or a disadvantage. The advantages of friction are that it is used in brakes to slow down and stop a car, and the friction of a match against a matchbox causes the match to ignite. The main disadvantages of friction are that it produces unnecessary heat in machinery, and that it slows down the motion of moving objects.
    h. Field forces are the result of an attracting or repelling force of one object on another object without the objects touching each other.
    i. Examples of field forces are gravitational force, magnetic force, and electrostatic force.
5. Demonstrate contact and non-contact forces as follows:
    a. Use the wooden block. Stand the block on a flat surface, for example, a desk. Demonstrate what happens to the block when your hand makes firm contact with it. This is an example of a contact force changing the speed and direction of an object.
    b. Use the rope. Get two learners to hold the rope so that it is slack. Then get learners to apply a tension (pulling) force so that the rope becomes taut. This is an example of a contact force.
    c. Use the spring. Place the spring on a flat surface, for example, a desk. Demonstrate compression by applying a downward pressure on the spring. This is an example of a contact force.
    d. Use the toy car and the sandpaper. Get a learner to move the car over a smooth surface, for example, a school desk and then to move the toy car over the sandpaper. The learner should describe how the car moved over the two surfaces. This is an example of friction, which is a contact force.

Checkpoint 1

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

a. What is a compression force?
b. What is a tension force?

Answers to the checkpoint questions are as follows:

a. A pushing force on a body that causes it to become squashed
b. A pulling force on a body, causing it to become taut

E CONCEPTUAL DEVELOPMENT

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

ACTIVITY

1. Oxen pulling a plough
2. Squeezing wet clothes to remove excess water
3. Stretching the spring of a chest expander
4. Lighting a match

TASK 1

1. Identify the type of contact force exerted. Use the words tension, compression or friction.

TASK 2

1. Give one situation in which friction is an advantage, and one situation in which friction is a disadvantage.

2. Explain Task 1 to the learners as follows:
   a. You have a list of different situations in which force is exerted. Think about each situation carefully and then classify the force as: tension, compression or friction.
   b. Remind learners to refer to the notes they wrote in their exercise books and the poster, as they complete Task 1.
3. Ask learners to share their answers to Task 1 with the class.
4. *Model answer: Task 1*

1. Oxen pulling a plough	*Tension*
2. Squeezing wet clothes to remove excess water	*Compression*
3. Stretching the spring of a chest expander	*Tension*
4. Lighting a match	*Friction*

5. When the learners have completed Task 1, hold a short class discussion in which you revise the forces of tension, compression and friction.
6. Next, get the learners to do Task 2:
   a. Remind leaners that friction is a contact force that is created when two objects move over each other; and that friction opposes the direction of movement. In our everyday lives there are situations in which friction is an advantage and situations where friction is a disadvantage.
7. *Model answer: Task 2*

Note: There are many possible answers. Here are some possible answers to situations in which friction is an advantage and disadvantage.

- *Braking system in vehicles and bicycles*
- *Lighting a match*

- *When walking or running – friction between the sole of shoe and the surface prevents slipping.*

Situations in which friction is a disadvantage:

- *Unnecessary heating in motors*
- *Causes wear and tear in machinery*
- *Causes unwanted slowing down of motion.*

Checkpoint 2

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

a. What is friction?
b. What force is exerted when a cable is used to tow a vehicle?

Answers to the checkpoint questions are as follows:

a. Contact force that is created when two objects move over each other
b. Tension

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Forces	145
Solutions for all	Forces	160
Spot On	Forces	95
Top Class	Forces	132
Via Afrika	Forces	118
Platinum	Forces	129
Oxford Successful	Forces	110
Pelican Natural Sciences	Forces	207
Sasol Inzalo Bk B	Forces	4

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=FVLAyphuZOU (10min 38sec) [Forces/ Types of forces/ Contact forces/ Non-contact forces]

1 C

Term 3, Week 1, Lesson C
Lesson Title: Gravitational force
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Field forces
CAPS Page Number	71

Lesson Objectives

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

- Explain that a field force results from action-at-a-distance between two bodies
- Describe the force of gravity
- Explain that objects with greater mass have more gravitational pull on each other
- Explain that force decreases as distance between the objects increases
- State the unit of measurement of gravity
- State four differences between weight and mass.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Poster: Types of forces	
Resource 7: Weight and mass	
Spring balance, triple beam balance, one kg mass piece and a variety of other objects heavy enough to be weighed, for example, a mug, book or stapler	Newton force meter, bathroom or kitchen scale, bag of sand that has a mass of exactly one kg (prepared in advance)
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

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

What is the main difference between a contact force and a field force?

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 contact force can only be exerted when the two objects touch each other, while a field force acts over a distance.

D ACCESSING INFORMATION

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

GRAVITATIONAL FORCE: A FIELD FORCE

1. A field force is exerted by one object on another object without the objects touching each other.
2. Gravitational force is a pulling force that bodies exert on each other over a distance due to their masses.
3. All matter has mass.
4. Gravitational forces act in a gravitational field.
5. Gravitational force works in pairs.
6. The Earth exerts a gravitational force on all matter.
7. There is a gravitational force between the Earth and the Moon, and between the Earth and the Sun.
8. The size of gravitational force depends on the mass of the two objects, and the distance between the two masses.
9. The differences between mass and weight:

Mass	**Weight**
Mass is a measure of the quantity of matter in an object.	Weight is a measure of the size of force of gravity acting on the mass of an object.
Mass is measured in kilograms (kg)	Weight is measured in Newtons (N).
The mass of an object is the same anywhere in the universe.	The weight of an object is different in different places in the universe.
The mass of an object does not depend on the size of the gravitational force on it.	The weight of an object depends on the size of the gravitational force on it.

2. Display the poster: 'Types of forces in the classroom'. Use Resource 7 – weight and mass
3. Explain the following to the learners:
    a. A field force is exerted by one object on another object without the objects touching each other.
    b. **Gravitational force** is a pulling force that bodies exert on each other over a distance due to their masses.
    c. Remind learners that they learnt about the gravitational force between the Earth and the Moon in GRADE 9. They also learned that force decreases as the distance between objects increases.
    d. Not only is there a gravitational force between the Earth and the Moon, but also between the Earth and the Sun.
    e. All matter has **mass**. There is a gravitational force between all matter on Earth and planet Earth itself. It is this force that causes objects to fall directly downwards.
    f. Gravitational forces act in a gravitational field.
    g. Gravitational force works in pairs.
    h. The size of gravitational force depends on the mass of the two objects, and the distance between the two masses.
    i. There are several differences between **weight** and mass:
        - Mass is a measure of the quantity of matter in an object, while weight is a measure of the size of force of gravity acting on the mass of an object.
        - Mass is measured in kilograms, while weight is measured in Newtons.
        - The mass of an object is the same anywhere in the universe, while weight is different in different places in the universe.
        - The mass of an object does not depend on the size of the gravitational force on it, while the weight of an object depends on the size of the gravitational force on it.
4. Demonstrate the investigation of the difference between the mass and weight of different objects as follows. Get different learners to take the readings. Emphasise the need to take accurate readings. All learners should record the readings in a table.
    a. Use the triple beam balance. Determine the mass of the one kg mass piece and the other objects.
    b. Use the spring balance or the Newton force meter. Determine the weight of the one kg mass piece and the other objects.
    c. Note: answers will vary.

Checkpoint 1

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

a. What is mass?
b. What is weight?

Answers to the checkpoint questions are as follows:

a. Mass is a measure of the quantity of matter in an object.
b. Weight is a measure of the size of force of gravity acting on the mass of an object.

E CONCEPTUAL DEVELOPMENT

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

ACTIVITY

TASK 1

1. What is the weight : mass ratio of the one kg mass piece?
2. Calculate the weight: mass ratio of all the other objects. Is it the same as the weight : mass ratio of the one kg mass piece?

TASK 2

1. If you measured the mass and weight of the same objects on the Moon, would the weight : mass ratio be the same? Explain your answer.

2. Explain Task 1 to the learners as follows:
   a. Remind learners to refer to the notes they took during the demonstration.
   b. Hold a short class discussion on mass (the quantity of matter in an object) and weight (the size of the force of gravity acting on the mass of an object).
   c. Remind learners that a ratio compares values, and that the order of the values must be weight : mass, as indicated in the question.
3. Ask learners to share their answers to Task 1 with the class.
4. *Model answer; Task 1*

   1. *9,8 : 1 or 10 : 1*
   2. *Approximately 10 : 1. Yes.*

5. When the learners have completed Task 1, hold a short class discussion. If the learners had measured accurately, then all the weight : mass ratios should be approximately the same. Explain to the learners that the gravitational acceleration on the surface of the Earth is 9,8 m/s²
6. Next, get the learners to do Task 2:
7. Remind leaners that the weight of an object is different in different places in the universe.
8. *Model answer: Task 2*

No. The weight of the same objects would be less on the Moon than on thee Earth because the force of gravity on the Moon is less than the force of gravity on Earth.

For interest: The weight : mass ratio on the Moon would be approximately 1,8 : 1.

Checkpoint 2

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

a. Which heavenly body has the higher force of gravity - the Earth or the Moon?
b. Why?

Answers to the checkpoint questions are as follows:

a. The Earth
b. The mass of the Earth is greater than the mass of the Moon.

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Forces	145
Solutions for all	Forces	160
Spot On	Forces	95
Top Class	Forces	132
Via Afrika	Forces	118
Platinum	Forces	129
Oxford Successful	Forces	110
Pelican Natural Sciences	Forces	207
Sasol Inzalo Bk B	Forces	4

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=05EXSF5rVSE (2min 12sec) [Gravitational force]
2. https://www.youtube.com/watch?v=rFdbY_V7vIo (3min 36sec) [Physics - Are mass and weight the same thing?]

2 A

Term 3, Week 2, Lesson A
Lesson Title: Gravitational force
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Field forces
CAPS Page Number	72

Lesson Objectives

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

- Explain that a magnetic force is a force that two magnetic materials exert on each other over a distance
- Explain that magnets attract magnetic substances
- Define a magnetic field
- State that all magnets have a magnetic field and two ends/ poles.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Poster: Types of forces	
Two bar magnets, sheet of white paper, iron filings, metal objects (iron nail, iron paper clip - not plastic coated, aluminium foil, brass buckle), non-metals (plastic, paper, wood), plastic ruler	
Resource 8: Magnetic force	
Resource 9: Magnetic compass	
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

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

True or false? Magnetism is a field force.

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.

True

D ACCESSING INFORMATION

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

MAGNETIC FORCE: A FIELD FORCE

1. A magnetic force is a force that two magnetic materials exert on each other over a distance.
2. A force of attraction is a pulling force that two objects exert on each other.
3. A force of repulsion is a pushing force that two objects exert on each other.
4. A magnetic field is an invisible area of magnetism around a magnet.
5. A magnet has a magnetic field around it.
6. A magnet has two magnetic poles, a north pole (N) and a south pole (S).
7. The magnetic field is strongest near the poles of a bar magnet.

8. Opposite poles attract, like poles repel.
9. The Earth has a magnetic field, with a magnetic north pole and a magnetic south pole.

2. Display the poster: 'Types of forces in the classroom'. Use Resource 8: 'Diagram of bar magnet' and Resource 9: 'Magnetic compass'.
3. Explain the following to the learners:
   a. A **magnetic force** is a field force that two magnetic materials exert on each other over a distance.
   b. A **magnet** is an object that is able to attract certain metals.
   c. A magnet has a **magnetic field** around it.
   d. A magnet has two **magnetic poles**, a north pole (N) and a south pole (S).
   e. Opposite poles attract, like poles repel.
   f. The Earth has a magnetic field, with a magnetic north pole and a magnetic south pole. The needle of a magnetic compass is a small magnet. Therefore, a magnetic compass can indicate the Earth's magnetic north pole.
4. Demonstrate the magnetic field and forces of a magnet. Note: this lesson is presented as a demonstration lesson. However, if there are sufficient magnets and iron filings, it would be better if the learners work in groups to do the investigation. Learners should record their observations. Tell learners to record their observations in a table, but they should work out the table format themselves.
   a. Use the magnet, metals and non-metals. Demonstrate which materials are attracted to the magnet.
   b. Use the magnet, plastic ruler and one of the objects that was attracted to the magnet. Ask learners to predict whether the metal object will still be attracted to the magnet if the plastic ruler is placed between the metal object and the magnet. Demonstrate this so that learners can check their predictions.
   c. Use the two bar magnets. Demonstrate that unlike poles attract and like poles repel.
   d. Use the magnet, iron filings and sheet of paper. Hold the bar magnet directly below the paper. Sprinkle iron filings on the paper. Learners must observe and draw the pattern of the iron filings. This is the magnetic field.

Checkpoint 1

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

a. What will happen when the north pole of one magnet is placed next to the north pole of another magnet?
b. What will happen when the north pole of one magnet is placed next to the south pole of another magnet?

Answers to the checkpoint questions are as follows:

a. The two magnets will repel each other.
b. The two magnets will attract each other.

E CONCEPTUAL DEVELOPMENT

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

ACTIVITY

1. List objects that are attracted to a magnet.
2. List objects that are not attracted to a magnet.
3. Complete the sentences. Use words from the word box.

repel	attract	equator	poles	north	south

   a. Like poles _____; unlike poles _____.
   b. The magnetic field is strongest at the _____.
   c. The _____pole of the needle of a magnetic compass will point towards the Earth's magnetic north pole.

TASK 1

1. Answer questions 1 and 2.

TASK 2

1. Answer question 3

2. Explain Task 1 to the learners as follows:
   a. Remind learners to refer to the notes they wrote in their exercise book and the notes they took during the demonstration.
   b. Learners answer questions 1 and 2.
3. Ask learners to share their answers to Task 1 with the class.
4. *Model answer: Task 1*

   1. *Answers will vary depending on materials but must include all the magnetic materials such as iron and nickel.*
   2. *Answers will vary depending on materials but must include all the non-magnetic materials such as plastic, wood and paper.*

5. When the learners have completed Task 1, hold a short class discussion in which you emphasise that most magnetic materials contain iron and/ or nickel.
6. Next, get the learners to do Task 2:
   a. Remind learners that the Earth acts like a giant magnet and has a magnetic field with a magnetic north pole and a magnetic south pole.
   b. Learners copy and complete question 3 using words from the word box.
7. *Model answer: Task 2*

   a. *Like poles repel; unlike poles attract.*
   b. *The magnetic field is strongest at the poles.*
   c. *The south pole of the needle of a magnetic compass will point towards the Earth's magnetic north pole.*

Checkpoint 2

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

a. What is a magnetic field?
b. What is a force of attraction?

Answers to the checkpoint questions are as follows:

a. Invisible area of magnetism around a magnet
b. Field force which pulls objects towards each other

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Forces	145
Solutions for all	Forces	160
Spot On	Forces	95
Top Class	Forces	132
Via Afrika	Forces	118
Platinum	Forces	129
Oxford Successful	Forces	110
Pelican Natural Sciences	Forces	207
Sasol Inzalo Bk B	Forces	4

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=yMEheEi-Hmo (49sec) [Magnetism: which materials attract magnets]

2 B

Term 3, Week 2, Lesson B
Lesson Title: Electrostatic force
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Field forces
CAPS Page Number	72

Lesson Objectives

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

- Explain that when certain materials are rubbed together they can acquire an electrostatic charge
- Explain electrostatic charge in terms of the movement of electrons
- Describe forces between unlike and like charges.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Poster: Types of forces	
Resource 10: An atom	
Perspex ruler, plastic ruler, glass rod, tissue paper, woollen cloth, string	Perspex strip, plastic comb, woollen jersey, silk cloth, cotton cloth
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

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

True or false? Electrostatics is a contact force.

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.

False

D ACCESSING INFORMATION

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

ELECTROSTATIC FORCE: A FIELD FORCE

1. An electrostatic force is a force that two electrostatically charged objects exert on each other over a distance.
2. Electronic forces act in an electrostatic field.
3. An electrostatic field exists around any charged object.
4. An atom consists of a nucleus with a cloud of negatively charged electrons spinning around it.
5. Inside the nucleus there are positively charged protons and neutral neutrons.
6. The protons and neutrons are held together in the nucleus by very strong forces. Under normal circumstances the protons and neutrons of an atom remain inside the nucleus.
7. Atoms are electronically neutral unless electrons are added or removed.
8. The electronic charge of substances can be changed by rubbing two substances together.

2. Display the poster: 'Types of forces in the classroom'. Use Resource 10: 'An atom'.
3. Explain the following to the learners:
   a. Remind learners that they learned about atoms in Grade 8.
   b. Revise the structure of the atom.
   c. An atom consists of a nucleus with a cloud of negatively charged electrons spinning around it – refer to Resource 10.
   d. Inside the nucleus there are positively charged protons and neutral neutrons.
   e. The protons and neutrons are held together in the nucleus by very strong forces. Under normal circumstances the protons and neutrons of an atom remain inside the nucleus.
   f. Atoms are electronically neutral unless electrons are added or removed. In an electronically neutral atom, the total positive charge in the nucleus is balanced by the total negative charge of the electrons around the nucleus.
   g. If electrons are removed (usually by rubbing one substance against another), then the atom is no longer neutral but positively charged, because there are more protons than electrons in the atom.
   h. If electrons are added, then the atom is no longer neutral but negatively charged, because there are more electrons than protons in the atom.
   i. An electrostatic force is a force that two electrostatically charged objects exert on each other over a distance.
   j. Electronic forces act in an electrostatic field.
   k. An electrostatic field exists around any charged object.
   l. The electronic charge of substances can be changed by rubbing two substances together.
   m. Under normal circumstances an electronic charge is only changed by the movement of electrons. This is because protons and neutrons are held in the nucleus by strong bonds.
4. Learners should work in groups to investigate electrostatic force fields. Note: this experiment does not work well in wet weather because the charge developed on the material leaks into water droplets in the air. If you do not have sufficient resources, then demonstrate the investigation. Learners should record their observations.
   a. Tell learners that when Perspex or glass is rubbed with a woollen cloth, it loses electrons and becomes positively charged. If plastic is rubbed with a woollen cloth, it gains electrons and becomes negatively charged.
   b. Tear the tissue paper into small pieces and spread them on your desk.
   c. Rub the plastic ruler with the woollen cloth.
   d. Bring the ruler near the pieces of paper. Record your observations.
   e. Do the same with the Perspex ruler. Record your observations.
   f. Tie a piece of string to the Perspex ruler so that the ruler hangs horizontally.
   g. Charge the Perspex ruler by rubbing it with the woollen cloth.
   h. Charge the plastic ruler by rubbing it with the woollen cloth.
   i. Slowly bring the charged plastic ruler close to the hanging Perspex ruler. Record your observations.
   j. Rub the glass rod with the woollen cloth. Slowly bring the charged glass rod close to the hanging Perspex ruler. Record your observations.

Checkpoint 1

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

a. If an object gains electrons, will it be positively or negatively charged?
b. When Perspex or glass is rubbed with a woollen cloth, it loses electrons. Does the Perspex or glass become positively or negatively charged?

Answers to the checkpoint questions are as follows:

a. Negatively charged
b. Positively charged

E CONCEPTUAL DEVELOPMENT

1. This will be a pairs or small group activity.
2. If there are insufficient materials, it can be done as a demonstrated activity.
3. PLEASE NOTE: This activity will not be successful on a very wet day!
4. Ideally the learners should work in pairs or small groups.
5. To do this activity, each group will need:
   - a plastic ruler
   - a perspex ruler
   - a few sheets of tissue or toilet paper
   - a glass rod
   - a woolen jersey/sock
   - string
6. Ensure you have these materials prepared for each group before the lesson starts.
7. Tell the learners that they are going to be doing an investigation where they will be exploring electrostatic force.
8. Write the following onto the chalkboard (always try to do this before the lesson starts):

PRACTICAL TASK

1. We are going to be exploring electrostatic charge in terms of the movement of electrons.
2. We are going to experiment with various materials to see how electrostatic force is generated and how it behaves.

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

Task 1: (10 marks)

Do the following investigation:

Note: When perspex or glass are rubbed with a woollen cloth, it loses electrons and becomes positively charged.

When plastic is rubbed with a woollen cloth, it gains electrons and becomes negatively charged.

- Tear the tissue into tiny pieces and spread it on your desk.
- Rub the plastic ruler with the woollen material.
- Bring the plastic ruler near the pieces of paper, What do you notice?
- Rub the perspex ruler with the woollen material.
- Bring the perspex ruler near the pieces of paper, What do you notice?

Complete the following sentences using the words in the block below:

repel, attract, negatively, positively, neutral, gains , loses

1.1. Two objects with like charges_____each other, whilst two objects with unlike charges_____ each other.

1.2. A perspex object becomes_____ charged when rubbed with a woollen cloth.

1.3. When plastic is rubbed with a woollen cloth, it _____ electrons.

Answer these questions:

1.4. What did you observe when the charged plastic ruler was brought near to the pieces of paper?

1.5. Why do you think the pieces of paper reacted in this way?

1.6. What did you notice when the charged perspex ruler was brought near to the pieces of paper?

1.7. Why do you think the paper reacted in this way even though the two rulers have different charge?

1.8. What state would we say the tissue was in?

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

Task 2: (10 marks)

- Tie a piece of string to one end of the perspex ruler so that you can hang it horizontally.
- Charge the perspex ruler by rubbing it with the woolen cloth.
- Charge the plastic ruler by rubbing it with the woolen cloth.
- Slowly bring the charged plastic ruler closer to the charged perspex ruler. Observe what happens.
- Charge the glass rod by rubbing it with the woolen cloth.
- Slowly bring the charged glass rod closer to the charged perspex ruler. Observe what happens.

Questions: (10 marks)

2.1. What did you observe when the charged plastic ruler was brought close to the charged perspex ruler? Why do you think that occurred?

2.2. Draw a sketch to show the reaction between the plastic ruler and the Perspex ruler.

2.3. What did you observe when the charged glass rod was brought close to the charged perspex ruler? Why do you think that occurred?

2.4. Draw a sketch to show the reaction between the glass rod and the perspex ruler.

21. Read through the task with the learners.
22. Ask them if they have any questions.
23. Tell the learners they have 10 minutes to complete this task.
24. Supervise the learners whilst they complete the task and answer any questions they may have.
25. After 10 minutes call the learners back to attention.
26. Tell the learners to return all equipment and to tidy their work areas and return equipment.
27. 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
Step-by-Step	Forces	145
Solutions for all	Forces	160
Spot On	Forces	95
Top Class	Forces	132
Via Afrika	Forces	118
Platinum	Forces	129
Oxford Successful	Forces	110
Pelican Natural Sciences	Forces	207
Sasol Inzalo Bk B	Forces	4

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=zHJkJGBdvwE (5min 23sec) [Positive and Negative charges]

2 C

Term 3, Week 2, Lesson C
Lesson Title: Electrostatic force: Lightning
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Field forces
CAPS Page Number	72

Lesson Objectives

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

- Explain that charged objects in an electrostatic system possess potential energy
- Describe the cause of a lightning strike
- List safety precautions that should be taken during thunder and lightning storms.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Poster: Types of forces	
Resource 11: Lightning	
Perspex ruler, plastic ruler, glass rod, tissue paper, woollen cloth, string	Perspex strip, plastic comb, woollen jersey, silk cloth, cotton cloth
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

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

What is potential 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.

Energy that is stored in a system

D ACCESSING INFORMATION

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

LIGHTNING

1. Potential energy is energy that is stored in a system.
2. Static electricity has potential energy because it can do work.
3. Lightning is a giant spark of electricity.
4. The movement of water droplets and air in clouds creates friction.
5. Friction causes different charges in different parts of the cloud.
6. When the electronic charge becomes high enough, it discharges.
7. The thunder is the rapid expansion of the air as a result of the lightning.
8. The energy in a lightning bolt is very high and can cause death.
9. You should take precautions during a thunder and lightning storm.

2. Display the poster: ‘Types of forces in the classroom’. Use Resource 11: ‘Lightning’.
3. Explain the following to the learners:
    a. Remind learners that they learned about potential energy in GRADE 9.
    b. Lightning is an example of the effects of electric charge on a very large scale.
    c. Clouds are made up of water molecules, ice and air. The movement of the water, ice and air particles as they rub against each other causes friction.
    d. You know that friction can cause particles to become positively or negatively charged.
    e. The positive charges build up at the top of the cloud and the negative charges build up at the bottom of the cloud.
    f. When the electrostatic charge becomes high enough, it discharges in the form of a lightning bond.
    g. Lightning can occur within a cloud (between the top and bottom of the cloud), between clouds, and between a cloud and the ground.
    h. Lightning causes thunder. A lightning bolt opens up a channel in the air. Once the light is gone, the air expands into the channel and creates a sound wave that we hear as thunder. We see lightning before we hear thunder. This is because light travels faster than sound.
    i. Safety precautions against thunder include: installing a lightning conductor; seeking shelter in a car or building; staying away from water and tall trees and structures; avoiding swimming, showering and bathing; avoiding using appliances that conduct electricity.

Checkpoint 1

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

a. What force causes the build-up of electrically charged particles in a cloud?
b. What charge (positive or negative) builds up at the bottom of a cloud?

Answers to the checkpoint questions are as follows:

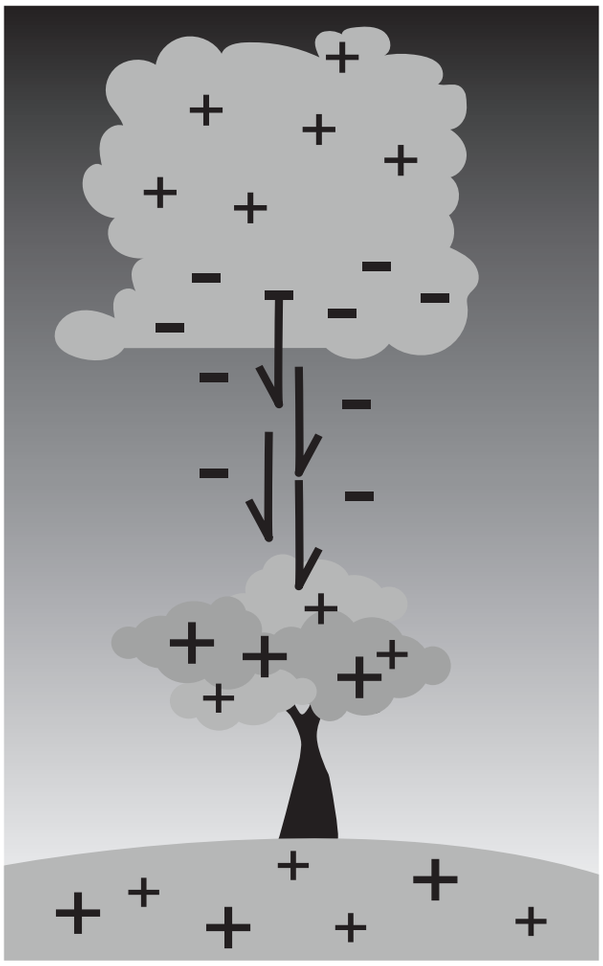
a. Friction
b. Positive

E CONCEPTUAL DEVELOPMENT

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

ACTIVITY

Note: consult Resource 11: 'Lightning'.



Answer the questions based on the diagram:

1. What force causes the formation of the electrostatically charged particles shown?
2. Explain the formation of the positive and negative charges in the diagram.
3. Name two possible consequences of the build-up of electrostatically charged particles, as shown in the diagram.
4. Write a paragraph in which you describe the formation of lightning from the time a cloud has formed to the time the lightning strikes.
5. List two safety precautions you could take to protect yourself against lightning.

TASK 1

1. Answer questions 1-3

TASK 2

1. Answer question 4-5

2. Explain Task 1 to the learners as follows:
   a. Remind learners to refer to the notes they wrote in their exercise book.
   b. Refer to Resource 11 and the diagram you have drawn on the chalkboard.
   c. Describe the formation of lightning, step-by-step. Do not allow learners to write down the answers at this stage. This is a listening activity.
   d. Learners answer questions 1-3.
3. Ask learners to share their answers to Task 1 with the class.
4. *Model answer: Task 1*

> 1. *Friction*
> 2. *As the air, ice and water particles move in the cloud, they collide. The collisions cause friction and the friction causes the movement of electrons. When electrons are lost, the particles become positively charged. When electrons are gained, the particle becomes negatively charged.*
> 3. *Thunder and lightning.*

5. When the learners have completed Task 1, hold a short class discussion in which you answer any difficulties they might have had when answering the questions.
6. Next, get the learners to do Task 2:
   a. Remind learners that a paragraph consists of more than two linked sentences. They can use their answers to questions 1 and 2 as the basis of their paragraph.
   a. Learners answer questions 4 and 5.
7. *Model answer: Task 2*

> 4. *As the air, ice and water particles move in a cloud, they collide. The collisions cause friction and the friction causes the movement of electrons. When electrons are lost, the particle becomes positively charged. When electrons are gained, the particle becomes negatively charged. When the electrostatic charge becomes high enough, it discharges in the form of lightning.*
> 5. *Any two of the following:*
> 6. *Installing a lightning conductor; seeking shelter in a car or building; staying away from water and tall trees and structures; avoiding swimming, showering and bathing; avoiding appliances that conduct electricity.*

Checkpoint 2

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

a. What is the correct scientific term for the discharge of an electrostatic charge between clouds, or between a cloud and the Earth's surface?
b. You have learned about three field forces. Which of these forces is constantly exerting a force on us?

Answers to the checkpoint questions are as follows:

a. Lightning
b. Gravitational force

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Forces	145
Solutions for all	Forces	160
Spot On	Forces	95
Top Class	Forces	132
Via Afrika	Forces	118
Platinum	Forces	129
Oxford Successful	Forces	110
Pelican Natural Sciences	Forces	207
Sasol Inzalo Bk B	Forces	4

G ADDITIONAL ACTIVITIES/ READING

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

1. http://environment.nationalgeographic.com/environment/natural-disasters/lightning-safety-tips/ [Lightning Safety Tips]
2. http://www.weatherwizkids.com/weather-lightning.htm [Lightning]

TOPIC OVERVIEW:

Electric cells as energy systems

Term 3, Weeks 3A

A. TOPIC OVERVIEW

TERM 3, WEEKS 3A

- This topic runs for half a week.
- It is presented over 1X 1 hour lesson.
- This topic's position in the term is as follows:

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

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

B. SEQUENTIAL TABLE

GRADE 8	GRADE 9	GRADE 10-12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Energy transfer in electrical systems	• Electric cells	**Grade 10** • Electric circuits **Grade 11** • Electric circuits

TOPIC: Electric cells as energy systems

C. SCIENTIFIC VOCABULARY

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

	TERM	EXPLANATION
1.	cell	System in which certain chemical reactions can cause the flow of electricity through and external circuit
2.	external circuit	The connecting wires and resistors outside the cell
3.	electrical charge	A type of charge; either positive, negative or zero; found on the particles of which all known matter is made
4.	battery	Group of connected cells
5.	system	Set of parts that work together to carry out an overall function
6.	potential energy	Stored energy
7.	electrical energy	Energy resulting from the flow of electric charge
8.	kinetic energy	Movement energy
9.	salt bridge	Link between electrically charged solutions
10.	wet cell	Source of power that produces energy through a chemical reaction in a solution
11.	dry cell	Source of power that has the reactive chemical in a dry paste
12.	ampere(s)	Unit(s) of measurement for electric current

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

Electricity is useful in our daily lives. We use electricity for heating, lighting and driving many electrical machines. Energy must be conducted in an electric circuit. An understanding of how electric circuits and electric cells work gives us a better understanding of the electricity we use in our daily lives.

E. PERSONAL REFLECTION

Reflect on your teaching at the end of each topic:

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

3 A

Term 3, Week 3, Lesson A
Lesson Title: Electric cells
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Electric cells
CAPS Page Number	73

Lesson Objectives

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

- Explain that a cell is a system in which certain chemical reactions can cause the flow of electricity through an external circuit
- Identify cells as a source of electricity
- Describe a battery as a group of connected cells.

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 symbols	
Resource 13: Energy of charge at different points in a circuit	
Resource 14: Zinc copper cell	
Strips of zinc and copper, zinc sulfate, copper sulfate, connecting wire, voltmeter, strip of cotton cloth or cotton wool, two glass beakers, water, measuring cylinder, teaspoon	Two glass jars, measuring cups. You could use a lemon, electrical wire and crocodile clips to make an electric cell
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

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

What is the circuit symbol for an electric cell?

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.

D ACCESSING INFORMATION

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

ELECTRIC CELLS AS ENERGY SYSTEMS

1. **Electrical energy** is energy resulting from the flow of **electric charge**.
2. A **cell** is a chemical system in which certain chemical reactions can cause the flow of electric charge through an **external circuit**.
3. We use electric cells to supply the energy needed for electrons to move around an electric circuit.
4. A cell stores chemical substances as **potential energy**.
5. When a cell is connected to an external circuit the substances react with each other.
6. The reaction produces an electric charge with high potential energy.

2. Use Resource 13: 'Energy of charge at different points in a circuit'. Explain the following to the learners:
    a. An electric cell is a system in which certain chemical reactions can cause the flow of electricity through an external circuit.
    b. A cell stores chemical substances as potential energy. When the cell is connected to an external circuit, these chemical substances substances react with each other to produce an electrical charge with high potential energy.
    c. The electrical charge which moves from the cell along the conducting wires of the circuit has high **kinetic energy**. Electrical energy is a form of kinetic energy.
    d. The electrical charge with high kinetic energy moves from the cell to a resistor (for example, a light bulb).
    e. The resistor uses the kinetic energy to do its work. For example, the light bulb uses the kinetic/ electrical energy to light up.
    f. The electrons re-enter the circuit and return to the cell.
    g. This process is repeated many times.
3. Demonstrate how to make an electric cell. Learners must observe and make note to record their observations.
4. Show learners Resource 14: 'Zinc copper cell'. Demonstrate as follows:
    a. In beaker 1, dissolve three teaspoons of zinc sulfate in 100 ml water.
    Do this as advance preparation for the lesson.
    b. In beaker 2, dissolve five teaspoons of copper sulfate in 100 ml water.
    Do this as advance preparation for the lesson
    c. Soak the cloth strip in the zinc sulfate.
    d. Make a **salt bridge** by connecting the two beakers with the cloth strip (as shown in Resource 14).
    e. In beaker 1, put the zinc metal strip in the zinc sulfate solution.
    f. In beaker 2, put the copper metal strip in the copper sulfate solution.
    g. Connect the voltmeter to the two metal strips:
        - Attach the red terminal to the copper metal strip.
        - Attach the black terminal to the copper metal strip.
    h. Take the voltmeter reading with the cloth strip acting as a salt bridge.
    Note: the reading should be approximately 1,1 V.
    i. Predict what the voltmeter reading will be if the cloth strip is removed.
    j. Remove the cloth strip and then take the voltmeter reading.
    k. Note: the reading should be 0 V.

Checkpoint 1

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

a. What is an electric cell?
b. What is the difference between potential energy and kinetic energy?

Answers to the checkpoint questions are as follows:

a. An electric cell is a system in which certain chemical reactions can cause the flow of electricity through an external circuit.
b. Potential energy is stored energy, while kinetic energy is movement energy.

E CONCEPTUAL DEVELOPMENT

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

ACTIVITY

1. What proof do you have that you constructed a functional electric cell?
2. Describe the energy conversion that takes place in the cell.
3. Explain the difference between the two voltmeter readings.
4. Draw a circuit diagram of the circuit with the salt bridge.
5. Is the cell you constructed suitable for use in a laptop? Give two reasons for your answer.

TASK 1

1. Answer questions 1, 2 and 3

TASK 2

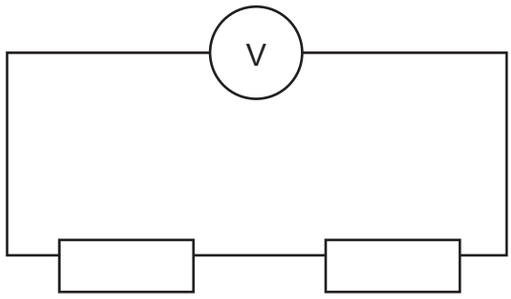
1. Answer question 4 and 5

2. Explain Task 1 to the learners as follows:
   a. Remind learners to refer to the notes they wrote in their workbooks and that they took during the demonstration.
   b. Explain to learners that, if the voltmeter indicates a reading, then we know that there is movement of an electrical charge in the circuit.
   c. Learners must answer questions 1-3.
3. Ask learners to share their answers to Task 1 with the class.
4. Write the answers on the chalkboard.
5. *Model answer: Task 1*

   1. *The fact that the voltmeter gives a reading*
   2. *The energy conversion is from chemical potential energy to electrical/ kinetic energy.*
   3. *The voltmeter reading, with the cloth strip, indicated a functional cell. The voltmeter reading of 0, without the cloth strip, showed that the cell was not functional as the circuit had been broken.*

6. When the learners have completed Task 1, hold a short class discussion on the answers to questions 1-3. Clarify where necessary.
7. Next, get the learners to do Task 2:
   a. Remind learners that in a circuit diagram we use symbols to represent the different parts of a circuit. Refer the learners to Resource 12: 'Circuit symbols'.
   b. Tell learners that the cell they have constructed is a **wet cell** that requires solutions to work. A **dry cell** contains a paste which cannot easily spill from the container.
8. Write the answers on the chalkboard.
9. *Model answer: Task 2*

4. *Circuit diagram*



5. *No. the cell is a wet cell and is too big.*

Checkpoint 2

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

a. What was the function of the cloth strip in the cell you constructed?
b. What does a voltmeter reading of 1.1 indicate?

Answers to the checkpoint questions are as follows:

a. It acted as a salt bridge to close the circuit.
b. That the cell is functional

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Electric cells as energy systems	158
Solutions for all	Electric circuits	190
Spot On	Electric cells, resistance and circuits	113
Top Class	Electric cells as energy systems	150
Via Afrika	Electric cells as energy systems	130
Platinum	Electric cells as energy systems	145-150
Oxford Successful	Electric cells as energy systems	126
Pelican Natural Sciences	Electric cells as energy systems	231
Sasol Inzalo Bk B	Electric cells as energy systems	60

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=UEPJXSXw7HA (4min 48sec) [Dry Cell]
2. https://www.youtube.com/watch?v=Rt7-VrmZuds (8min 43sec) [Electrochemistry]

TOPIC OVERVIEW:

Resistance

Term 3, Weeks 3B - 4A

A. TOPIC OVERVIEW

TERM 3, WEEKS 3B - 4A

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

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

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

B. SEQUENTIAL TABLE

GRADE 8	GRADE 9	GRADE 10-12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Energy transfer in electrical systems	• Uses of resistors • Factors that affect resistance in a circuit	**Grade 10** • Electrical conductivity • Electrical conductors, • semiconductors and insulators • Electric circuits • Resistance is • the opposition to the flow of electric current **Grade 11** • Electric circuits

TOPIC: Resistance

C. SCIENTIFIC VOCABULARY

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

	TERM	EXPLANATION
1.	conductor	Substance that allows a flow of electric charge through it
2.	resistance	Opposition to the movement of charge through a substance
3.	resistor	A conductor that opposes the flow of electric charge
4.	rheostat	Resistor in which the resistance can be manually changed. Also called a variable resistor
5.	variable resistor	Resistor in which the resistance can be manually changed. Also called a rheostat
6.	Ohm (Ω)	Unit to measure resistance
7.	potential difference	Difference in electrical energy (volts) between two points in a circuit
8.	incandescent light bulb	Light bulb with a wire filament
9.	semi-conductor	Substance that conducts electric current under certain conditions
10.	insulator	Substance that does not allow electric current to flow through it
11.	ammeter	Instrument for measuring electric current in amperes (A)

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

Resistors are electrical components that help control the flow of current in a circuit. A high resistance means there is less current available for a given voltage. Resistors convert electrical energy into heat. This means that they make good heating elements for toasters, heaters and electric stoves. Traditional light bulbs work because the very high temperature from their resistance turns a metal filament white-hot, producing light.

E. PERSONAL REFLECTION

Reflect on your teaching at the end of each topic:

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

3 B

Term 3, Week 3, Lesson B
Lesson Title: Resistance
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Uses of resistors
CAPS Page Number	73

Lesson Objectives

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

- Explain that conductors heat up when current passes through them
- Explain that some energy is 'lost'/ 'wasted' from conductors as heat
- Describe what a resistor is
- Describe how a resistor works
- List uses of resistors.

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: Different types of resistors used to add resistance to an electrical circuit. See end of lesson	
Resource 16: Inside an electric kettle	
Resource 17: An incandescent light bulb	
Resource 18: An electric toaster	
Kettle with visible element	Resource 16: Inside an electric kettle
Incandescent light bulb	Resource 17: An incandescent light bulb
Toaster	Resource 18: An electric toaster
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

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

What is the circuit symbol for 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.

D ACCESSING INFORMATION

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

RESISTANCE

1. A **conductor** is a substance that allows the flow of electric charge through it.
2. **Resistance** is the way in which a material opposes (attempts to prevent) the flow of something through it.
3. A **resistor** is a conductor that opposes the flow of something through it.
4. A resistor tries to prevent the flow of electric charge.
5. A resistor is placed in a circuit to control current, or to provide useful energy transfer.
6. Examples of resistors are bulbs, **rheostats** and motors.
7. A rheostat is a resistor in which the resistance can be manually changed.

2. Explain the following to the learners:
    a. Think about your school break time. Imagine that all the learners are outside on the field. The school bell rings, signaling the end of break. All the learners start moving towards the school building. Learners are able to move easily because there is sufficient space on the field. When the learners enter the narrow corridor, some learners bump into each other because the space is limited. Space becomes even more limited as the learners reach the classroom door - only one or two learners at a time can move through the door. The movement of learners is similar to the movement of electrons in an electrical conductor:
        - The field offers very little resistance to the learners. The learners are able to move freely. In the same way, electrical current can flow freely through a conductor in a circuit.
        - The narrow corridor and doorway restricts the movement of the learners. In the same way, a resistor restricts the movement of an electrical current in a circuit.
    b. Resistance in an electrical circuit opposes the passage of electrons. The unit of measurement for resistance is the ohm, with the symbol Ω.
3. Demonstrate the uses of resistors as follows:
    a. Resistors can be used to control the current in a circuit. Use Resource 15: 'Different types of resistors used to add resistance to an electrical circuit'.
    b. Resistors can be used to provide useful energy transfers:
        - Use Resource 16: 'Inside an electric kettle', as well as an electric kettle (if available). The metal coil in the kettle is a resistor. When the electrons move through the resistor, they release a lot of energy in overcoming the resistance. This energy is transferred to the water in the form of heat. This transfer of energy is useful as the thermal energy is used to boil the water in the kettle.
        - Use Resource 17: 'An incandescent light bulb'. Can you see there is a small coiled wire in the glass bulb? This is called the filament. The filament is made from tungsten wire. Tungsten has a high resistance. When the electrons move through the filament they experience high resistance. This means that they transfer a lot of their energy to the filament when they pass through. This causes the filament to give off light and heat.

Checkpoint 1

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

a. True or false? The element in an electric kettle is a resistor.
b. What is the wasted energy output in a light bulb?

Answers to the checkpoint questions are as follows:

a. True
b. Heat

E CONCEPTUAL DEVELOPMENT

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

ACTIVITY

1. What is the resistor in the toaster?
2. Why does the element in the toaster glow?
3. What is the useful output energy in the toaster system?
4. What is the wasted output energy in the toaster system?

TASK 1

1. Answer questions 1 and 2

TASK 2

1. Answer question 3 and 4

2. Explain Task 1 to the learners as follows:
   a. RLearners should refer to Resource 18: 'Electric toaster'.
   b. Remind learners that resistors can provide useful energy transfers, and that a toaster is used to 'roast' bread.
3. Ask learners to share their answers to Task 1 with the class.
4. Write the answers on the chalkboard.
5. *Model answer: Task 1*

1. The element
2. When the current flows through the resistor, some energy is lost as light.

6. When the learners have completed Task 1, hold a short class discussion on resistors that are used to provide useful energy transfer. For example, the element in a toaster turns electrical energy into heat energy used to toast the bread.
7. Next, get the learners to do Task 2:
   a. Remind learners that all conductors, even good ones, heat up when current passes through them and so some of the energy is lost as heat, and sometimes light.
8. Write the answers on the chalkboard.
9. *Model answer: Task 2*

3. Heat
4. Light

Checkpoint 2

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

a. What is the scientific term for the electric component that is used to provide useful energy transfer?
b. What is the scientific term for a resistor in which the resistance can be manually changed?

Answers to the checkpoint questions are as follows:

a. Resistor
b. Variable resistor or rheostat

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Resistance	160
Solutions for all	Electric circuits	190
Spot On	Electric cells, resistance and circuits	113
Top Class	Resistance	154
Via Afrika	Resistance	134
Platinum	Resistance	151
Oxford Successful	Resistance	128
Pelican Natural Sciences	Resistance	243
Sasol Inzalo Bk B	Resistance	70

G ADDITIONAL ACTIVITIES/ READING

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

1. https://phet.colorado.edu/en/simulation/battery-resistor-circuit [Phet simulation: Battery-Resistor Circuit]
2. https://www.youtube.com/watch?v=Gc1wVdbVI0E (6min 30sec) [What is a resistor?]
3. https://www.youtube.com/watch?v=wyYoE4fXKbE (43sec) [How do electric kettles work?]
4. https://www.youtube.com/watch?v=YnMP1Uj2nz0 (1min 13sec) [How a light bulb works]

3 C

Term 3, Week 3, Lesson C
Lesson Title:Factors that affect resistance in a circuit
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Factors that affect resistance in a circuit
CAPS Page Number	73

Lesson Objectives

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

- List four factors that affect resistance in a circuit
- Discuss four factors that affect resistance in a circuit
- Investigate the effect of length of a conductor on resistance.

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
One metre nichrome wire, copper connecting wire, ammeter, variable resistor (rheostat), battery, bulb or LED light	
Resource 12: Circuit symbols	
Resource 19: Effect of temperature on electrical resistance	
Resource 20: Construction of circuit	
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

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

What is the difference between a rheostat and 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.

In a rheostat, or variable resistor, the resistance can be adjusted, while in a resistor the resistance is fixed.

D ACCESSING INFORMATION

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

<u>FACTORS THAT AFFECT RESISTANCE IN A CIRCUIT</u>

1. The four main factors that affect resistance in a circuit:

Length of the conductor	The longer the conductor, the higher the resistance
Thickness of the conductor	The thinner the conductor, the higher the resistance
Temperature of the conductor	The resistance of most metals increases with increasing temperature
Type of material	Some metals, for example copper, are better conductors than other metals, such as nichrome. The higher the conductivity, the lower the resistance.

2. Electric current is measured in amperes (A).
3. Electric current is measured using an ammeter.

2. Explain the following to the learners:
   a. Electric current is measured in **amperes** (A).
   b. Electric current is measured using an ammeter.
   c. Different materials offer different resistance to the flow of electric current.
   d. Good **conductors** offer low resistance to the flow of electrical charge. Silver, copper and gold are good electrical conductors.
   e. Silicon can conduct electricity under certain circumstances and is called a **semi-conductor**.
   f. Wood and rubber have such a high electrical resistance that we say that they do not conduct electricity. Wood and rubber are **insulators**.
   g. The longer the resistor is connected in an electric circuit, the higher the resistance in a circuit.
   h. The thicker the conductor, the lower the resistance. Compare two hosepipes of different thickness – a thicker pipe has more space for water than a thinner pipe. There is less resistance in a thicker pipe.
   i. Electrical resistance varies with temperature. For most metals, the resistance increases with increasing temperature. Use Resource 19: 'Effect of temperature on electrical resistance'.
   j. An ammeter does not measure resistance directly, but if we measure the flow of electrical current in different situations, we can deduce their relative resistance..
3. Demonstrate the effect of length of conductor on resistance as follows:
   a. Use Resource 20: 'Construction of circuit'. Set up the circuit as shown. Use the copper wire as the connecting wire in the circuit. This should be done as advance preparation for the lesson.
   b. Learners must observe the investigation. Learners should record their observations in a table like this:

Length of wire	**Ammeter reading**	**Brightness of bulb**
100 cm		
80 cm		
60 cm		
40 cm		
20 cm		

   c. Connect 100cm nichrome wire between points A and B. Learners record the ammeter reading and the brightness of the bulb in the table.
   d. Repeat this with 80cm, 60cm, 40cm and 20cm lengths of nichrome wire.
4. *Model answer (Answers will vary but the trends should be as follows):*

Length of wire	Ammeter reading	Brightness of bulb
100 cm	*highest*	*dimmest*
80 cm		
60 cm		
40 cm		
20 cm	*lowest*	*brightest*

Checkpoint 1

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

a. Will a long piece of wire have a higher or lower resistance than a short piece of the same wire?
b. What is the unit of measure for electrical current?

Answers to the checkpoint questions are as follows:

a. Higher
b. Ampere (A)

E CONCEPTUAL DEVELOPMENT

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

ACTIVITY

1. Draw a graph to show the relationship between the length of the wire and the ammeter reading.
2. What does the graph tell you about the effect of conductor length on the resistance of the conductor?
3. Write a sentence that summarises how the resistance of the conductor and the length of the wire affect the brightness of the bulb.

TASK 1

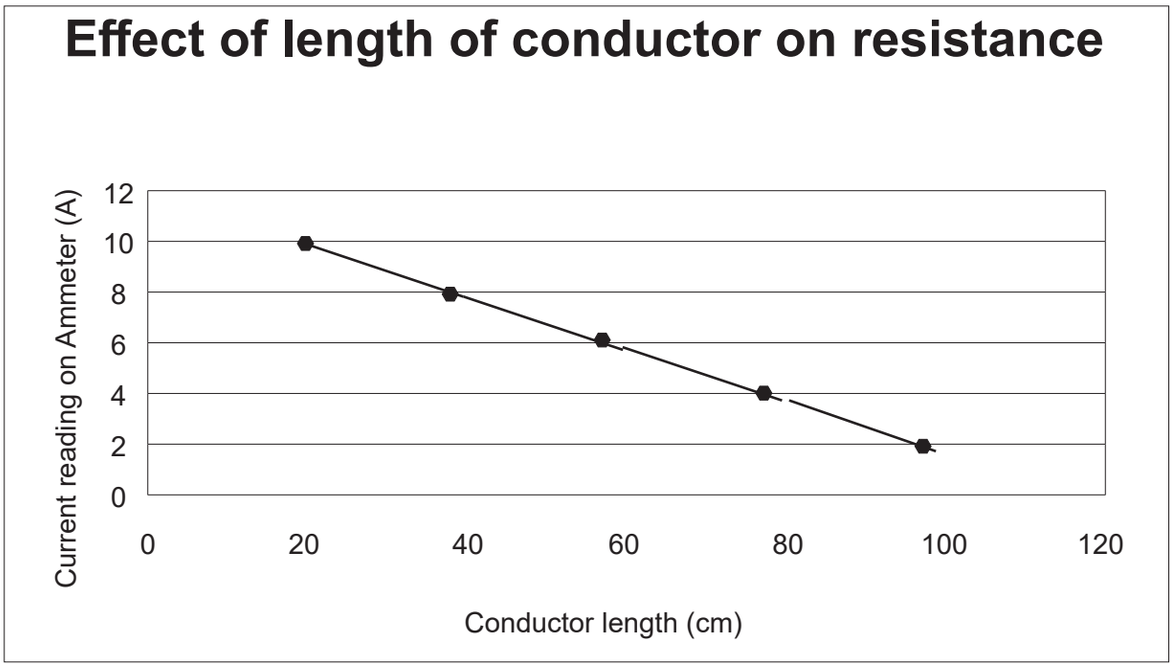
1. Answer questions 1

TASK 2

1. Answer question 2 and 3

2. Explain Task 1 to the learners as follows:
   a. Learners should refer to their notes on the factors that affect resistance in a circuit, as well as the notes they took during the demonstration.
   b. Learners should prepare their graph with length of wire on the horizontal axis and ammeter reading on the vertical axis.
   c. Learners should label the horizontal and vertical axes and give the graph a heading.
3. Ask learners to share their answers to Task 1 with the class.
4. Write the answers on the chalkboard.
5. *Model answer: Task 1*

   1. *The graph should be a straight-line graph showing that the longer the wire, the lower the ammeter reading.*



6. When the learners have completed Task 1, discuss the graph. Note again that it is a straight- line graph indicating that the length of the conductor wire is directly proportional to the resistance of the wire.
7. Next, get the learners to do Task 2:
8. Write the answers on the chalkboard.
9. *Model answer: Task 2*

   2. *The longer the wire, the greater the resistance*
   3. *The shorter the wire, the lower the resistance and the brighter the bulb*

      OR

      The longer the wire, the higher the resistance and the dimmer the bulb

Checkpoint 2

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

a. What is the relationship between the length of the conductor and resistance?
b. What is the relationship between the thickness of the conductor and resistance?

Answers to the checkpoint questions are as follows:

a. The longer the conductor, the higher the resistance
b. The thinner the conductor, the higher the resistance

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Resistance	160
Solutions for all	Electric circuits	190
Spot On	Electric cells, resistance and circuits	113
Top Class	Resistance	154
Via Afrika	Resistance	134
Platinum	Resistance	151
Oxford Successful	Resistance	128
Pelican Natural Sciences	Resistance	243
Sasol Inzalo Bk B	Resistance	70

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=w4xT6jMoubQ (6min 0sec) [Factors affecting the resistance]

4 A

Term 3, Week 4, Lesson A
Lesson Title:Investigate factors that affect resistance in a circuit
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Factors that affect resistance in a circuit
CAPS Page Number	73

Lesson Objectives

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

- List four factors that affect resistance in a circuit
- Discuss four factors that affect resistance in a circuit
- Investigate the effect of different materials on resistance.

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
30 cm copper wire, 30 cm nichrome wire – both wires should be the same thickness, 60 cm copper wire to use as connecting wire in the circuit, ammeter, variable resistor (rheostat), battery, bulb or LED light	
Resource 12: Circuit symbols	
Resource 20: Construction of circuit	
Projector and laptop with internet	

C CLASSROOM MANAGEMENT

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

What will happen to the ammeter readings as the length of a conductor is increased?

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 ammeter reading will drop.

D ACCESSING INFORMATION

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

THE EFFECT OF DIFFERENT MATERIALS ON RESISTANCE IN A CIRCUIT

1. Different materials offer different amounts of resistance to the flow of electric current.
2. Good electrical conductors offer low resistance to the flow of electrical charge.
3. Silver, copper and gold are the best electrical conductors.
4. In many circuits, copper is used as a conducting wire, as it is not as expensive as silver and gold.
5. Silver and gold are used in the wiring of computers and cellphones.
6. Metals or mixtures of metals, such as tungsten or nichrome conduct electricity, but offer much electrical resistance.

2. Explain the following to the learners:
    a. All metals are electrical conductors, but some metals offer less resistance to the flow of electricity than others.
    b. Conductors that offer little resistance are called good conductors.
    c. Conductors that offer high resistance are called resistors.
    d. Some metals, for example copper, are better conductors than other metals, such as nichrome. The higher the conductivity is, the lower the resistance.
    e. Good conductors of electricity are used in devices where it is necessary to keep resistance as low as possible.
3. Demonstrate the effect of length of conductor on resistance as follows:
    a. Use Resource 20: 'Construction of circuit'. Set up the circuit as shown. This should be done as advance preparation for the lesson. The circuit set-up is the same as for Lesson 3C.
    a. Learners must observe the investigation. Learners should record their observations in a table like this:

Type of wire	**Ammeter reading**
Copper	
Nichrome	

    c. Connect 30cm copper wire between points A and B. Learners record the ammeter reading in the table.
    d. Repeat this with 30cm of nichrome wire. Emphasise the fact that the two wires were the same length and thickness.

Checkpoint 1

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

a. Are gold, silver and copper electrical conductors or resistors?
b. Is the resistance high or low when the ammeter reading is high?

Answers to the checkpoint questions are as follows:

a. Electrical conductors
b. Low

E CONCEPTUAL DEVELOPMENT

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

ACTIVITY

1. In the investigation, why was it important that the two wires were the same length and thickness?
2. Which wire gave the higher ammeter reading?
3. Which wire has the lower resistance? Give a reason for your answer.
4. Which wire would you use to connect the lights in a house? Give a reason for your answer.
5. Why is silver or gold wire used in the wiring of computers and cellphones?

TASK 1

1. Answer questions 1-3

TASK 2

1. Answer question 4-5

2. Explain Task 1 to the learners as follows:
   a. Learners should refer to their notes on the factors that affect resistance in a circuit, as well as the notes they took during the investigation.
   b. Remind learners of the relationship between the ammeter reading and resistance: the ammeter reading gives a reading of the flow of current, not resistance. When the ammeter reading is high, it means the current is flowing easily and thus the resistance is low.
3. Ask learners to share their answers to Task 1 with the class.
4. Write the answers on the chalkboard.
5. *Model answer: Task 1*

   1. *The wires needed to be the same length and thickness so that only one variable (the material) changes.*
   2. *Copper wire*
   3. *The copper wire has the lower resistance. The copper wire had the higher ammeter reading, indicating that it offered less resistance to the flow of electrical current.*

6. When the learners have completed Task 1, discuss their answers. Clarify where necessary. Ensure that learners understand the relationship between ammeter reading and resistance.
7. Next, get the learners to do Task 2.
8. Write the answers on the chalkboard.
9. *Model answer: Task 2*

   4. *Copper wire because it is a good electrical conductor and will allow electrical current to flow to household appliances easily. This saves electricity.*
   5. *Silver and gold are both good conductors of electrical current, and thus limit the transfer of energy.*

Checkpoint 2

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

a. True or false: A good electrical conductor resists the flow of electrical current?
b. If I am placed in an electrical circuit to cause useful energy transfer, what am I?

Answers to the checkpoint questions are as follows:

a. False
b. Resistor/ variable resistor/ rheostat

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Resistance	160
Solutions for all	Electric circuits	190
Spot On	Electric cells, resistance and circuits	113
Top Class	Resistance	154
Via Afrika	Resistance	134
Platinum	Resistance	151
Oxford Successful	Resistance	128
Pelican Natural Sciences	Resistance	243
Sasol Inzalo Bk B	Resistance	70

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=w4xT6jMoubQ (6min) [Factors affecting the resistance in a circuit]

TOPIC OVERVIEW:
Series and parallel circuits
Term 3, Weeks 4B - 6A

A. TOPIC OVERVIEW

TERM 3, WEEKS 4B - 6A

- This topic runs for 2 weeks.
- It is presented over 6 x 1 hour lessons.
- This topic's position in the term is as follows::

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

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

B. SEQUENTIAL TABLE

GRADE 8	GRADE 9	GRADE 10-12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Energy transfer in electrical systems • Components of a circuit • Effects of an electric current • Series and parallel circuits	• Series and parallel circuits	**Grade 10** • Electric circuits **Grade 11** • Electric circuits

C. SCIENTIFIC VOCABULARY

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

	TERM	EXPLANATION
1.	series circuit	An electric circuit that only has one pathway for current to flow through
2.	current	The flow of electricity through a conductor
3.	cell	A device that supplies an electric circuit with chemical potential energy that allows an electric current to flow through the circuit as a result of a chemical reaction
4.	resistor	A device that opposes the flow of electric current
5.	battery	Two or more cells connected in series
6.	parallel circuit	An electric circuit that has more than one pathway for current to flow through
7.	voltage	Electric force that forces electrons to move from one atom to another
8.	potential difference	Difference in potential energy (volts) between two points in a circuit
9.	electron	Negatively charged particles
10.	voltmeter	A device used to measure voltage (potential difference)
11.	resistance	A measure of how the flow of electric current is opposed
12.	ohm	Unit of measure for resistance
13.	ammeter	A device used to measure current
14.	ampere	Unit of measure for current
15.	electrical system	A system made up of parts and devices that transfer electrical energy
16.	fuse	A device that breaks or melts when the desired voltage is exceeded

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

Electricity is used all around us in our daily lives. Electricity is used to make electric devices work, such as making a light bulb glow or driving machines like cars and toys. All electricity must be in a closed electrical circuit. The circuit has a power source that provides electrical energy, electrical devices that transfer electrical energy into other energy forms and conducting wires that connect the power source and electrical devices. The components in an electric circuit can either be connected in series or parallel. Components that are connected in series will behave differently to the components that are connected in parallel. For example, if a light bulb that is connected in series to other light bulb stops working, all the other light bulbs will stop working. If the light bulb is connected in parallel to the other light bulbs, all the other light bulbs will continue to work. For this reason, the lighting system in our houses is connected in parallel. It is important for us to understand the difference between series and parallel circuits, and the effects of connecting components in this manner.

E. PERSONAL REFLECTION

Reflect on your teaching at the end of each topic:

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

4 B

Term 3, Week 4, Lesson B
Lesson Title:Circuit diagrams of series and parallel circuits
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Diagrams and components of series and parallel circuits
CAPS Page Number	73

Lesson Objectives

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

- Identify, describe and draw simple series and parallel circuit diagrams.

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 symbols	

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 are the factors that affect resistance in a circuit?

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.

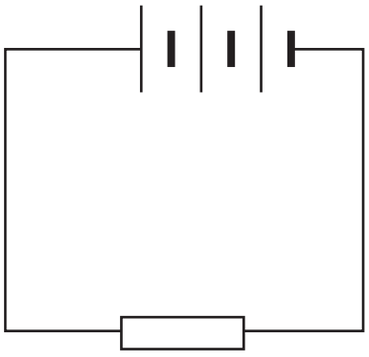
Type of conducting material, thickness of the conductor, length of the conductor and the temperature of the conductor

D ACCESSING INFORMATION

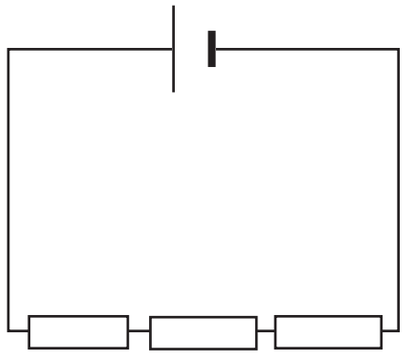
1. Write the following onto the chalkboard (always try to do this before the lesson starts):

SERIES CIRCUITS

1. A **series circuit** provides only one pathway for current to flow.
2. The **current** is the same everywhere along the circuit.
3. **Cells** or **resistors** can be connected in series in a circuit.
4. Cells connected in series is called a **battery**.



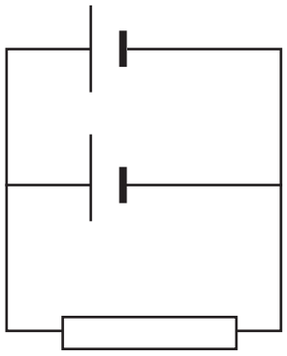
Cells in series



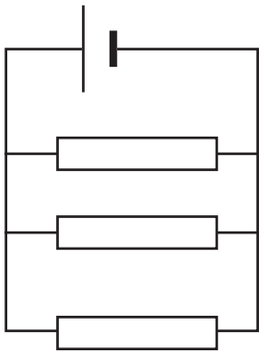
Resistors in series

PARALLEL CIRCUITS

1. A **parallel circuit** provides two or more pathways for current to flow.
2. The current can be different in each pathway, depending on the components in that pathway.
3. Cells or resistors can be connected in parallel in a circuit.



Cells in parallel



Resistors in parallel

2. Explain the following to the learners:
   a. An electrical circuit is a closed path that electrical energy flows through. Electrical energy can only flow through a circuit if it is a closed loop.
   b. A series circuit provides only one pathway for current to flow. All the components are connected in one line.
   c. The current is the same everywhere along the circuit. That means that the current flowing through each component in a series circuit is the same.
   d. Cells or resistors can be connected in series in a circuit.
   e. Cells that are connected in series comprise a battery.
   f. A parallel circuit provides two or more pathways for current to flow. We can say that the circuit has branches.
   g. The current can be different in each pathway or branch, depending on the components in that pathway.
   h. Cells or resistors can be connected in parallel in a circuit.

Checkpoint 1

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

a. What is a series circuit?
b. What is a parallel circuit?

Answers to the checkpoint questions are as follows:

a. A series circuit is a circuit that has only one pathway for current to flow.
b. A parallel circuit is a circuit that has two or more pathways for current to flow.

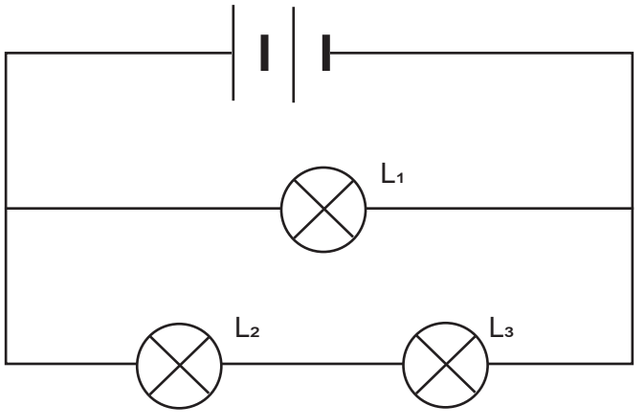
E CONCEPTUAL DEVELOPMENT

1. Make sure that Resource 12 of 'Circuit symbols' is on display in the classroom.
2. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

Use the circuit symbols displayed in the classroom to draw the following circuit diagrams. Make sure you use the correct symbols and make sure the drawings are neatly drawn with a ruler.

1. A cell connected in series to a resistor with an open switch.
2. A battery connected to a light bulb. There is another light bulb connected in parallel to the first light bulb. The switch only controls both light bulb.
3. A cell is connected in parallel to another cell which is connected to two light bulbs that are in series.
4. Describe the connections in the following circuit diagram:



TASK 1

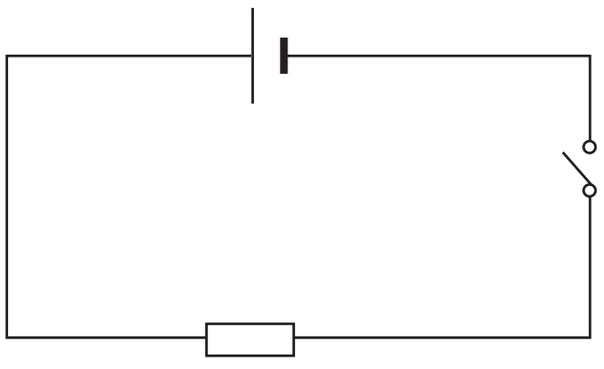
1. Answer questions 1-3

TASK 2

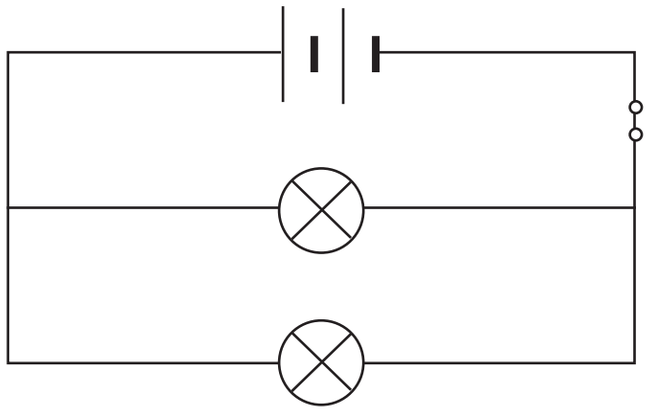
1. Answer question 4

3. Explain Task 1 to the learners as follows:
4. Give learners some time to complete Task 1 in their workbooks.
5. Ask learners to share their answers to Task 1 with the class.
6. The completed circuit diagrams are shown below.
7. *Model answer: Task 1*

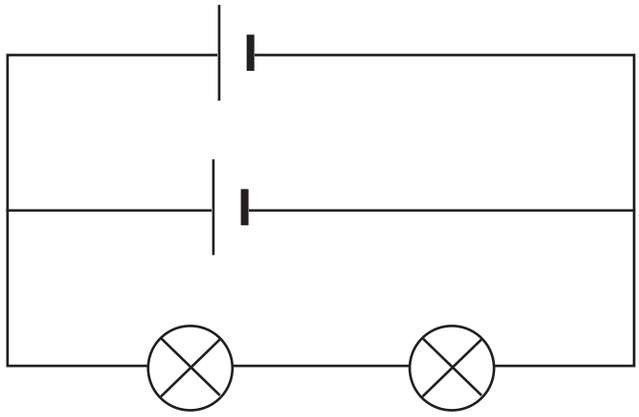
1.



2.



3.



8. Next, get the learners to do Task 2.
9. Explain Task 2 to the learners as follows:
   a. Work on your own.
   b. Answer the questions in Task 2.
10. Give learners some time to do Task 2.
11. Ask learners to share their answers to Task 2 with the class.
12. Discuss the answers with the learners.
13. *Model answer: Task 2*

> *4. The two cells care connected in series. Light bulb 1 is connected in parallel to light bulbs 2 and 3. Light bulbs 2 and 3 are connected in series to each other.*

14. When the learners have completed Task 2, hold a short class discussion to revise:
   a. A series circuit provides only one pathway for current to flow.
   b. The current is the same everywhere along the circuit.
   c. A parallel circuit provides two or more pathways for current to flow.
   d. The current can be different in each pathway, depending on the components in that pathway.

Checkpoint 2

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

a. What do we know about the current at any point in a series circuit?
b. What do we know about the current at any point in a parallel circuit?

Answers to the checkpoint questions are as follows:

a. The current is the same everywhere along the circuit.
b. The current can be different in each pathway, depending on the components in that pathway.

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Series and parallel circuits	162-166
Solutions for all	Series and parallel circuits	203
Spot On	Series and parallel circuits	118,121
Top Class	Series and parallel circuits	159,164
Via Afrika	Series and parallel circuits	139-143
Platinum	Series and parallel circuits	161
Oxford Successful	Series and parallel circuits	143
Pelican Natural Sciences	Series and parallel circuits	255
Sasol Inzalo Bk B	Series and parallel circuits	125

G ADDITIONAL ACTIVITIES/ READING

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

1. https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc [Phet simulation: Circuit Construction Kit]
2. https://www.youtube.com/watch?v=O8GgRIIB1Yc (5min 46sec) [Series vs parallel circuits]
3. https://www.youtube.com/watch?v=x2EuYqj_0Uk (8min 04sec) [Series and parallel circuits]

4 C

Term 3, Week 4, Lesson C
Lesson Title:Connecting cells in series
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Connecting cells in series
CAPS Page Number	73

Lesson Objectives

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

- Explain that the total voltage in a series circuit is equal to the sum of the voltages of individual cells in the circuit
- State that voltage is measured with a voltmeter
- Explain that voltmeters are always connected in parallel because they have a high resistance
- Explain that the brightness of a light bulb increases as more cells are connected in series.

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
Circuit board	• Cell holders
Three 1.5 volt cells	
Two identical light bulbs	• LED light bulbs
Conducting wire	
Voltmeter	
Resource 21: Voltmeter	

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 series and a parallel circuit?

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.

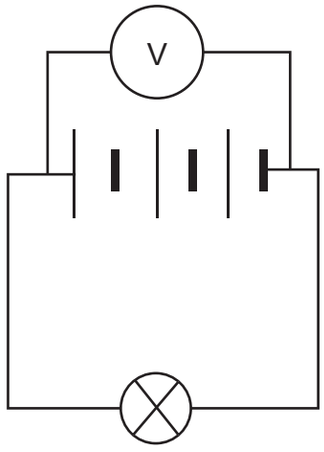
A series circuit only has one pathway for current to flow. A parallel circuit has more than one pathway for current to flow.

D ACCESSING INFORMATION

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

CONNECTING CELLS IN SERIES

1. When cells are connected in series, the total **voltage** is equal to the sum of the voltages of individual cells.
2. Voltage is also called **potential difference**, and is the difference in the potential energy before and after current has passed through a component.



3. As we add more cells in a series circuit, the brighter the light bulb will glow.
4. Adding more cells increases the voltage in the series circuit.
5. This increases the force with which **electrons** are pushed through the circuit, and the electrons move faster.
6. Remember current is the measure of the speed at which charge flows. Therefore, more current flows through the light bulb and it will glow brighter.
7. This increases the voltage (potential difference) across the light bulb.
8. We can measure the voltage (potential difference) across the cells using a **voltmeter**.
9. Because they have a very high **resistance**, voltmeters are always connected in parallel to the component they are measuring the voltage across.

2. Make sure that Resource 21 of 'Voltmeter' is on display in the classroom.
3. Explain the following to the learners:
   a. When cells are connected in series, the total voltage is equal to the sum of the voltages of individual cells. As we add cells in series, the voltage in the circuit will increase.
   b. Voltage is also called potential difference, and is the difference in the potential energy before and after current has passed through a component.
   c. As we add more cells in a series circuit, the light bulb will glow more brightly.
   d. Adding more cells increases the voltage in the series circuit. Remember that voltage is a measure of the force with which electrons are pushed through a conductor. This increases the force with which electrons are pushed through the circuit, and the electrons move faster.
   e. Remember current is the measure of the speed at which charge flows. Therefore, more current flows through the light bulb and it will glow more brightly.
   f. This increases the voltage (potential difference) across the light bulb.
4. Show learners Resource 21: 'Voltmeter'.
5. Explain the following to the learners:
   a. We can measure the voltage (potential difference) across the cells using a voltmeter.
   b. Because they have a very high resistance, voltmeters are always connected in parallel to the component whose voltage they are measuring.
   c. In the diagram on the chalkboard, the voltmeter is connected in parallel across the three cells (battery). The reading on the voltmeter will be equal to the sum of the voltages of the three cells.

Checkpoint 1

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

a. What is the total voltage in a circuit that has three 1.5 volt cells connected in series?
b. What happens to the total voltage of a series circuit as we add more cells?

Answers to the checkpoint questions are as follows:

a. 1.5 + 1.5 + 1.5 = 4.5 volts
b. The voltage increases.

E CONCEPTUAL DEVELOPMENT

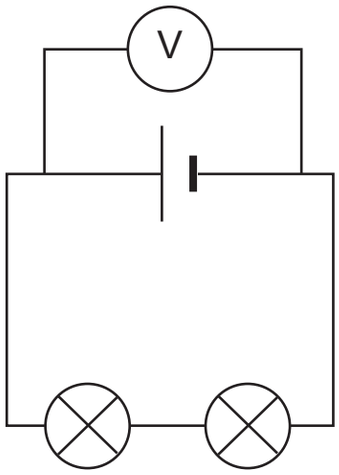
1. Advance preparation: ensure that you have all the resources for the demonstration.
2. If you have enough resources, you can get the learners to do the investigation in groups.
3. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

Number of cells	Voltmeter reading (V)	Brightness of light bulbs
1		
2		
3		

TASK 1

1. Copy the table into your workbooks.
2. Set up a series circuit with two light bulbs in series and one 1.5 volt cell. The voltmeter must be connected in parallel across the cell.



3. Discuss what you think will happen to the brightness of the light bulbs as you add cells in series to the circuit.
4. Observe the brightness of the light bulbs and record the reading on the voltmeter each time a cell is added in series to the circuit.
5. Record your observations and readings in the table.

TASK 2

1. What conclusion can you make about the total voltage in a circuit as more cells are added in series.
2. Think about the current flowing through the circuit and answer the following questions:
   a. What happens to the current through the circuit as more cells are added?
   b. How do we know that this happens to the current?

4. Explain Task 1 to the learners as follows:
   a. The table drawn on the chalkboard has three columns.
   b. The first column has the following heading: Number of cells.
   c. The second column has the following heading: Voltmeter reading (V).
   d. The third column has the following heading: Brightness of light bulbs.
   e. Work in groups and complete Task 1.
5. Give learners some time to do Task 1.
6. Ask learners to share their answers to Task 1 with the class.
7. Discuss the answers with the learners.
8. *Model answer: Task 1*

Number of cells	Voltmeter reading (V)	Brightness of light bulbs
1	*1.5*	*dim*
2	*3*	*brighter*
3	*4.5*	*brightest*

9. Next, get the learners to do Task 2.
10. Explain Task 2 to the learners as follows:
    a. Work on your own.
    b. Answer the questions in Task 2.
11. Give learners some time to do Task 2.
12. Ask learners to share their answers to Task 2 with the class.
13. Discuss the answers with the learners.
14. *Model answer: Task 2*

1. The total voltage increases as more cells are added. The total voltage is the sum of the voltages of each cell connected in series.

2.

a. The current increases.

b. The light bulbs glow brighter.

15. When the learners have completed Task 2, hold a short class discussion to revise the following:
    a. When cells are connected in series, the total voltage is equal to the sum of the voltages of individual cells.
    b. As we add more cells in the series circuit above, the light bulb will glow more brightly.
    c. Adding more cells in series increases the voltage in the series circuit.
    d. Remember current is the measure of the speed at which charge flows. Therefore, more current flows through the light bulb and it will glow more brightly.

Checkpoint 2

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

a. What is the name of the device used to measure voltage in a circuit?
b. Why do light bulbs glow brighter as we add more cells in series in a circuit?

Answers to the checkpoint questions are as follows:

a. Voltmeter
b. The voltage of the circuit increases which increases the current in the circuit, making the light bulbs glow brighter.

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Series and parallel circuits	162-166
Solutions for all	Series and parallel circuits	203-204
Spot On	Series and parallel circuits	118-119
Top Class	Series and parallel circuits	159-161
Via Afrika	Series and parallel circuits	139-141
Platinum	Series and parallel circuits	162
Oxford Successful	Series and parallel circuits	134-136
Pelican Natural Sciences	Series and parallel circuits	255-263
Sasol Inzalo Bk B	Series and parallel circuits	96-103

G ADDITIONAL ACTIVITIES/ READING

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

1. https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc [Phet simulation: Circuit Construction Kit]
2. https://www.youtube.com/watch?v=mvQe_Z-YpYA (6min 56sec) [Connecting Batteries in Parallel and Series]

5 A

Term 3, Week 5, Lesson A
Lesson Title: Connecting resistors in series
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Connecting resistors in series
CAPS Page Number	73-74

Lesson Objectives

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

- Explain that the total voltage across the battery is equal to the sum of the voltages across each of the resistors in a series circuit
- Explain that a resistor with a high resistance will have a higher voltage across it
- Explain that a resistor with a lower resistance will have a lower voltage across it
- State that the current is the same when measured at any point in a series circuit
- State that current is measured using an ammeter
- Explain that ammeters are always connected in series because they have a low resistance
- Explain that the current in a circuit decreases with every resistor added in a series 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
Circuit board	Cell holders
Four 1.5 volt cells	6 volt battery
Three resistors with different resistances	
Conducting wire	
Voltmeter	
Ammeter	
Resource 22: Ammeter	

C CLASSROOM MANAGEMENT

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

Is a voltmeter connected in series or parallel and why?

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.

Voltmeters are always connected in parallel because they have a high resistance and will affect the current flowing through the circuit.

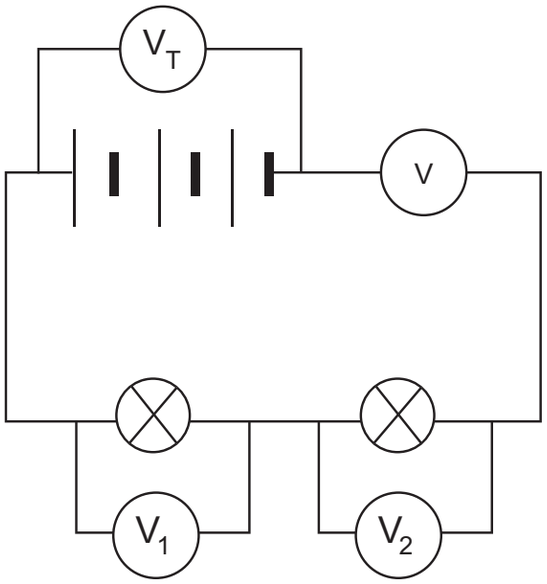
D ACCESSING INFORMATION

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

CONNECTING RESISTORS IN SERIES

1. Resistors can be connected in series in a circuit.
2. A light bulb is a type of resistor.
3. The unit of measure for resistance is the ohm (Ω).
4. The total voltage across the battery is equal to the sum of voltages across each resistor in the circuit.

$V_T = V_1 + V_2$



5. A resistor that has a high resistance will have a higher voltage across it.
6. A resistor that has a lower resistance will have a lower voltage across it.
7. The current anywhere in the series circuit will be the same.
8. The current in the circuit decreases with each resistor that is added.
9. We can measure current with an **ammeter**.
10. The unit of measure of current is the **ampere** (A).
11. An ammeter is always connected in series because it has a very low resistance.

2. Make sure that Resource 22: 'Ammeter', is on display in the classroom.
3. Explain the following to the learners:
   a. Resistors can be connected in series in a circuit.
   b. A light bulb is a type of resistor.
   c. The total voltage across the battery is equal to the sum of voltages across each resistor in the circuit. The total voltage in the circuit increases each time we add a cell in series. We can represent this using the equation:
   d. A resistor that has a high resistance will have a higher voltage across it.
   e. A resistor that has a lower resistance will have a lower voltage across it.
   f. The current anywhere in the series circuit will be the same.
   g. The current in the circuit decreases with each resistor that is added.
   h. Show learners Resource 22: ‘Ammeter’.
4. Explain the following to the learners:
5. We can measure current with an ammeter.
6. An ammeter is always connected in series with the component with which we measure the current because they have a very low resistance.

Checkpoint 1

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

a. What do we know about the current strength at any point in a series circuit?
b. What do we know about the total voltage across the battery of a circuit with resistors connected in series?

Answers to the checkpoint questions are as follows:

a. It will be the same.
b. The total voltage across the battery of a circuit with resistors connected in series is equal to the sum of the voltages across each resistor.

E CONCEPTUAL DEVELOPMENT

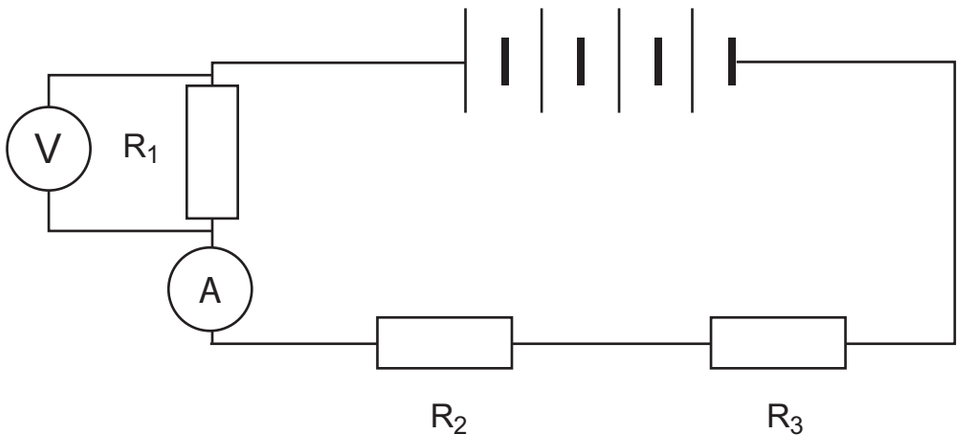
1. Advance preparation: ensure that you have all the resources for the demonstration.
2. If you have enough resources, you can get the learners to do the investigation in groups.
3. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

Resistor number	Resistance (Ω)	Voltage across resistor (V)	Ammeter reading after each resistor (A)	Voltage across battery (V)
R_1				
R_2				
R_3				
Total				

TASK 1

1. Copy the table into your workbooks.
2. Set up a series circuit with three resistors in series and four 1.5 volt cells or a 6 volt battery.



3. Fill in the second column in the table by reading off the resistance of each resistor. This should be written on the resistor.
4. Use a voltmeter and measure the voltage across each resistor. Make sure you connect the voltmeter in parallel across each resistor. The diagram shows how to connect the voltmeter for resistor 1 (R1). Record the voltmeter readings in the third column.
5. Measure the voltage across the battery and record the reading in the last column.
6. Connect an ammeter in series after each resistor and record the current strength at each position. The diagram shows how to connect the ammeter after resistor 1 (R1). Record the ammeter readings in the fourth column.
7. Add up the voltages across each resistor and record the total in the table.

TASK 2

1. Compare the added voltage across each resistor to the total voltage measured across the battery.
   a. What do you notice?
   b. What conclusion can you make about the voltage across the battery, and the sum of the voltages across the resistors in a series circuit?
2. What did you notice about the current strength at any point in the circuit?
3. Which resistor had the highest voltage?
4. Which resistor had the lowest voltage?
5. What is the relationship between the resistance of a resistor and the voltage across the resistor?

4. Explain Task 1 to the learners as follows:
   a. The table drawn on the chalkboard has five columns.
   b. The first column has the following heading: Resistor number.
   c. The second column has the following heading: Resistance (Ω).
   d. The third column has the following heading: Voltage across resistor (V).
   e. The fourth column has the following heading: Ammeter reading after each resistor (A).
   f. The fifth column has the following heading: Voltage across battery (V).
   g. Work in groups and complete Task 1.
5. Give learners some time to do Task 1.
6. Ask learners to share their answers to Task 1 with the class.
7. Discuss the answers with the learners.
8. *Model answer: Task 1*

Values will vary according to the resistors and battery that are available. For this model answer, resistors with a resistance of 0.25 Ω, 0.75 Ω and 2 Ω are used. The voltage across the battery is 6 volts.

Resistor number	**Resistance (Ω)**	**Voltage across resistor (V)**	**Ammeter reading after each resistor (A)**	**Voltage across battery (V)**
R_1	0.25	0.5	2	6
R_2	0.75	1.5	2	
R_3	2	4	2	
Total		6		

It is important that the sum of the voltages across the resistors is equal to the voltage across the battery, and the readings on the ammeters are the same.

9. Next, get the learners to do Task 2.
10. Explain Task 2 to the learners as follows:
    a. Work on your own.
    b. Answer the questions in Task 2.
11. Give learners some time to do Task 2.
12. Ask learners to share their answers to Task 2 with the class.
13. Discuss the answers with the learners.
14. Model answer: Task 2

1.
   a. *The voltages are the same.*
   b. *The sum of the voltages across the resistors adds up to the voltage across the battery in a series circuit.*
2. *The current is the same at any point in a series circuit.*
3. *Resistor 2 (R_2)*
4. *Resistor 1 (R_1)*
5. *A resistor that has a high resistance will have a higher voltage across it.*
6. *A resistor that has a lower resistance will have a lower voltage across it.*
7. *(Answers for questions 3 and 4 will vary according to the resistors used.)*

15. When the learners have completed Task 2, hold a short class discussion to revise the following:
    a. The total voltage across the battery is equal to the sum of voltages across each resistor in the circuit.
    b. A resistor that has a high resistance will have a higher voltage across it.
    c. A resistor that has a lower resistance will have a lower voltage across it.
    d. The current anywhere in the series circuit will be the same.
    e. The current in the circuit decreases with each resistor that is added.

Checkpoint 2

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

a. What happens to the current strength when more resistors are added in series to a circuit?
b. What do you think will happen to the brightness of a light bulb if another light bulb is added in series?

Answers to the checkpoint questions are as follows:

a. The current decreases as more resistors are added.
b. The brightness of the light bulb will decrease.

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Series and parallel circuits	162-166
Solutions for all	Series and parallel circuits	204-208
Spot On	Series and parallel circuits	119-120
Top Class	Series and parallel circuits	162-164
Via Afrika	Series and parallel circuits	139-141
Platinum	Series and parallel circuits	163-166
Oxford Successful	Series and parallel circuits	137-139
Pelican Natural Sciences	Series and parallel circuits	255-263
Sasol Inzalo Bk B	Series and parallel circuits	103-110

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://phet.colorado.edu/en/simulation/circuit-construction-kit-dc [Phet simulation: Circuit Construction Kit]
2. https://www.youtube.com/watch?v=O8GgRIIB1Yc (5min 46sec) [Series vs parallel circuits]
3. https://www.youtube.com/watch?v=x2EuYqj_0Uk (8min 04sec) [Series and parallel circuits]

5 B

Term 3, Week 5, Lesson B
Lesson Title: Connecting cells in parallel
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Connecting cells in parallel
CAPS Page Number	74

Lesson Objectives

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

- Explain that, when cells of the same voltage are connected in parallel, the voltage across each cell is the same as the voltage for one cell on its own
- Explain that the brightness of a light bulb does not change as more cells are connected in parallel.

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
Circuit board	Cell holders
Three 1.5 volt cells	
Two identical light bulbs	LED
Conducting wire	
Voltmeter	

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 total voltage when more cells are added in series to a circuit?

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 total voltage in the circuit increases.

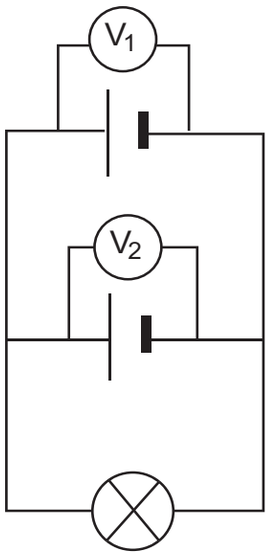
D ACCESSING INFORMATION

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

CONNECTING CELLS IN PARALLEL

1. When cells (of the same voltage) are connected in parallel, the voltage across each cell is the same as the voltage for one cell.

$V_1 = V_2$



2. As more cells of the same voltage are added in parallel, the brightness of the light bulb does not change.

2. Explain the following to the learners:
   a. When cells (of the same voltage) are connected in parallel, the voltage across each cell is the same as the voltage for one cell. The total voltage in the circuit stays the same. We can represent this using the equation:

$$V_1 = V_2$$

   b. As more cells of the same voltage are added in parallel, the brightness of the light bulb does not change. Since the total voltage in the circuit does not change, the light bulbs will not glow more brightly.

Checkpoint 1

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

a. What is the total voltage across each cell in a circuit that has three 1.5 volt cells connected in parallel?
b. What happens to the total voltage of a parallel circuit as we add more cells?

Answers to the checkpoint questions are as follows:

a. 1.5 volts
b. It stays the same.

E CONCEPTUAL DEVELOPMENT

1. Advance preparation: ensure that you have all the resources for the investigation.
2. If you have enough resources, you can get the learners to do the investigation in groups.
3. Write the following onto the chalkboard (always try to do this before the lesson starts):

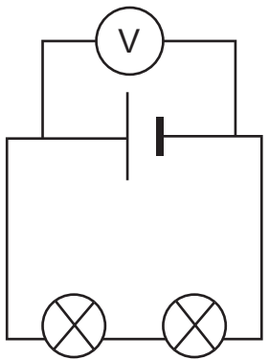
ACTIVITY

Number of cells	Voltmeter reading (V)	Brightness of light bulbs
1		
2		
3		

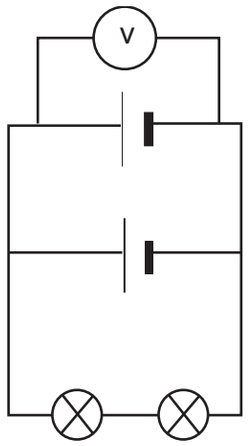
TASK 1

1. Copy the table into your workbooks.
2. Discuss what you think will happen to the brightness of the light bulbs, as you add cells in parallel to the circuit.
3. Set up a circuit with two light bulbs in series and one 1.5 volt cell. The voltmeter must be connected in parallel across the cell.

Circuit with one cell



Circuit with two cells in parallel



4. Observe the brightness of the light bulbs and record the reading on the voltmeter each time a cell is added in parallel to the circuit.
5. Record your observations and readings in the table.
6. When you have added three cells in parallel, move the voltmeter across each cell, one by one, and record the voltage across each cell.

TASK 2

1. What happened to the brightness of the light bulbs, as more cells were added to the circuit in parallel?
2. What did you notice about the voltage across each cell, when three cells were connected in parallel?
3. What is the total voltage in the parallel circuit?

4. Explain Task 1 to the learners as follows:
   a. The table drawn on the chalkboard has three columns.
   b. The first column has the following heading: Number of cells.
   c. The second column has the following heading: Voltmeter reading (V).
   d. The third column has the following heading: Brightness of light bulbs.
   e. Work in groups and complete Task 1.
5. Give learners some time to do Task 1.
6. Ask learners to share their answers to Task 1 with the class.
7. Discuss the answers with the learners.
8. *Model answer: Task 1*

Number of cells	**Voltmeter reading (V)**	**Brightness of light bulbs**
1	*1.5*	*same brightness*
2	*1.5*	*same brightness*
3	*1.5*	*same brightness*

9. Next, get the learners to do Task 2.
10. Explain Task 2 to the learners as follows:
    a. Work on your own.
    b. Answer the questions in Task 2.
11. Give learners some time to do Task 2.
12. Ask learners to share their answers to Task 2 with the class.
13. Discuss the answers with the learners.
14. *Model answer: Task 2*

    1. *The brightness of the light bulbs did not change.*
    2. *The voltage of each cell is the same (1.5 volts).*
    3. *1.5 volts*

15. When the learners have completed Task 2, hold a short class discussion to revise the following:
    a. When cells are connected in parallel, the total voltage is equal to the voltage of each individual cell.
    b. As we add more cells in the parallel circuit above, the brightness of the light bulbs does not change.
    c. Adding more cells in parallel does not increase the voltage of the circuit.

Checkpoint 2

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

a. What is the name of the device used to measure current in a circuit?
b. What happens to the brightness of a light bulb as more cells are added in parallel?

Answers to the checkpoint questions are as follows:

a. Voltmeter
b. The brightness of the light bulb will not change.

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Series and parallel circuits	162-166
Solutions for all	Series and parallel circuits	208-209
Spot On	Series and parallel circuits	121-122
Top Class	Series and parallel circuits	164-168
Via Afrika	Series and parallel circuits	141-142
Platinum	Series and parallel circuits	167
Oxford Successful	Series and parallel circuits	140-141
Pelican Natural Sciences	Series and parallel circuits	263-267
Sasol Inzalo Bk B	Series and parallel circuits	111-113

G ADDITIONAL ACTIVITIES/ READING

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

1. https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc [Phet simulation: Circuit Construction Kit]
2. https://www.youtube.com/watch?v=mvQe_Z-YpYA (6min 56sec) [Connecting Batteries in Parallel and Series]

5 C

Term 3, Week 5, Lesson C
Lesson Title: Connecting resistors in parallel
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Connecting resistors in parallel
CAPS Page Number	74

Lesson Objectives

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

- Explain that the voltage is the same across each resistor that is connected in parallel in a circuit
- Explain that the total current through the battery is equal to the sum of the currents through the resistors in parallel
- The total current in the circuit increases as more resistors are added in parallel.

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
Circuit board	Cell holders
Four 1.5 volt cells	6 volt battery
Three resistors with different resistances	
Conducting wire	
Voltmeter	
Ammeter	

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 voltage across cells as more cells are added in parallel?

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 voltage does not change and is the same for one cell as on its own.

D ACCESSING INFORMATION

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

CONNECTING RESISTORS IN PARALLEL

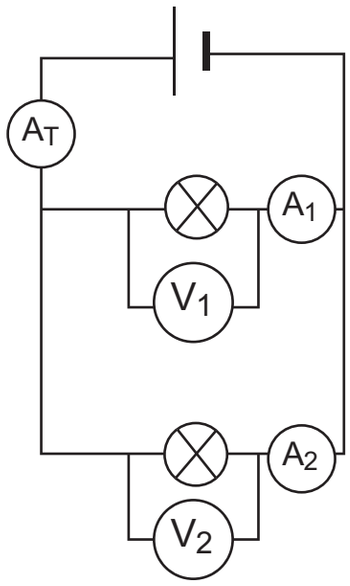
a. Resistors can be connected in parallel in a circuit.

b. The voltage is the same across each resistor connected in parallel.

$$V_1 = V_2$$

c. The total current through the battery is equal to the sum of the currents through the resistors.

$$I_T = I_1 + I_2$$



d. The total current in the circuit increases with each resistor that is added in parallel.

2. Explain the following to the learners:
   a. Resistors can be connected in series in a circuit.
   b. The voltage is the same across each resistor connected in parallel. We can represent this using the equation:

$$V_1 = V_2$$

   c. The total current through the battery is equal to the sum of the currents through the resistors. We can represent this using the equation:

$$I_T = I_1 + I_2$$

   d. The total current in the circuit increases with each resistor that is added in parallel.

Checkpoint 1

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

a. What do we know about the total current through the battery in a circuit that has resistors connected in parallel?
b. What do we know about the total voltage across the battery of a circuit with resistors connected in parallel?

Answers to the checkpoint questions are as follows:

a. The total current through the battery is equal to the sum of the currents through the resistors.
b. The voltage is the same across each resistor connected in parallel and across the battery.

E CONCEPTUAL DEVELOPMENT

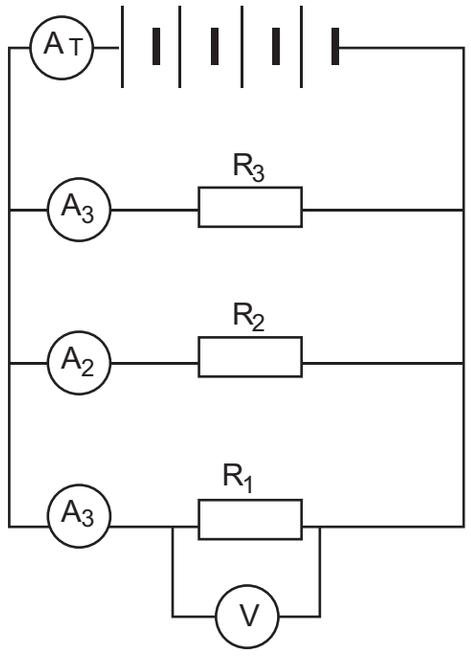
1. Advance preparation: ensure that you have all the resources for the investigation.
2. If you have enough resources, you can get the learners to do the investigation in groups.
3. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

Resistor number	Resistance (Ω)	Voltage across resistor (V)	Ammeter reading after each resistor (A)	Voltage across battery (V)	Ammeter reading at battery (A)
R1					
R2					
R3					
Total					

TASK 1

1. Copy the table into your workbooks.
2. Set up a series circuit with three resistors in series and four 1.5 volt cells or a 6 volt battery.



3. Fill in the second column in the table by reading off the resistance of each resistor. This should be written on the resistor.
4. Use a voltmeter and measure the voltage across each resistor. Make sure you connect the voltmeter in parallel across each resistor. The diagram shows how to connect the voltmeter for resistor 1 (R1). Record the voltmeter readings in the third column.

5. Measure the voltage across the battery and record the reading in the last column.
6. Connect an ammeter in series at each resistor and record the current strength at each position. The diagram shows how to connect the ammeter after resistor 1 (R1). Record the ammeter readings in the fourth column.
7. Connect the ammeter at the battery and record the current strength at ammeter AT.
8. Add up the current readings at each resistor and record the summation in the table.

TASK 2

1. Compare the added ammeter readings at each resistor to the total ammeter reading measured at the battery.
   a. What do you notice?
   b. What conclusion can you make about the total current flowing through the battery and the sum of the currents at each resistor connected in parallel?
2. What did you notice about the voltage at any point in the circuit?
3. Which resistor had the highest current flowing through it?
4. Which resistor had the lowest current flowing through it?
5. What is the relationship between the resistance of a resistor and the current flowing through the resistor when the resistors are connected in parallel?

4. Explain Task 1 to the learners as follows:
   a. The table drawn on the chalkboard has six columns.
   b. The first column has the following heading: Resistor number.
   c. The second column has the following heading: Resistance (Ω).
   d. The third column has the following heading: Voltage across resistor (V).
   e. The fourth column has the following heading: Ammeter reading after each resistor (A).
   f. The fifth column has the following heading: Voltage across battery (V).
   g. The sixth column has the following heading: Ammeter reading at battery (A).
   h. Work in groups and complete Task 1.
5. Give learners some time to do Task 1.
6. Ask learners to share their answers to Task 1 with the class.
7. Discuss the answers with the learners.
8. *Model answer: Task 1*

Values will vary according to the resistors and battery that are available. For this model answer, resistors with a resistance of 0.25 Ω, 0.75 Ω and 2 Ω are used. The voltage across the battery is 6 volts.

Resistor number	**Resistance (Ω)**	**Voltage across resistor (V)**	**Ammeter reading after each resistor (A)**	**Voltage across battery (V)**	**Ammeter reading at battery (A)**
R1	*0.25*	*6*	*24*	*6*	*35*
R2	*0.75*	*6*	*8*		
R3	*2*	*6*	*3*		
Total			*35*		

It is important that the sum of the ammeter readings at the resistors is equal to the ammeter reading at the battery, and the readings on the voltmeters across the resistors and across the battery are the same.

9. Next, get the learners to do Task 2.
10. Explain Task 2 to the learners as follows:
    a. Work on your own.
    b. Answer the questions in Task 2.
11. Give learners some time to do Task 2.
12. Ask learners to share their answers to Task 2 with the class.
13. Discuss the answers with the learners.
14. *Model answer: Task 2*

1.
   a. *The ammeter readings are the same, therefore the current is the same.*
   b. *The total current through the battery is equal to the sum of the currents through the resistors.*
2. *The voltage is the same at any point in a parallel circuit.*
3. *Resistor 1 (R_1)*
4. *Resistor 3 (R_3)*
5. *A resistor that has a high resistance will have a lower current flowing through it. A resistor that has a lower resistance will have a higher current flowing through it. (Answers for questions 3 and 4 will vary according to the resistors used.)*

15. When the learners have completed Task 2, hold a short class discussion to revise th following:
    a. The voltage is the same across each resistor connected in parallel.
    b. The total current through the battery is equal to the sum of the currents through the resistors.
    c. The total current in the circuit increases with each resistor that is added in parallel.

Checkpoint 2

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

a. What happens to the current through the battery when more resistors are added in parallel to a circuit?
b. What do you think will happen to the brightness of a light bulb if another light bulb is added in parallel?

Answers to the checkpoint questions are as follows:

a. The current strength increases.
b. The brightness will not change.

16. 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:

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Platinum	Series and parallel circuits	167
Oxford Successful	Series and parallel circuits	140-141
Pelican Natural Sciences	Series and parallel circuits	263-267
Sasol Inzalo Bk B	Series and parallel circuits	111-113

G ADDITIONAL ACTIVITIES/ READING

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

1. https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc [Phet simulation: Circuit Construction Kit]
2. https://www.youtube.com/watch?v=O8GgRIIB1Yc (5min 46sec) [Series vs parallel circuits]
3. https://www.youtube.com/watch?v=Az7VRuTA8dQ (4min 23sec) [GCSE Physics Revision Current in Parallel Circuits]
4. https://www.youtube.com/watch?v=x2EuYqj_0Uk (8min 04sec) [Series and parallel circuits]

6 A

Term 3, Week 6, Lesson A
Lesson Title: Series and parallel circuits in the home
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Series and parallel circuits in the home
CAPS Page Number	74

Lesson Objectives

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

- Explain that the lighting system in homes is usually connected in parallel
- Explain why the lighting system in homes is usually connected in parallel
- Explain that resistors are designed to have accurate resistance to control the current strength.

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
N/A	

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 more cells are added in parallel?

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 brightness of the light bulbs stays the same.

D ACCESSING INFORMATION

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

SERIES AND PARALLEL CIRCUITS IN THE HOME

1. Resistors can control the voltage and current in parallel and series circuits.
2. Resistors are designed to have accurate resistances in order to control the current through the **electrical system**.
3. For example, for two circuits that have the same total voltage, the circuit with the lower resistance will have a higher current and the circuit with the higher resistance will have the lower current.
4. Electric circuits are used for the wiring in our homes, cars and even in toys.
5. The lighting system in our homes is usually connected in parallel.
6. If one light bulb **fuses** (the filament breaks), the rest of the lights will stay on, because they are each connected to the mains circuit by their own parallel path.

2. Explain the following to the learners:
   a. Resistors are designed to have accurate resistances in order to control the current through the electrical system.
   b. For two circuits that have the same total voltage, the circuit with the lower resistance will have a higher current, and the circuit with the higher resistance will have the lower current.
   c. Electric circuits are used for the wiring in our homes, cars and even in toys.
   d. The lighting system in our homes is usually connected in parallel.

e. If one light bulb fuses (the filament breaks), the rest of the lights will stay on because they are each connected to the mains circuit by their own parallel path.

f. Many Christmas lights are connected in series. This can cause a problem, because if one light bulb fuses or breaks, all the lights will stop working.

Checkpoint 1

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

a. Why is a parallel circuit used in the lighting system in our houses?

b. What are resistors designed to control?

Answers to the checkpoint questions are as follows:

a. If one light bulb fuses (the filament breaks), the rest of the lights will stay on, because they are each connected to the mains circuit by their own parallel path.

b. The current and voltage through an electrical system

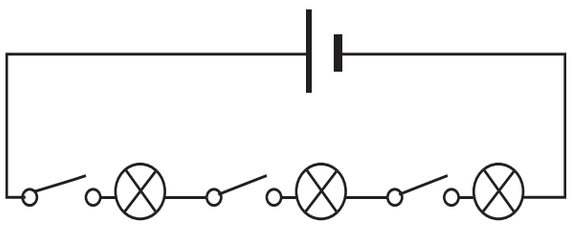
E CONCEPTUAL DEVELOPMENT

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

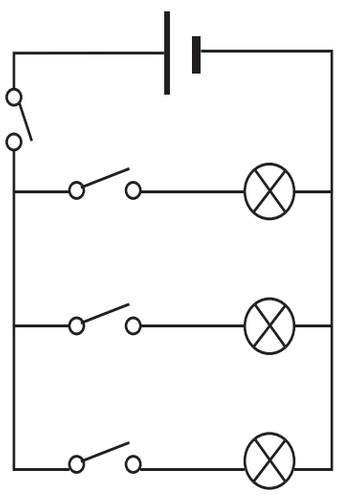
ACTIVITY

Tebogo is buliding her house and decided to draw a plan (diagram 1) of how she is going to wire the lights in her house. Her friend, Nombulelo told Tebogo that it is not a good idea to wire her lights in that way. Nombulelo told Tebogo to redraw her plan (diagram 2).

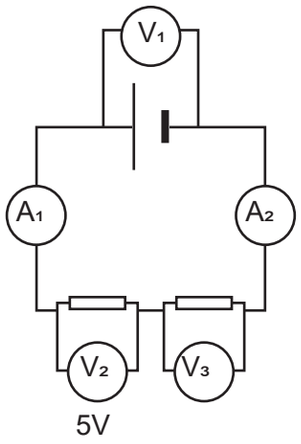
Circuit Diagram 1



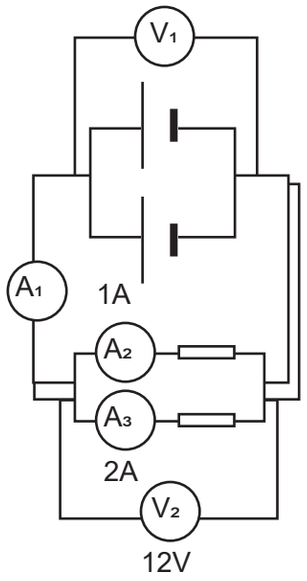
Circuit Diagram 2



Circuit Diagram 3



Circuit Diagram 4



TASK 1

1. Look at circuit diagrams 1 and 2 and copy them into your workbooks.
2. Do you agree with Nombulelo telling Tebogo to change her plans? Explain.

TASK 2

1. Look at circuit diagram 3 and copy it into your workbooks.
   a. What is the voltage reading on voltmeter V_3?
   b. What is the ammeter reading on ammeter A_2?
2. Look at circuit diagram 4 and copy it into your workbooks.
   a. What is the voltage reading on voltmeter V_1?
   b. What is the ammeter reading on ammeter A_1?

2. Explain Task 1 to the learners as follows:
   a. Work with the person sitting next to you.
3. Give learners some time to complete Task 1 in their workbooks.
4. Ask learners to share their answers to Task 1 with the class.
5. Write the answers on the chalkboard.
6. *Model answer: Task 1*

2. Yes.

Tebogo's light wiring plans have the lights connected in series. If one light fuses, then all the lights in Tebogo's house will stop working. It is a better idea to wire the lights the way Nombulelo has suggested, where the lights are connected in parallel. This means that if one light fuses, the others will still work.

7. Next, get the learners to do Task 2.
8. Explain Task 2 to the learners as follows:
    a. Work on your own.
    b. Answer the questions in Task 2.
9. Give learners some time to do Task 2.
10. Ask learners to share their answers to Task 2 with the class.
11. Discuss the answers with the learners.
12. *Model answer: Task 2*

2.

a. 7V

b. 2A

3.

a. 12V

b. 3A

13. When the learners have completed Task 2, hold a short class discussion to revise the following:
    a. Resistors can control the voltage and current in parallel and series circuits.
    b. For two circuits that have the same total voltage, the circuit with the lower resistance will have a higher current and the circuit with the higher resistance will have the lower current.
    c. The lighting system in our homes is usually connected in parallel.

Checkpoint 2

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

a. If two circuits each have a voltage of 4 volts, but the one circuit has a resistance of 3 Ω and the other has a resistance of 6 Ω, which circuit will have the lower current?
b. Which circuit is suitable for electric wiring in a house?

Answers to the checkpoint questions are as follows:

a. The circuit with the 6 Ω resistor (higher resistance) will have the lower current.
b. Parallel circuit

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Series and parallel circuits	162-166
Solutions for all	Series and parallel circuits	112-16
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Platinum	Series and parallel circuits	171-173
Oxford Successful	Series and parallel circuits	144-147
Pelican Natural Sciences	Series and parallel circuits	267-273
Sasol Inzalo Bk B	Series and parallel circuits	122

G ADDITIONAL ACTIVITIES/ READING

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

1. https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc [Phet simulation: Circuit Construction Kit]
2. https://www.youtube.com/watch?v=O8GgRIIB1Yc (5min 46sec) [Series vs parallel circuits]
3. https://www.youtube.com/watch?v=Az7VRuTA8dQ (4min 23sec) [GCSE Physics Revision Current in Parallel circuits]
4. https://www.youtube.com/watch?v=x2EuYqj_0Uk (8min 04sec) [Series and parallel circuits]

TOPIC OVERVIEW:
Safety with electricity
Term 3, Weeks 6B - 6C

A. TOPIC OVERVIEW

TERM 3, WEEKS 6B - 6C

- This topic runs for half a week.
- It is presented over 2 x 1 hour lessons.
- This topic's position in the term is as follows:

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

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

B. SEQUENTIAL TABLE

GRADE 8	GRADE 9	GRADE 10-12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Effects of an electric circuit: fuses	• Safety practices	

C. SCIENTIFIC VOCABULARY

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

	TERM	EXPLANATION
1.	overload	To put too much load on or in something
2.	circuit breaker	A safety device that stops electricity from flowing when the current is too high
3.	fuse	A device that has a metal wire that will melt if too much current flows through it
4.	earth leakage	A system that allows extra current produced to travel safely to the earth
5.	circuit boards	A unit that houses the circuit breakers, fuse and earth leakage
6.	electromagnet	An electromagnet is formed when an electric current travels through a coil around a bar magnet

7.	insulated	Separated from conducting bodies by material that prevents electricity from passing pass through it
8.	casing	A material that forms a protective barrier around something
9.	illegal connections	Connecting to the national power supply without authorisation; it is a criminal offence.

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

It is important for us to understand the dangers of electricity. We use electricity in our homes to provide light and power our electronic devices and appliances. However, we seldom think about the dangers of electricity if it is not used correctly. Circuits can undergo power surges where the current through the circuit is too high, or can become overloaded when too many appliances are plugged into one power point. This can cause wires to heat up and start fires or damage your appliances. Simple devices like 3-pin plugs are specially designed with earth wires to prevent us from getting shocked, if the live wires in the appliances become loose. It is important for us to know how to wire a 3-pin plug correctly to make sure that the earth wire is protecting us. Our homes also have safety devices such as circuit breakers, fuses and earth leakage systems that stop dangerously high current from flowing through the electric circuit of the house.

E. PERSONAL REFLECTION

Reflect on your teaching at the end of each topic:

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

6 B

Term 3, Week 6, Lesson B
Lesson Title: Circuit breakers, fuses and earth leakage systems
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Safety practices
CAPS Page Number	75

Lesson Objectives

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

- Explain that parallel circuits can cause overload on main circuits
- Explain circuit breakers, fuses and earth leakage systems as safety devices.

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 23: Circuit board with circuit breakers	
Resource 24: Circuit breaker diagram	
Resource 25: Fuse	

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 are lighting systems in our homes connected in parallel?

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.

If one light bulb fuses, the rest of the lights remain on because they are each connected to their own parallel pathways.

D ACCESSING INFORMATION

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

SAFETY PRACTICES WITH ELECTRICITY

1. Circuits that have parallel connections can cause overloads on main circuits.
2. The current increases every time another pathway is added.
3. A circuit is overloaded when more current flows through the circuit than the circuit can handle, for example, when too many devices are plugged into one power point.
4. This is dangerous because the wires can become very hot and start fires. The wires can also melt and break the circuit.
5. **Circuit breakers**, **fuses** and earth leakages can be used as safety devices.

CIRCUIT BREAKERS

1. A circuit breaker is a safety device that stops electricity from flowing when the current is too high. Circuit breakers are used in **circuit boards**.
2. A circuit breaker has an **electromagnet** that breaks the circuit when the current is too high. There are different circuit breakers for the different circuits in the house.

FUSES

1. A fuse is a device that is connected in series to the main supply.
2. If the current becomes too high, the (filament) wire in the fuse melts and breaks the circuit, disconnecting the main supply to the house. Each fuse shows the maximum current it can carry before it breaks.
3. Once a fuse has melted, it has to be replaced.

EARTH LEAKAGE SYSTEMS

1. An earth leakage system allows extra current produced to travel safely to the earth. People who are working on a system, or animals that may have accidentally come into contact with a high voltage line, are protected from being shocked.

2. Make sure that Resource 23: 'Circuit board with circuit breakers', Resource 24: 'Circuit breaker diagram' and Resource 25: 'A fuse', are on display in the classroom.
3. Explain the following to the learners:
   a. Circuits that have parallel connections can cause overloads on main circuits.
   b. The current increases every time another pathway is added.
   c. A circuit is overloaded when more current flows through it than the circuit can handle, for example, when too many devices are plugged into one power point.
   d. This is dangerous because the wires can become very hot and start fires. The wires can also melt and break the circuit.
4. Show learners Resource 23: 'Circuit board with circuit breakers'.
5. Explain the following to the learners:
   a. Circuit breakers, fuses and earth leakages can be used as safety devices.
   b. A circuit breaker is a safety device that stops electricity from flowing when the current is too high. Circuit breakers are used in circuit boards.
6. Show learners Resource 24: 'Circuit breaker diagram'.
7. Explain the following to the learners:
   a. A circuit breaker has an electromagnet that breaks the circuit when the current is too high. Remember, an electromagnet is formed when an electric current travels through a coil around a bar magnet.
   b. As the current through the coil increases, the strength of the electromagnet also increases. When the current is too high, the electromagnet is strong enough to attract the iron catch which is a long **iron rod**. The iron catch holds the contact point in place so that current flows. Once the iron catch moves towards the electromagnet, the contact between the two points is broken and electricity can no longer flow.
   c. There are different circuit breakers for the different circuits in the house. There is a circuit breaker for the lights, and circuit breakers for the plugs in different rooms, the geysers and other connections. There is also a main circuit breaker that is connected in series to all other circuit breakers. If the current is too high from the main supply, the main circuit breaker will trip and no current will flow through any part of the house. The main circuit breaker should always be disconnected before any electrical work is done on the house.

8. Show learners Resource 25: 'A fuse'.
9. Explain the following to the learners:
    a. A fuse is a device that is connected in series to the main supply.
    b. If the current becomes too high, the wire in the fuse melts and breaks the circuit, disconnecting the main supply to the house.
    c. An earth leakage system allows extra current produced to travel safely to the earth, protecting people who are working on a system or animals that may have accidentally come into contact with a high voltage line. Lightning strikes increase the current suddenly. Earth leakages allow the extra current to flow safely to the ground.

Checkpoint 1

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

a. What is the function of a circuit breaker?
b. What is the function of an earth leakage system?

Answers to the checkpoint questions are as follows:

a. A circuit breaker, breaks an electric circuit when the current flowing through the circuit is dangerously high.
b. An earth leakage system allows excess current to flow safely to the earth, preventing shock or damage to appliances as a result of high current flowing through the circuit.

E CONCEPTUAL DEVELOPMENT

1. Make sure that Resource 23: 'Circuit board with circuit breakers', Resource 24: 'Circuit breaker diagram' and Resource 25: 'A fuse', are on display in the classroom.
2. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

1. Use the diagram of a circuit breaker to explain how a circuit breaker works.
2. Jerry is going to change the fitting on a wall plug. What is the first thing he must do before starting to change the fitting?
3. Look at the picture of a fuse. Sketch a diagram of a fuse and explain how it works. Label the thin wire in the diagram.
4. What is the purpose of an earth leakage system?
5. At home, ask an adult to help you identify the circuit breakers, fuses and earth leakage systems in your home.

TASK 1

Answer questions 1 and 2 in your workbooks.

TASK 2

Answer questions 3-5 in your workbooks.

2. Explain Task 1 to the learners as follows:
   a. Work on your own and complete Task 1.
3. Give learners some time to do Task 1.
4. Ask learners to share their answers to Task 1 with the class.
5. *Model answer: Task 1*

> 1. *A circuit breaker has an electromagnet that breaks the circuit when the current is too high. An electromagnet is formed when an electric current travels through a coil around a bar magnet. As the current through the coil increases, the strength of the electromagnet also increases. When the current is too high, the electromagnet is strong enough to attract the iron catch (refer to Resource 24). The iron catch holds the contact point in place so that current flows. Once the iron catch moves towards the electromagnet, the contact between the two points is broken and electricity can no longer flow.*
> 2. *Jerry must switch off the main circuit breaker, or he must switch off the circuit breaker for the room in which he will be working. This will stop electricity from flowing, and he will not be shocked.*

6. Next, get the learners to do Task 2.
7. Explain Task 2 to the learners as follows:
   a. Work on your own.
   b. Answer the questions in Task 2.
8. Give learners some time to do Task 2.
9. Ask learners to share their answers to Task 2 with the class.
10. Discuss the answers with the learners.
11. *Model answer: Task 2*

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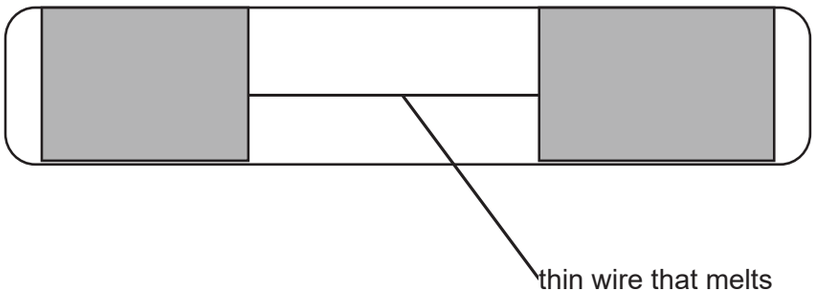
> 
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> 4. *An earth leakage system allows extra current produced to travel safely to the earth, preventing people who are working on a system from being shocked, or animals that may have accidentally come into contact with a high voltage line. The filament melts and breaks the circuit.*

Checkpoint 2

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

a. Why are fuses and circuit breakers important?
b. How do we know that the current was too high when we examine a fuse?

Answers to the checkpoint questions are as follows:

a. Fuses and circuit breakers stop the flow of current when it is dangerously high, and prevent the possibility of fires or damage to electrical appliances and devices.
b. The thin wire in the fuse will be broken because it melted as a result of the high current.

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Safety with Electricity	167
Solutions for all	Safety with Electricity	218-221
Spot On	Safety with Electricity	124
Top Class	Safety with Electricity	172-174
Via Afrika	Safety with Electricity	144
Platinum	Safety with Electricity and the national electricity grid	175-177
Oxford Successful	Safety with Electricity	148-153
Pelican Natural Sciences	Safety with Electricity	274-277
Sasol Inzalo Bk B	Safety with Electricity	132-141

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=RXBQ6OP4PPA (3min 3sec) [Circuit breakers video]
2. https://www.youtube.com/watch?v=R7TcGgoK5P8 (3min 17sec) [Fuse vs circuit breaker - Difference between fuses and circuit breakers]

6 C

Term 3, Week 6, Lesson C
Lesson Title: Three-pin plugs
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Safety practices
CAPS Page Number	75

Lesson Objectives

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

- Connect a 3-pin plug
- Identify the live, neutral and earth wires in a 3-pin plug
- Explain the purpose of the earth wire
- Draw a plan for wiring lights and light switches in a house.

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 26: 3-pin plug wiring	
Resource 27: Illegal electricity connection	
3-pin plug/s	
Screw driver	
Craft knife	Knife or pair of scissors

C CLASSROOM MANAGEMENT

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

Why is it important to have circuit breakers in our homes?

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.

Circuit breakers stop current from flowing when the current is dangerously high, preventing the possibility of fires and damage to appliances.

D ACCESSING INFORMATION

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

3-PIN PLUGS

1. Many devices use a 3-pin plug as a safety device to connect to the main electricity supply.
2. 3-pin plugs have a live wire (brown), neutral wire (blue) and an earth wire (green and yellow).
3. Some 3-pin plugs also have fuses.
4. All the wires are **insulated** with a plastic covering, preventing the current from flowing to other objects that touch the wires.
5. The live and neutral wires carry the current around the circuit.
6. The earth wire is connected to the outer metal **casing** of the appliance. For example, the casing of a kettle.
7. The other end of the earth wire is connected to the earth cable in the ground by the wall plug.

8. If the live wire becomes loose and touches the outer casing of the appliance, the appliance becomes live and we can get shocked when we touch the appliance. The earth wire has almost zero resistance. It prevents current from flowing through us when we touch the live appliance by safely discharging the current to the ground.
9. **Illegal connections** to the ESKOM mains supply are dangerous and are considered as energy theft.

2. Make sure that Resource 26: '3-pin plug wiring' and Resource 27: 'Illegal electricity connection' are on display in the classroom.
3. Show learners Resource 26: '3-pin plug wiring'.
4. Explain the following to the learners:
    a. Many devices use a 3-pin plugs as a safety device to connect to the main electricity supply.
    b. 3-pin plugs have a live wire (brown), neutral wire (blue) and an earth wire (green and yellow). The 3-pin plug must be wired as shown with the correct wires in the correct places. Some 3-pin plugs also have fuses which can protect appliances from being damaged when the current is too high.
    c. All the wires are insulated with a plastic covering, preventing the current from flowing to other objects that touch the wires. The plastic covering acts as an insulator.
    d. The live and neutral wires carry the current around the circuit.
    e. The earth wire is connected to the outer metal casing of the appliance, for example, the casing of a kettle.
    f. The other end of the earth wire is connected to the earth cable in the ground by the wall plug.
    g. If the live wire becomes loose and touches the outer casing of the appliance, the appliance becomes live and we can get shocked when we touch the appliance. The earth wire has almost zero resistance. It prevents current from flowing through us when we touch the live appliance by safely discharging the current to the ground.
5. Show learners Resource 27: 'Illegal electricity connection'.
6. Explain the following to the learners:
    a. Illegal connections to the ESKOM mains supply is dangerous and is considered as energy theft.

Checkpoint 1

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

a. What are the three wires in a 3-pin plug?
b. What is the purpose of the earth wire?

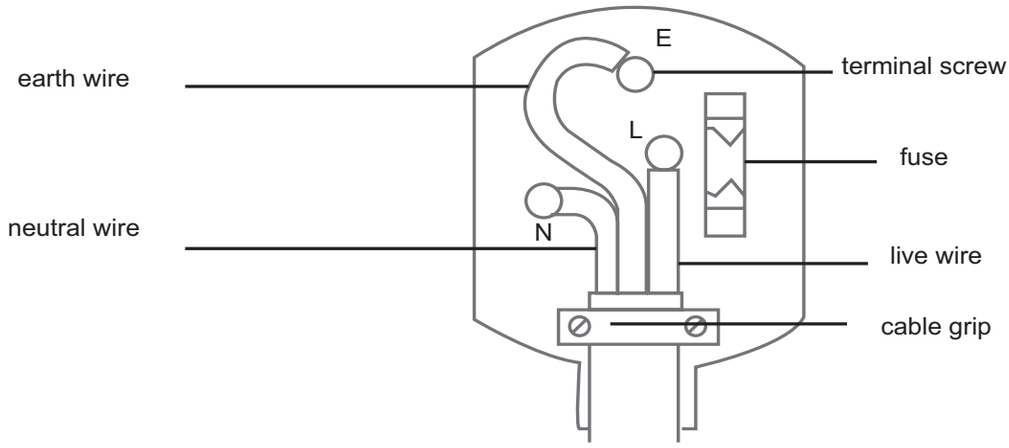
Answers to the checkpoint questions are as follows:

a. Live, neutral and earth wire.
b. The earth wire is there to prevent current from flowing through us when we touch an appliance. When the live wire has become loose and has touched the outer casing of the appliance, the earth wire safely discharges the current to the ground.

E CONCEPTUAL DEVELOPMENT

1. Advance preparation: demonstrate how to wire a 3-pin plug to the learners. Ensure that you have all the resources for the demonstration.
2. If you have enough resources, you can get the learners to do the demonstration in groups.
3. Write and draw the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY



1. Use a flat screwdriver to loosen the plug screw and remove the cover.
2. Remove the fuse and use the screw driver to loosen the screws for each terminal.
3. Remove some of the cable plastic casing to expose the three inner wires.
4. Twist the exposed copper strands at the end of each wire.
5. Place the cable under the cable grip and secure it.
6. Fit each wire into the correct terminal hole and tighten each terminal screw.
7. Check that the correct wires are connected to the correct terminals and then place the fuse back in its position.
8. Screw the cover back onto the plug.

TASK 1

1. Copy the diagram and instructions of how to wire a 3-pin plug into your workbooks.
2. Observe your teacher or practise how to wire a 3-pin plug.

TASK 2

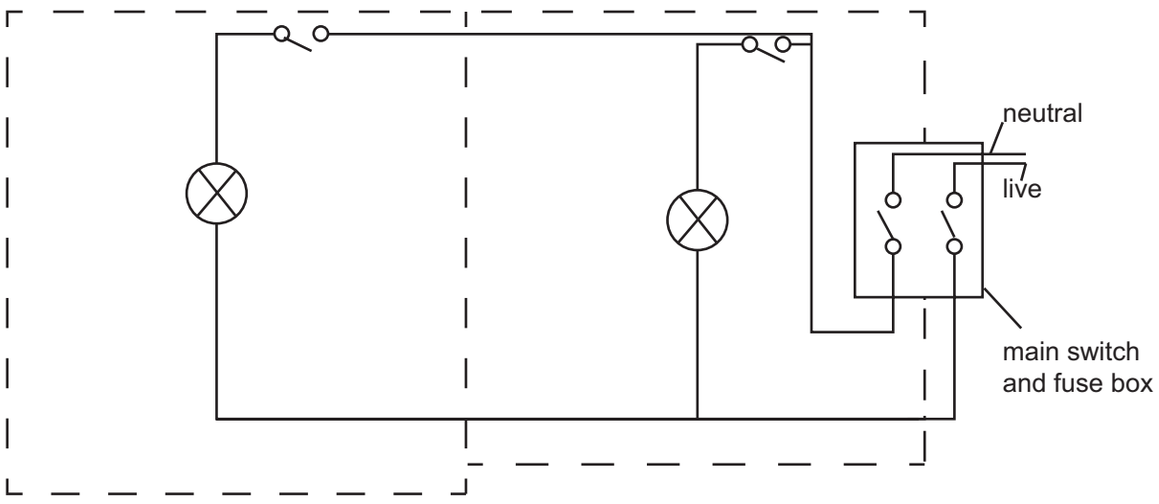
1. Draw the wiring system in a room of a house. Show how you would wire the lights with their switches.
2. The house must also have a main switch and a fuse.

1. Explain Task 1 to the learners as follows:
   a. Remind learners that they must make sure that the correct colour wire is connected to the correct terminal screw.
2. Give learners some time to complete Task 1 in groups or on their own, if enough resources are available.
3. Check that each group has wired the 3-pin plug correctly
4. *Model answer: Task 1*

Make sure the 3-pin plug is wired correctly with each wire colour connected to the correct terminal screw.

5. Next, get the learners to do Task 2:
   a. Remind learners that the lights in a house are connected in parallel and that there is a live and neutral part of the circuit.
6. Draw the answers on the chalkboard.
7. *Model answer: Task 2*

The diagrams of learners may vary. Make sure that the light bulbs are connected in parallel and that there is a live and neutral part of the circuit.



Checkpoint 2

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

a. What colour is the live wire in a 3-pin plug?
b. Why are the wires on a 3-pin plug covered in a plastic casing?

Answers to the checkpoint questions are as follows:

a. Brown
b. The plastic casing acts as insulation and prevents the current from flowing through other objects that may touch the live wires.

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Safety with Electricity	168-170
Solutions for all	Safety with Electricity	222-225
Spot On	Safety with Electricity	125-128
Top Class	Safety with Electricity	175-179
Via Afrika	Safety with Electricity	145-147
Platinum	Safety with Electricity and the national electricity grid	178-179
Oxford Successful	Safety with Electricity	148-153
Pelican Natural Sciences	Safety with Electricity	277-284
Sasol Inzalo Bk B	Safety with Electricity	141-153

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=Pr9YntO7V1U (4min 26sec) [Kids safety]
2. https://www.youtube.com/watch?v=a52UVl3FoSA (1min 59sec) [Indoor Electric Safety]
3. https://www.youtube.com/watch?v=1NlUb5FRnx4 (1min 11sec) [How to wire a plug]
4. https://www.youtube.com/watch?v=ZPLRwEMASbA (2min 24sec) [Illegal connections]

TOPIC OVERVIEW:

Energy and the national electricity grid

Term 3, Weeks 7A - 7C

A. TOPIC OVERVIEW

TERM 3, WEEKS 7A - 7C

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

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

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

B. SEQUENTIAL TABLE

GRADE 8	GRADE 9	GRADE 10-12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Energy transfer in electrical systems	• Energy generation • Alternative energy sources • Nuclear power in South Africa • The National Electricity Grid • Power surges and grid overload	Grade 10 • Electric circuits Grade 11 • Electric circuits

C. SCIENTIFIC VOCABULARY

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

	TERM	EXPLANATION
1.	power station	A system of parts that work together to generate electricity and transfer it from the power station to homes and other facilities
2.	generate(s)	Produce(s) or create(s)
3.	coal	A fossil fuel that is non-renewable and used in the generation of electricity
4.	turbine(s)	Device(s) with blades that are turned by the force of moving air or wind
5.	generator	A device that transfers kinetic energy to electrical energy
6.	nuclear fission	A process where the nucleus of an atom is split and results in the release of large amounts of energy
7.	renewable	can be re-used
8.	non-renewable	Cannot be re-used
9.	sustainable	Using resources to meet current needs without compromising the ability of future generations to meet their own needs
10.	environmental impact	Effects on our natural surroundings (usually refers to the negative effects)
11.	carbon dioxide	A colourless gas that is produced when we breathe out and when coal is burned
12.	global warming	The increase in temperature of the atmosphere of the Earth because of the presence of certain gases like carbon dioxide
14.	nuclear power station	A power station that uses nuclear fuel (uranium) to generate electricity by using the energy released when the nucleus of atoms is split (nuclear fission)
15.	radioactive	Giving off harmful energy rays by breaking down the atom of an element
16.	uranium	An element used as nuclear fuel in the generation of electricity at nuclear power stations
17.	nuclear fuel	Fuel that can be used to generate electricity in a nuclear power station, for example: uranium
18.	nuclear waste	Nuclear fuel that has been used and is still radioactive
19.	national grid	A network of interacting parts that generate and transfer electrical energy from the power station to homes and other facilities
20.	power lines	Long cables that carry electrical energy from power stations to homes and other buildings
21.	transformers	Devices that change the voltage of electricity
22.	power surge	A voltage that is 110% above the normal voltage in the power line because of a break-down in a part of the grid

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

It is important for us to understand where the electricity (energy) in our homes comes from. This is important because South Africa has a limited supply of electricity. Most of our electricity is produced in coal power stations. Coal is a fossil fuel and is a non-renewable source of energy. This means that we will eventually run out of coal. The use of coal for the generation of electricity is not sustainable and it has a negative environmental impact since it releases carbon dioxide when it is burned, contributing to global warming. We must look into alternative sources of energy that are sustainable and have less negative environ-mental impacts. Nuclear power is one alternative energy source that can produce large amounts of energy and could one day replace coal power stations. However, nuclear waste must be disposed of carefully. These energy resources feed electrical energy to the National Electricity Grid which transfers electrical energy to our homes. It is important for us to understand and prevent power surges and overloads, because they can disrupt power supplies.

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: Electricity generation
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Power stations in South Africa and alternative energy resources
CAPS Page Number	75

Lesson Objectives

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

- Explain that a power station is a system for generating electricity
- Explain how coal generates electricity
- List other alternative sources of energy that can be used to drive turbines and generators
- Compare alternative resources in terms of sustainability and environmental impact.

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

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

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 28: The national grid	
Resource 29: Alternative energy sources diagram	
Resource 30: Alternative energy sources	

C CLASSROOM MANAGEMENT

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

Which fossil fuel is the most used in South Africa for the generation of electricity?

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.

Coal

D ACCESSING INFORMATION

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

ELECTRICITY GENERATION

1. A **power station** is a system that **generates** electricity.
2. Most power stations in South Africa use coal as a fuel in the generation of electricity.
3. Coal is burned in order to boil water.
4. The steam from the boiling water rises and turns **turbines**.
5. The turbines turn a **generator** which produces electricity.

ALTERNATIVE RESOURCES OF ENERGY

1. Alternative energy sources besides coal can be used to drive turbines and generators to generate electricity for the national grid.
2. Examples of such alternative resources include: wind, falling water (hydroelectric), sun-heated steam, **nuclear fission**, and waves in the sea.
3. These alternative resources are **renewable** and can be re-used or replaced.
4. Coal is a **non-renewable** energy source and cannot be replaced once it is used up.
5. This means that coal is not a **sustainable** energy source.
6. Coal also has a negative **environmental impact**. Burning coal produces **carbon dioxide** that contributes to **global warming**.

2. Explain the following to the learners:
    a. Energy cannot be created or destroyed, but it can be transferred from one form to another. Power stations use energy from coal, oil, natural gas, nuclear resources, and other renewable resources, and transfer the energy into electrical energy. A power station is made up of many parts that work together in a system to transfer the energy from one form to another.
    b. A power station is a system that generates electricity. Eskom is the leading supplier of electricity in South Africa.
    c. Most power stations in South Africa use coal as a fuel in the generation of electricity.
3. Show learners Resource 28: 'The national grid'.
4. Explain the following to the learners:
    a. Coal is burned in order to boil water.
    b. The steam from the boiling water rises and turns turbines.
    c. The turbines turn a generator which produces electricity.
5. Show learners Resource 29: 'Alternative energy sources diagram'.
6. Explain the following to the learners:
    a. Alternative energy sources besides coal can be used to drive turbines and generators to generate electricity for the **national grid**.
7. Point to the corresponding alternative energy in Resource 29.
8. Explain the following to the learners:
    a. Examples of such alternative resources include: wind, falling water (hydroelectric), sun-heated steam, nuclear fission and waves in the sea.
    b. Wind turns turbines that turn generators which produce electricity.
    c. Falling water, which is usually found in dams, also turns turbines that turn generators which produce electricity.
    d. Sun-heated steam uses the Sun's energy to generate electricity.
    e. Nuclear fission involves the splitting of the nucleus of an atom which releases large amounts of energy that is used to turn generators and produce electricity in nuclear power stations.
    f. In coastal areas, the waves of the ocean can be used to generate electricity.
    g. These alternative resources, except for nuclear energy, are renewable and can be re-used or replaced.
    h. Coal is a non-renewable energy source and cannot be replaced once it is used up.
    i. This means that coal is not a sustainable energy source.
    j. Coal also has a negative environmental impact. Burning coal produces carbon dioxide that contributes to global warming.

Checkpoint 1

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

a. How does a coal power station generate electricity?
b. What are some examples of alternative energy sources?

Answers to the checkpoint questions are as follows:

a. Coal is burned in order to boil water. The steam from the boiling water rises and turns turbines. The turbines turn a generator which produces electricity.
b. Wind, falling water (hydroelectric), sun-heated steam, nuclear fission and waves in the sea

E CONCEPTUAL DEVELOPMENT

1. Divide the class into manageable groups. Give each group a copy of Resource 30: 'Alternative energy sources' from the resource pack.
2. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

Source of energy	Advantages	Disadvantages
Wind		
Hydroelectric		
Sun-heated steam		
Nuclear fission		
Waves		

TASK 1

1. Read the information on alternative resources handed out to you by your teacher.
2. Fill in the columns, listing the advantages and disadvantages of using that source of energy.

TASK 2

1. South Africa has a limited amount of coal that can be used to generate electricity. Which energy source do you think should replace coal power stations once coal is depleted? Support your answer using the information from the resource.

3. Explain Task 1 to the learners as follows:
   a. In your groups, read the information about each energy source.
   b. Use the information to list advantages and disadvantages of the energy sources.
4. Give learners some time to complete Task 1 in their workbooks.
5. Ask learners to share their answers to Task 1 with the class.
6. The completed table is shown below. Fill in the advantages and disadvantages of the energy sources on the table on the chalkboard.

7. Model answer: Task 1

ACTIVITY

Source of energy	Advantages	Disadvantages
Wind	• Renewable and sustainable • More environmentally friendly than fossil fuels • No waste	• Not efficient when there is no wind • Does not produce large amounts of electricity • Noise pollution • Kills birds • Visually not pleasing
Hydroelectric	• Renewable and sustainable • More environmentally friendly than fossil fuels • Produces large amounts of electricity	• Largest environmental impact of the alternative energy sources • Dams destroy habitats • Dams displace animals and people • No waste
Sun-heated steam	• Renewable and sustainable • No waste	• Does not produce large amounts of electricity • Not efficient on cloudy days • Destruction of habitat since large areas are needed
Nuclear fission	• Large amounts are still available making it renewable and sustainable • Produces the most amount of electricity of the alternative energy sources	• Destruction of habitat since large areas are needed • Produces nuclear waste which is radioactive • Waste is buried underground destroying habitats • More expensive than all other sources
Waves	• Renewable and sustainable	• Does not produce large amounts of electricity • Destroys habitats along coast • Displaces marine animals • Visually not pleasing

8. When the learners have completed Task 1, hold a short class discussion on alternative energy sources besides coal (these sources can be used to drive turbines and generators to generate electricity for the national grid).
9. Next, get the learners to do Task 2:

10. Next, get the learners to do Task 2:
    a. Remind learners that coal has a negative impact on the environment. Coal is dug up from the ground. When it is burned, it releases carbon dioxide which destroys habitats, thus contributing to global warming.
11. Give learners some time to complete Task 2 in their groups.
12. Ask learners to share their answers to Task 2 with the class.
13. *Model answer: Task 2*

Answers will vary. All energy sources have some environmental impact. Learners are required to substantiate their answers using the information. They should create an argument as to why the chosen energy source should replace coal power stations.

Checkpoint 2

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

a. Why is burning coal for electricity production not sustainable?
b. What is the environmental impact of burning coal for electricity generation?

Answers to the checkpoint questions are as follows:

a. Coal is non-renewable and will eventually run out.
b. Burning coal releases carbon dioxide, which contributes to global warming.

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Energy and the national electricity grid	171
Solutions for all	Energy and the national electricity grid	226-231
Spot On	Energy and the national electricity grid	129-132
Top Class	Energy and the national electricity grid	180-183
Via Afrika	Energy and the national electricity grid	148-150
Platinum	Energy and the national electricity grid	180-181
Oxford Successful	Energy and the national electricity grid	154-155
Pelican Natural Sciences	Energy and the national electricity grid	285-290
Sasol Inzalo Bk B	Energy and the national electricity grid	154-161

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=SeXG8K5_UvU&t=4s (2min 12sec) [How a coal power station works]
2. https://www.youtube.com/watch?v=0Kx3qj_oRCc (1min 21sec) [How wind turbines generate electricity]
3. https://www.youtube.com/watch?v=rnPEtwQtmGQ (2min 10sec) [How hydroelectricity works]
4. https://www.youtube.com/watch?v=FgjfJGfusdE (2min 47sec) [Solar Thermal 101]
5. https://www.youtube.com/watch?v=_UwexvaCMWA (4min 47sec) [How nuclear power plants work]
6. https://www.youtube.com/watch?v=gcStpg3i5V8 (2min 43sec) [Ocean energy]

7 B

Term 3, Week 7, Lesson B
Lesson Title: Nuclear power in South Africa
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Nuclear power stations
CAPS Page Number	75

Lesson Objectives

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

- Explain the process that occur in nuclear power stations in electricity generation
- Explain nuclear fission
- State that nuclear waste is radioactive
- Explain why nuclear waste needs to be properly disposed of.

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: Nuclear fuel: uranium	
Resource 32: Nuclear waste disposal	

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 we need to consider energy sources other than coal to generate electricity?

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.

Coal is a non-renewable resource and will eventually run out. It also has a negative environmental impact through the production of carbon dioxide which contributes to global warming.

D ACCESSING INFORMATION

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

NUCLEAR POWER IN SOUTH AFRICA

1. A nuclear power station uses radioactive fuel to generate electricity.
2. South africa has a nuclear power station called koeberg that is in the western cape.
3. Uranium is an element that is the radioactive fuel used in the power station.
4. Radioactivity produces heat during nuclear fission.
5. Nuclear fission is the splitting of atoms. This process releases heat.
6. The heat is then used to boil water and produce steam.
7. The steam spins a turbine which turns a generator that produces electricity.
8. The electricity is then channeled into the national electricity grid.
9. Nuclear fuel that has been used is called nuclear waste.
10. Nuclear waste is still radioactive for hundreds of years.
11. It can be dangerous to people if not disposed of properly.
12. Nuclear waste can be disposed of by being stored in special containers and buried underground.

2. Make sure that Resource 31: 'Nuclear fuel: uranium' and Resource 32: 'Nuclear waste disposal' are on display in the classroom.
3. Explain the following to the learners:
    a. A nuclear power station uses radioactive fuel to generate electricity. Radioactive fuel releases rays of energy when atoms are broken down.
    b. South Africa has a nuclear power station called Koeberg that is in the Western Cape.
4. Show learners Resource 31: 'Nuclear fuel: uranium'.
5. Explain the following to the learners:
    a. Uranium is an element that is the radioactive fuel. Uranium is yellow in colour and is mined out of the ground as uranium ore.
    b. Nuclear fission is the splitting of the nucleus of an atom. The nucleus of the atoms of uranium is split and this process releases heat.
    c. Radioactivity produces heat during nuclear fission.
    d. The heat is then used to boil water and produce steam.
    e. The steam spins a turbine which turns a generator that produces electricity.
    f. The electricity is then channeled into the National Electricity Grid.
    g. Nuclear fuel that has been used is called nuclear waste.
6. Show learners Resource 32: 'Nuclear waste disposal'.
7. Explain the following to the learners:
    a. Nuclear waste is still radioactive for hundreds of years.
    b. It can be dangerous to people if not disposed of properly. Exposure to nuclear waste can cause cancerous growths and can cause genetic problems for plants and animals for many generations.
    c. Nuclear waste can be disposed of by being stored in special containers and buried underground.

Checkpoint 1

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

a. What fuel does a nuclear power station use to generate electricity?
b. How is nuclear waste disposed of?

Answers to the checkpoint questions are as follows:

a. Radioactive material such as uranium
b. It is buried underground in sealed containers.

E CONCEPTUAL DEVELOPMENT

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

ACTIVITY

1. What is the difference between a coal power station and a nuclear power station?
2. Explain the process in which nuclear power stations generate electricity.
3. What are the final products of a coal power station and a nuclear power station?
4. How do the final products of both the coal and nuclear power stations affect the environment?

TASK 1

Answer questions 1-2.

TASK 2

Answer questions 3-4.

2. Explain Task 1 to the learners as follows:
   a. Remind learners that coal power stations use coal to generate electricity and nuclear power stations use radioactive material.
3. Give learners some time to complete Task 1 in their workbooks.
4. Ask learners to share their answers to Task 1 with the class.
5. Write the answers on the chalkboard
6. *Model answer: Task 1*

   1. *Coal power stations use coal which is burned to produce heat. Nuclear power stations use radioactive material such as uranium. The nucleus of uranium atoms is split during nuclear fission. This produces heat.*
   2. *Nuclear power stations undergo fission which is the splitting of atoms. The atoms of radioactive elements such as uranium are split. This process releases heat. The heat is then used to boil water and produce steam. The steam turns a turbine which turns a generator that produces electricity. The electricity is then channeled into the National Electricity Grid.*

7. When the learners have completed Task 1, hold a short class discussion in which you revise the process of electricity generation in nuclear power stations.
8. Next, get the learners to do Task 2:
   a. Remind learners that the burning of coal released carbon dioxide into the air and that nuclear waste remains after the radioactive material has been used to generate electricity.
9. Write the answers on the chalkboard.
10. *Model answer: Task 2*

3. *The final products of both the coal power station and the nuclear power station is electrical energy. Coal power stations produce carbon dioxide and nuclear power stations produce nuclear waste.*
4. *The carbon dioxide produced by coal power stations adds to the carbon dioxide in the air and contributes to global warming. Nuclear waste is radioactive and harmful to plants and animals. It is stored underground in special containers which can cause habitat destruction.*

Checkpoint 2

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

a. Why must nuclear waste be disposed of carefully?
b. How do nuclear power stations generate electricity?

Answers to the checkpoint questions are as follows:

a. Nuclear waste is still radioactive for many years and can be harmful to life.
b. Radioactivity produces heat by nuclear fission (the splitting of the nucleus of an atom). The heat boils water to produce steam which turns turbines and generators.

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Energy and the national electricity grid	173
Solutions for all	Energy and the national electricity grid	231-232
Spot On	Energy and the national electricity grid	133
Top Class	Energy and the national electricity grid	183-184
Via Afrika	Energy and the national electricity grid	151
Platinum	Energy and the national electricity grid	182-183
Oxford Successful	Energy and the national electricity grid	156-157
Pelican Natural Sciences	Energy and the national electricity grid	290-292
Sasol Inzalo Bk B	Energy and the national electricity grid	162-165

G ADDITIONAL ACTIVITIES/ READING

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

1. https://www.youtube.com/watch?v=_UwexvaCMWA (4min 47sec) [How nuclear power plants work]

7 C

Term 3, Week 7, Lesson C
Lesson Title: National Electricity Grid
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	National Electricity Grid
CAPS Page Number	76

Lesson Objectives

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

- Describe the national grid as a network of interacting parts
- Explain that power stations feed electrical energy into the national grid at high voltages
- Explain that power lines carry electricity at high voltages
- Explain why power lines carry electricity at high voltages
- Explain the purpose of step-down transformers
- State that 15% of the electrical energy is wasted in the form of heat energy when it is carried along transmission lines and transformers
- Explain that power surges and grid overload can disrupt the power supply.

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 28: The national grid	

C CLASSROOM MANAGEMENT

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

Which company is the leading supplier of electricity in South Africa?

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.

Eskom

D ACCESSING INFORMATION

1. Write the following information on the chalkboard (always need to do this before you start the lesson):

NATIONAL ELECTRICITY GRID

1. The national grid is a network of interacting parts.
2. It is a system where a change in one part of the grid affects the other parts of the grid.
3. The three main parts of the national grid include a power station, power lines and transformers.
4. The power stations feed electrical energy into the national grid at high voltages.
5. Power lines carry electricity at high voltages from the power station to our homes. Power lines carry electricity over long distances and need to have high voltages to make sure electricity with a high enough voltage reaches houses.
6. The electricity travels at high voltages (as high as 500 000 volts) to reduce heat loss. These voltages are too high and will damage our appliances and need to be lowered.
7. Transformers step down the voltage for local distributors and consumers to 230 volts.
8. 15% Of the energy is wasted due to heating in the transmission lines and transformers.
9. A power surge occurs when the voltage is 110% above the normal voltage in the power line.
10. Power surges occur when one part of the grid breaks down and the other parts of the grid must carry more electricity.
11. Power surges and grid overload can disrupt the power supply.

2. Make sure that Resource 28: 'The national grid' is on display in the classroom.
3. Explain the following to the learners:
    a. The national grid is a network of interacting parts.
    b. It is a system where a change in one part of the grid affects the other parts of the grid.
    c. The three main parts of the national grid include a power station (labels 1-4), power lines (labels 6 and 7) and transformers (label 5).
    d. The power stations feed electrical energy into the national grid at high voltages.
    e. Power lines carry electricity at high voltages from the power station to our homes.
    f. The electricity travels at high voltages (as high as 500 000 volts) because of the need to transport electricity over long distances and to reduce heat loss. If the current is very high, the power lines can melt, and if the voltage is too low, then the voltage of the electricity reaching homes would be too low. These high voltages will damage our appliances and need to be lowered. Most of our appliances are designed to receive a voltage of 230 volts.
    g. A transformer is a device that changes the voltage. Transformers step down the voltage for local distributors and consumers to 230 volts.
    h. 15% of the energy is wasted due to heating in the transmission lines and transformers.
    i. A power surge occurs when the voltage is 110% above the normal voltage in the power line. The voltage is too high and can damage many appliances in your home. Many appliances have fuses which melt and cause a break in the system during power surges. This protects your appliance.
    j. Power surges occur when one part of the grid breaks down and the other parts of the grid must carry more electricity.
    k. Power surges and grid overload can disrupt the power supply.

Checkpoint 1

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

a. What is a power surge?
b. Why do transformers need to reduce the voltage to our homes?

Answers to the checkpoint questions are as follows:

a. A power surge is a sudden increase in the voltage supply of 110% above the normal voltage. It occurs when one part of the grid breaks down, and the other parts of the grid must carry more electricity, overloading the system.
b. The voltage carried by the power lines is too high for use in our homes.

E CONCEPTUAL DEVELOPMENT

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

ACTIVITY

1. Electrical power is transported through power lines at very high voltages. Why is it necessary to have such high voltages?
2. Which device reduces high voltages to 230 volts for comercial use?
3. Explain how damage in one part of the national grid can affect other parts of the national grid.
4. Bongani connected six appliances to one wall plug. When he switched all the appliances on, the power tripped. What caused the power to trip?

TASK 1

Answer questions 1 and 2.

TASK 2

Answer questions 3 and 4.

2. Explain Task 1 to the learners as follows:
   a. Remind learners that the three main parts of the national grid include a power station, power lines and transformers.
   b. The power stations feed electrical energy into the national grid at high voltages.
   c. Power lines carry electricity at high voltages from the power station to our homes.
3. Give learners some time to complete Task 1 in their workbooks.
4. Ask learners to share their answers to Task 1 with the class.
5. Write the answers on the chalkboard.
6. Model answer: Task 1

   1. *Power lines carry electricity over long distances and need to have high voltages to make sure electricity with a high enough voltage reaches houses. Power lines also carry electricity at high voltages to reduce heat loss, as electricity travels along the power lines.*
   2. *Transformers*

7. When the learners have completed Task 1, hold a short class discussion on power stations and voltages.
8. Next, get the learners to do Task 2:
   a. Remind learners that the national grid is a network of interacting parts.
   b. It is a system where a change in one part of the grid affects the other parts of the grid.
9. Ask learners to share their answers to Task 2 with the class.
10. Write the answers on the chalkboard.
11. *Model answer: Task 2*

3. *When one part of the grid breaks down, the other parts of the grid must carry more electricity. This can cause power surges as the voltage through the other parts of the circuit becomes too high.*
4. *Bongani connected too many appliances to the power supply. More electricity was needed than what was available for use. This caused a circuit overload.*

Checkpoint 2

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

a. 15% of the energy is wasted in the transmission lines and transformers. In what form is this energy wasted?
b. What has occurred in the national grid when your appliances are damaged from the supply of electricity?

Answers to the checkpoint questions are as follows:

a. Heat energy
b. A power surge

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Energy and the national electricity grid	172
Solutions for all	Energy and the national electricity grid	233-235
Spot On	Energy and the national electricity grid	134-137
Top Class	Energy and the national electricity grid	184-186
Via Afrika	Energy and the national electricity grid	151-153
Platinum	Energy and the national electricity grid	184-186
Oxford Successful	Energy and the national electricity grid	158-159
Pelican Natural Sciences	Energy and the national electricity grid	293-299
Sasol Inzalo Bk B	Energy and the national electricity grid	166-175

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=nbPmsBmo03Y (3min 46sec) [Electrical grid 101]
2. https://www.youtube.com/watch?v=s8LzYzYRMOk (1min 49sec) [How does electricity reach our homes?]
3. https://www.youtube.com/watch?v=yS4DdqDh2wY (3min 14sec) [What is a power surge?]

TOPIC OVERVIEW:
Cost of electrical power
Term 3, Weeks 8A - 9C

A. TOPIC OVERVIEW

TERM 3, WEEKS 8A - 9C

- This topic runs for 2 weeks.
- It is presented over 6 x 1 hour lessons.
- This topic's position in the term is as follows:

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

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

B. SEQUENTIAL TABLE

GRADE 8	GRADE 9	GRADE 10-12
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Insulation and energy saving • Energy transfer to surroundings • The national electricity supply system: Conserving electricity in the home	• Cost of electrical power • The cost of power consumption	Grade 11 • Electric circuits

C. SCIENTIFIC VOCABULARY

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

	TERM	EXPLANATION
1.	electrical power	The rate at which electrical energy is supplied
2.	electric current	The flow of electric charge
3.	voltage	An electric force that allows electrons to flow
4.	electron(s)	Negatively charged particles
5.	conductor(s)	Materials that allow electricity to flow through them easily
6.	watt	Unit of measure of power
7.	power rating	Electrical power an appliance needs in order to work
8.	joule	Unit of measure of the amount of energy
9.	consumer(s)	People who use and pay for electricity
10.	kilowatt hour	Measure of the quantity of electrical power used
11.	unit price of electricity	Cost of electricity in Rands or cents per kilowatt hour
12.	sliding scale	Costing system where the unit price of electricity increases at certain intervals as more electricity is used
14.	prepaid electricity card(s)	Cards onto which money is loaded and inserted into an electricity meter. Once the money on the card is finished the electricity supply is switched off.
15.	prepaid electricity meter	Special electricity meter that supplies a quantity of electricity power that is limited to the amount of money loaded onto a prepaid electricity card
16.	energy efficient	Using energy wisely and not wasting it
17.	fluorescent light bulb	A light bulb that uses mercury in the form of vapour to produce light. They are more efficient than incandescent light bulbs.
18.	incandescent light bulb(s)	Light bulbs that have a high resistance wire, made of tungsten that heats up and produces light when there is a current flowing through it. A lot of energy is wasted as heat energy.
19.	solar heating panel	A device that uses the Suns heat energy to heat up water in a tank
20.	renewable	Able to be re-used
21.	convection	The transfer of heat in a liquid or gas that involves the rising of warmer particles and the sinking of cooler particles, forming convection currents The creation of a magnetic field by moving an iron core through a current carrying a coiled conductor

D. UNDERSTANDING THE USES / VALUE OF SCIENCE

Electricity is used all around us every day. All the appliances that help us work and survive need electricity to work. However, different appliances need different amounts of electrical power in order to work. We can read off the power rating in watts on the label at the back of the appliance. Electricity is not free. We need to pay for all the electrical power that we use every day. Electrical meters record the quantity of electrical power that has been used in kilowatt hours. It is important for us to be able to calculate the cost of the electrical energy that we use so that we can be more careful when it comes to using electricity. Prepaid electricity meters can help us understand and control the amount of electricity we use. Some appliances are more energy efficient than others and cost less to run. There are also electrical appliances that do not need electricity to perform the same work. Using less electricity not only means we pay less, but also means that there is less impact on the environment.

E. PERSONAL REFLECTION

Reflect on your teaching at the end of each topic:

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

8 A

Term 3, Week 8, Lesson A
Lesson Title: Electrical Power
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The cost of power consumption
CAPS Page Number	76

Lesson Objectives

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

- Define electrical power as the rate at which electrical energy is supplied
- State that electrical power is measured in units called watts (W) or kilowatts (kW)
- Explain that all electrical appliances use electrical power to work
- Explain that the power rating of appliances can be determined by looking at the back panel of the appliance.

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

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

TOPIC: Cost of electrical power

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
A kettle	Any other appliance that has a power rating on the back panel
Resource 33: Power rating of different appliances	

C CLASSROOM MANAGEMENT

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

Through which interconnected system is electrical energy transported to our homes?

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 National Electricity Grid

D ACCESSING INFORMATION

1. Write the following information on the chalkboard (always need to do this before you start the lesson):

ELECTRICAL POWER

1. Electrical power is the rate of electrical energy supply.
2. Electrical power is the amount of electrical current that is flowing through a system as a result of voltage.
3. Remember, current (i) is the rate at which electrons flow through a conductor.
4. Voltage (v) is the force with which electrons are pushed through a conductor.
5. Electrical power is measured in units called watts (W) or kilowatts (kW).
6. All electrical appliances use electrical power to work.
7. The power rating of appliances can be determined by looking at the back panel of the appliance.

2. Explain the following to the learners:
    a. Electrical power is the rate of electrical energy supply.
    b. Electrical power is the amount of electrical current that is flowing through a system as a result of voltage.
    c. Remember current (I) is the rate at which electrons flow through a conductor.
    d. Voltage (V) is the force with which electrons are pushed through a conductor.
    e. Electrical power is measured in units called watts (W) or kilowatts (kW).
    f. All electrical appliances use electrical power to work.
3. Show learners the back panel of a kettle.
4. Explain the following to the learners:
    a. The power rating of appliances can be determined by looking at the back panel of the appliance.
    b. The back panel of an appliance usually shows the voltage that the appliance requires, and the power rating of the appliance.

Checkpoint 1

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

a. What is electrical power?
b. What is the unit of measure of electrical power?

Answers to the checkpoint questions are as follows:

a. Rate of electrical energy supply
b. Watts (W) or kilowatts (kW)

E CONCEPTUAL DEVELOPMENT

1. Divide the class into manageable groups. Give each group a copy of Resource 33: ' Power rating of different appliances' from the resource pack.
2. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

Appliance	Power rating (W)
Television	
Radio	
Electric iron	
Toaster	
Kettle	
Electric carving knife	
Slow cooker	

TASK 1

1. Copy the table into your workbooks.
2. Use the pictures of the back labels of different appliances handed out to you by your teacher and fill in the table.

TASK 2

1. Arrange the appliances in order from those that have the highest power rating to those that have the lowest power rating.
2. Which appliance do you think would be the most expensive to use?

3. Explain Task 1 to the learners as follows:
   a. The table drawn on the chalkboard has two columns.
   b. The first column has the following heading: Appliance.
   c. The second column has the following heading: Power rating (W).
   d. Work in groups and complete Task 1.
5. Give learners some time to do Task 1.
6. Ask learners to share their answers to Task 1 with the class.
7. Complete the table on the chalkboard
8. Discuss the answers with the learners.
9. *Model answer: Task 1*

2. ACTIVITY

Appliance	Power rating (W)
Television	140
Radio	80
Electric iron	2200
Toaster	1500
Kettle	2200
Electric carving knife	120
Slow cooker	320

10. Next, get the learners to do Task 2.
11. Explain Task 2 to the learners as follows:
    a. Work on your own.
    b. Answer the questions in Task 2.
12. Give learners some time to do Task 2.
13. Ask learners to share their answers to Task 2 with the class.
14. Discuss the answers with the learners.
15. *Model answer: Task 2*

1. Electric iron, kettle, toaster, slow cooker, television, electric carving knife, radio
2. The electric iron or the kettle

Checkpoint 2

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

a. Where can we read the power rating of an appliance?
b. What does the power rating of an appliance tell us?

Answers to the checkpoint questions are as follows:

a. On the back label of the appliance
b. It tells us how much electrical power an appliance uses.

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Cost of electrical power	174-177
Solutions for all	Cost of electrical power	237-247
Spot On	Cost of electrical power	138-142
Top Class	Cost of electrical power	187-192
Via Afrika	Cost of electrical power	154-157
Platinum	Cost of electrical power	187-191
Oxford Successful	Cost of electrical power	160-162
Pelican Natural Sciences	Cost of electrical power	300-315
Sasol Inzalo Bk B	Cost of electrical power	176-179

G ADDITIONAL ACTIVITIES/ READING

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

1. http://www.eskom.co.za/sites/idm/SchoolYard/Documents/EducatorguideScienceGr9.pdf [How to save energy]
2. https://www.youtube.com/watch?v=VSpB3HivkhY&t=36s (5min 20sec) [Basic Electricity-Power and Watts]

8 B

Term 3, Week 8, Lesson B
Lesson Title: Measure electrical power
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Measure electrical power
CAPS Page Number	76

Lesson Objectives

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

- State that one watt of power is equal to one joule of energy supplied in a second
- State that 1 watt = 1 joule per second
- Explain that consumers pay for the quantity (amount) of power they use
- Explain that we can calculate the quantity of electrical power used by multiplying the power rating of the appliance by the number of hours it was in use.

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

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

TOPIC: Cost of electrical power

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
N/A	

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 electrical power?

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 rate of electrical energy supply

D ACCESSING INFORMATION

1. Write the following information on the chalkboard (always need to do this before you start the lesson):

MEASURING ELRCTRICAL POWER

1. Electrical power is measured in units called watts (W) or kilowatts (kW).
2. 1 000 Watts = 1kW
3. One watt of power is equal to one **joule** of energy supplied in a second.
4. 1 Watt = 1 **joule** per second
5. **Consumers** pay for the quantity (amount) of power they use.
6. An electric meter records how much electricity you have used so that the company that is supplying the electricity can charge you the necessary costs.
7. The quantity of electrical power used is measured in kWh (**kilowatt hours**).
8. We can calculate the quantity of electrical power used by multiplying the power rating of the appliance by the number of hours it was used for:

Electrical power used = power rating x number of hours used.

2. Explain the following to the learners:
    a. Electrical power is measured in units called watts (W) or kilowatts (kW):
    b. 1 000 watts = 1kW
    c. To convert watts to kilowatts, we divide by 1000.
    d. One watt of power is equal to one joule of energy supplied in a second. Remember that the joule is the unit of measure of energy. Therefore, the watt is a measure of the rate at which energy is used: 1 watt = 1 joule per second.
    e. Consumers pay for the quantity (amount) of power they use. The more power we use, the more we have to pay.
    f. If we use appliances with a higher power rating, it will cost more to run.
    g. If we use appliances for longer periods of time, it will cost more to run.
    h. An electric meter records how much electricity you have used so that the company that is supplying the electricity can charge you the necessary costs.
    i. The quantity of electrical power used is measured in kWh (kilowatt hours).
    j. An electric meter records the amount of power used in kWh.
    k. We can calculate the quantity of electrical power used by multiplying the power rating of the appliance by the number of hours it was used for:

        Electrical power used = power rating x number of hours used.

Checkpoint 1

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

a. How do we convert from watts to kilowatts?
b. How can we calculate the quantity of electrical power used?

Answers to the checkpoint questions are as follows:

a. Divide by 1000
b. Multiplying the power rating of the appliance by the number of hours it was in use

E CONCEPTUAL DEVELOPMENT

1. Divide the class into manageable groups. Give each group a copy of Resource 33: ' Power rating of different appliances' from the resource pack.
2. Write the following onto the chalkboard (always try to do this before the lesson starts):

ACTIVITY

Appliance	Power rating (W)	Power rating (kW)	Number of hours used per day (hrs)	Power used per day (kWh)
Television	140		6	
Radio	80		2	
Electric iron	2200		0.5	
Toaster	1500		0.2	
Kettle	2200		0.5	
Electric carving knife	120		0.25	
Slow cooker	320		12	

TASK 1

1. Copy the table into your workbooks.
2. Convert the power rating from watts to kilowatts and filling in the third column.
3. Calculate the power used per day and fill in the fifth column.

TASK 2

1. Arrange the appliances in order from those that use the most power to those that use the least power every day.
2. Which appliance is used for the longest during the day?
3. Which appliance is used for the shortest during the day?
4. Which appliance do you think costs the most every day given the time that it is used for?

3. Explain Task 1 to the learners as follows:
   a. The table drawn on the chalkboard has five columns.
   b. The first column has the following heading: Appliance.
   c. The second column has the following heading: Power rating (W).
   d. The third column has the following heading: Power rating (kW).Give learners some time to do Task 1.

e. The fourth column has the following heading: Number of hours used per day (hrs).
f. The fifth column has the following heading: Power used per day (kWh).
g. Remember that we divide by 1000 when we convert from watts to kilowatts.
h. Remember that we multiply the power rating of the appliance by the number of hours it was used to calculate the quantity of power used.
i. Work with the person sitting next to you and complete Task 1.

4. Give learners some time to do Task 1.
5. Ask learners to share their answers to Task 1 with the class.
6. Complete the table on the chalkboard.
7. Discuss the answers with the learners.
8. *Model answer: Task 1*

Appliance	Power rating (W)	Power rating (kW)	Number of hours used per day (hrs)	Power used per day (kWh)
Television	*140*	*0.14*	*6*	*0.84*
Radio	*80*	*0.08*	*2*	*0.16*
Electric iron	*2200*	*2.2*	*0.5*	*1.1*
Toaster	*1500*	*1.5*	*0.2*	*0.3*
Kettle	*2200*	*2.2*	*0.5*	*1.1*
Electric carving knife	*120*	*0.12*	*0.25*	*0.03*
Slow cooker	*320*	*0.32*	*12*	*3.84*

9. Next, get the learners to do Task 2.
10. Explain Task 2 to the learners as follows:
    a. Work on your own.
    b. Answer the questions in Task 2.
11. Give learners some time to do Task 2.
12. Ask learners to share their answers to Task 2 with the class.
13. Discuss the answers with the learners.
14. *Model answer: Task 2*

1. *Slow cooker, electric iron and kettle, television, toaster, radio, electric carving knife*
2. *Slow cooker*
3. *Electric carving knife*
4. *Slow cooker*

Checkpoint 2

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

a. Do you think it is a good idea to leave appliances running when they are not being used? Why?
b. Where can we read off the amount of kWh that we have used?

Answers to the checkpoint questions are as follows:

a. Yes. Electrical appliances use electrical power to work, so they should be turned off when they are not being used in order to save energy.
b. Electric meter

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Cost of electrical power	174-177
Solutions for all	Cost of electrical power	237-247
Spot On	Cost of electrical power	138-142
Top Class	Cost of electrical power	187-192
Via Afrika	Cost of electrical power	154-157
Platinum	Cost of electrical power	187-191
Oxford Successful	Cost of electrical power	160-162
Pelican Natural Sciences	Cost of electrical power	300-315
Sasol Inzalo Bk B	Cost of electrical power	176-190

G ADDITIONAL ACTIVITIES/ READING

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

1. http://www.eskom.co.za/sites/idm/SchoolYard/Documents/EducatorguideScienceGr9.pdf [How to save energy]
2. https://www.youtube.com/watch?v=41-37Kv_ljw (7min 27sec) [Electric power (1 of 3) and Watts, an Explanation]

8 C

Term 3, Week 8, Lesson C
Lesson Title: Measure electrical power
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	The cost of electrical power
CAPS Page Number	76

Lesson Objectives

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

- Explain that the cost is calculated by multiplying the power rating of the appliance by the number of hours it was in use, multiplied by the unit price of electricity
- Explain that the unit price of electricity changes every year
- Explain that in South Africa, our electricity unit charges work on a sliding scale.

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

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

TOPIC: Cost of electrical power

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 34: Sample Electricity tariff account	

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 much is 1 watt in terms of joules per second?

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.

1 joule per second

D ACCESSING INFORMATION

1. Write the following information on the chalkboard (always need to do this before you start the lesson):

THE COST OF ELECTRICAL POWER

1. We can calculate the cost of electricity to the consumer.
2. The cost is calculated by multiplying the power rating of the appliance by the number of hours it was in use, multiplied by the unit price of electricity.
   Cost = power rating x number of hours used x unit cost of electricity.
3. The **unit price of electricity** changes every year.
4. In south africa, our electricity unit charges work on a **sliding scale**.
5. This means that the cost of electricity increases at certain intervals as you use more electricity.
6. We can also load money on **prepaid electricity cards** to help us control and understand how much energy we are consuming, and how much money we spend on electricity.
7. To use prepaid electricity cards, we need to have a **prepaid electricity meter.**

2. Explain the following to the learners:
    a. We can calculate the cost of electricity to the consumer.
    b. The cost is calculated by multiplying the power rating of the appliance by the number of hours it was in use, and then multiplied by the unit price of electricity.
    c. The unit price of electricity changes every year.
    d. In South Africa, our electricity unit charges work on a sliding scale
    e. This means that the cost of electricity increases at certain intervals as you use more electricity.
3. Show learners Resource 34: 'Sample electricity tariff account'.
4. Explain the following to the learners:
    a. Once a month, households receive an electricity tariff account that states how much their electricity usage has cost for that month.
    b. From the sample electricity tariff we can read:
        i. The reading period, which is 31 days.
        ii. The actual meter readings (power used in kWh) - note that there are two meter readings on this sample.
        iii. The daily average consumption, which is 35kWh.
        iv. The structure of the charges which are on a sliding scale. From the sample, we can see that the charge is R1.1065/kWh for the first 509.24 kWh. Then the charge increases to R1.2698/kWh for the next 509.24kWh.
        v. As the quantity of power used increases, so does the unit cost. This is a sliding scale.
        vi. A management levy, service charge, network charge and VAT charges are also added onto the cost of electricity.
    c. We should all know how to read our electricity tariff accounts and calculate our electricity costs.
    d. We can also load money on prepaid electricity cards. This means that our electricity will switch off once all the money on the card has been used. This can help us control and understand how much energy we are consuming and how much money we spend on electricity.
    e. We need to have a prepaid meter installed in our houses to use a prepaid electricity card.

Checkpoint 1

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

a. How do we calculate the cost of electrical power?
b. What is the quantity of electrical power measured in?

Answers to the checkpoint questions are as follows:

a. Multiply the power rating of the appliance by the number of hours it was in use, multiplied by the unit price of electricity
b. kilowatt hours (kWh)

E CONCEPTUAL DEVELOPMENT

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

ACTIVITY

Appliance	Power used per day (kWh)	Power used per month - 30 days (kWh)
Television	1	
Radio	1.2	
Electric iron	14	
Toaster	0.2	
Kettle	4	
Electric carving knife	13.2	

Electricity cost sliding scale for 2017

Step	Cost (R/kWh)
Step 1 [0 < 509.24kWh]	1.1065
Step 2 [509.24 - 1018.48kWh]	1.2698

TASK 1

1. Copy the tables into your workbooks.
2. Convert the power used per day into power used per month by multiplying each value by 30.
3. Calculate the total power used in kWh for the month.
4. Use the sliding scale in the table to calculate the cost of the total cost of electricity for that month.

TASK 2

1. The power rating of an LED light bulb is 30 watts. Busi has 11 LED light bulbs in her restaurant. Busi leaves each light on for 5 hours every day. The unit cost of electricity is R 1.12 per kWh.
   a. How much electrical power in kWh do all the lights in Busi's restaurant use every day?
   b. How much electrical power in kWh do all the lights in Busi's restaurant use every month (30 days)?
   c. How much does it cost Busi every month to keep the lights on?
2. The monthly cost to run a 2kW geyser for 5 hours a day is R 300. Calculate the unit cost of electricity in R/kWh.

2. Explain Task 1 to the learners as follows:
   a. There are two tables drawn on the chalkboard.
   b. The first table drawn on the chalkboard has three columns.
   c. The first column has the following heading: Appliance.
   d. The second column has the following heading: Power used per day (kWh).
   e. The third column has the following heading: Power used per month - 30 days (kWh).
   f. The second table drawn on the chalkboard has two columns.
   g. The second table shows the rates used on a sliding scale for 2017.
   h. Remember that a sliding scale means that the cost of electricity increases as more electricity is used.
   i. The first column has the following heading: Step.
   j. The second column has the following heading: Cost (R/kWh).
   k. Work with the person sitting next to you and complete Task 1.
3. Give learners some time to do Task 1.
4. Ask learners to share their answers to Task 1 with the class.
5. Copy the table on to the chalkboard.
6. Discuss the answers with the learners.
7. *Model answer: Task 1*

Appliance	**Power rating (W)**	**Power rating (kW)**
Television	*1*	*30*
Radio	*1.2*	*36*
Electric iron	*14*	*420*
Toaster	*0.2*	*6*
Kettle	*4*	*120*
Electric carving knife	*13.2*	*396*

3. 1 008 kWh

4. Total cost for Step 1 [0 < 509.24kWh] = 509. 24 x 1.1065
= R563.47

kWh left after step 1 = 1008 - 509.24
= R498.76

Step 2 [509.24 - 1018.48kWh] = 498.76 x 1.2698
= R633.33

The total cost = 498.76 + 633.33
= R1 132.09

8. Next, get the learners to do Task 2.
9. Explain Task 2 to the learners as follows:
    a. Work on your own.
    b. Answer the questions in Task 2.
10. Give learners some time to do Task 2.
11. Ask learners to share their answers to Task 2 with the class.
12. Discuss the answers with the learners.
13. *Model answer: Task 2*

1.

a. Electrical power per day = 30 watts x 11 light bulbs x 5 hours

1650xWh ÷ 1 000 - 1.65 kWh = 1650 Wh

b. 1.65 kWh x 30 = 49.5 kWh

c. 49.5 kWh x 1.12 = R 55.4

2. 2 kW x 5 hrs = 10 kWh per day

10 kWh x 30 days = 300 kWh per mpnth

$$\text{Unit cost} = \frac{R300}{300\ kWh}$$

$$= \frac{1\ R}{kWh}$$

$$= 1\ R / kWh$$

Checkpoint 2

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

a. What advantages dos a prepaid meter and prepaid electricity card offer?
b. What does it mean to use a sliding scale as the unit cost of electricity?

Answers to the checkpoint questions are as follows:

a. It can help us control and understand how much energy we are consuming and how much money we spend on electricity.
b. The more electricity you use, the more you will pay per unit.

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Cost of electrical power	174-177
Solutions for all	Cost of electrical power	237-247
Spot On	Cost of electrical power	138-142
Top Class	Cost of electrical power	187-192
Via Afrika	Cost of electrical power	154-157
Platinum	Cost of electrical power	187-191
Oxford Successful	Cost of electrical power	160-162
Pelican Natural Sciences	Cost of electrical power	300-315
Sasol Inzalo Bk B	Cost of electrical power	176-190

G ADDITIONAL ACTIVITIES/ READING

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

1. http://www.eskom.co.za/sites/idm/SchoolYard/Documents/EducatorguideScienceGr9.pdf [How to save energy]
2. https://www.youtube.com/watch?v=pffcs7Vlo-w (5min 53sec) [The cost of electricity - GCSE Physics]
3. https://www.youtube.com/watch?v=nnsl-IIihdM (5min 42sec) [Electric Power (3 of 3) Calculating the Cost of Electric Power]

9 A

Term 3, Week 9, Lesson A
Lesson Title: Compare energy consumption of appliances I
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Energy consumption of appliances
CAPS Page Number	76

Lesson Objectives

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

- State that different appliances consume different amounts of energy
- Explain that fluorescent light bulbs are more energy efficient than incandescent light bulbs
- Explain that appliances that use less energy to work will reduce the cost 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	

TOPIC: Cost of electrical power

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 35: Incandescent and fluorescent light bulbs	

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 calculate the cost of electricity that an appliance uses?

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 cost is calculated by multiplying the power rating of the appliance by the number of hours it was in use, multiplied by the unit price of electricity.

D ACCESSING INFORMATION

1. Write the following information on the chalkboard (always need to do this before you start the lesson):

COMPARE THE COST OF ELECTRICAL POWER

1. Different appliances consume different amounts of energy.
2. Some appliances that do the same thing are more **energy efficient** than other appliances.
3. **Fluorescent light bulbs** are more energy efficient than **incandescent light bulbs**.
4. Fluorescent light bulbs still need electricity to work, but they use much less electricity than incandescent light bulbs to light up a room.
5. Appliances that use less energy to work will reduce the cost of electricity.

2. Explain the following to the learners:
   a. Different appliances consume different amounts of energy.
   b. Some appliances that do the same thing are more energy efficient than other appliances.
   c. Fluorescent light bulbs are more efficient than incandescent light bulbs.
3. Show learners Resource 35: ‘Incandescent and fluorescent light bulbs’.
4. Explain the following to the learners:
   a. Fluorescent light bulbs still need electricity to work, but they use much less electricity than incandescent light bulbs to light up a room.

b. Appliances that use less energy will reduce the cost of electricity.
c. New, more modern appliances may be more expensive to purchase, but they often use less electricity than older appliances. In the long term, we can save energy and money. Some appliances also have a lower environmental impact.

Checkpoint 1

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

a. How do appliances that use less electricity affect our electricity costs?
b. Why are fluorescent light bulbs better to use than incandescent light bulbs?

Answers to the checkpoint questions are as follows:

a. They reduce our electricity costs.
b. Fluorescent light bulbs have a lower power rating and use less electricity than the incandescent light bulbs to do the same job.

E CONCEPTUAL DEVELOPMENT

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

ACTIVITY

Appliance	Power rating (watts)
Incandescent light bulb	60
Fluorescent light bulb	11
Old box TV	130
Flat screen TV	74

TASK 1

1. Copy the table into your workbooks.
2. Which light bulb would you install in your house?
3. Why would you choose that light bulb?

TASK 2

1. Tom is trying to reduce his electricity costs. He has already replaced all his incandescent light bulbs with more energy efficient fluorescent light bulbs. His brother is giving him a free flat screen TV. Tom already has an old box TV in his house and is wondering if he should or should not replace it with a newer flat screen TV. Use the table to advise Tom on what he should do.

2. Explain Task 1 to the learners as follows:
   a. The table drawn on the chalkboard has two columns.
   b. The first column has the following heading: Appliance.
   c. The second column has the following heading: Power rating (watts).
   d. Work with the person sitting next to you and complete Task 1.

3. Give learners some time to do Task 1.
4. Ask learners to share their answers to Task 1 with the class.
5. Discuss the answers with the learners.
6. *Model answer: Task 1*

> 2. *Fluorescent light bulb*
> 3. *Fluorescent light bulbs have a lower power rating (11 watts) than incandescent light bulbs (60 watts). Lowering the power rating of appliances will reduce the cost of electricity*

7. Next, get the learners to do Task 2.
8. Explain Task 2 to the learners as follows:
   a. Work on your own.
   b. Answer the questions in Task 2.
9. Give learners some time to do Task 2.
10. Ask learners to share their answers to Task 2 with the class.
11. Discuss the answers with the learners.
12. *Model answer: Task 2*

> 4. *Tom should accept the flat screen TV from his brother and use it instead of the old box TV. The flat screen TV has a lower power rating (74 watts) than the old box TV (130 watts). Lowering the power rating of appliances will reduce the cost of electricity.*

Checkpoint 2

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

a. True or false? Appliances that use less electricity are better for the environment.
b. Can you give reasons for your answer?

Answers to the checkpoint questions are as follows:

a. True
b. Electricity is produced through the burning of coal. When coal is burned, it releases gases such as carbon dioxide, harming the environment. Using less electricity reduces the amount of coal we use. This is less harmful to the environment.

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Cost of electrical power	174-177
Solutions for all	Cost of electrical power	237-247
Spot On	Cost of electrical power	138-142
Top Class	Cost of electrical power	193
Via Afrika	Cost of electrical power	158-163
Platinum	Cost of electrical power	192-193
Oxford Successful	Cost of electrical power	162-163
Pelican Natural Sciences	Cost of electrical power	300-315
Sasol Inzalo Bk B	Cost of electrical power	191-192

G ADDITIONAL ACTIVITIES/ READING

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

1. http://www.eskom.co.za/sites/idm/SchoolYard/Documents/EducatorguideScienceGr9.pdf [How to save energy]
2. https://www.youtube.com/watch?v=76SHiFQq4t0 (5min 24sec) [LED vs CFL vs Incandescent A19 Light Bulbs]
3. https://www.youtube.com/watch?v=TdI98ciCf3c (2min 27sec) [Energy Efficiency At Home: Appliances]

9 B

Term 3, Week 9, Lesson B
Lesson Title: Compare energy consumption of appliances II
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Alternative appliances
CAPS Page Number	76

Lesson Objectives

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

- State that alternative appliances and systems can be used to reduce electricity usage and costs
- Explain that solar heating panels can be used to reduce electricity usage and costs.

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

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

TOPIC: Cost of electrical power

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
Resource 36: Solar water heating diagram	

C CLASSROOM MANAGEMENT

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

Are fluorescent light bulbs less costly than incandescent light bulbs?

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.

Fluorescent light bulbs are less costly. They have a lower power rating and use less energy to light up a room.

D ACCESSING INFORMATION

1. Write the following information on the chalkboard (always need to do this before you start the lesson):

WAYS TO USE ENERGY MORE CAREFULLY

1. Leaving appliances on all the time, or using appliances that have high power ratings, like ovens and heaters, uses a lot of electricity.
2. These are some ways in which we can reduce our electricity usage:
   - Switching off appliances when they are not in use
   - Drying clothes on a washing line instead of a tumble drier
   - Closing doors and wearing warm clothing instead of using heaters.
3. The more electricity we use, the more coal we need to burn to produce more electricity.
4. The more coal we burn, the more we pollute the air around us. This has a having a negative impact on the environment.
5. We should not only use appliances that use less electricity, but we should also consider alternative appliances that do not use any electricity.

TOPIC: Cost of electrical power

ALTERNATIVE APPLIANCES

1. Alternative appliances or systems can also be used to reduce electricity.
2. Solar heating panels can be used to heat water in homes.
3. **Solar heating panels** can be used instead of electric geysers. Electric geysers have a very high power rating and contribute greatly to the cost of electricity.
4. A solar heating panel does not need electricity to heat up the water, and it reduces the cost of electricity.
5. Solar heating panels use **renewable** energy from the Sun to heat water.
6. Special solar energy collectors collect the heat energy from the Sun and heat water in a tank by **convection**.

2. Explain the following to the learners:
   a. Leaving appliances on all the time, or using appliances that have high power ratings, like ovens and heaters, uses a lot of electricity. Leaving the lights on unnecessarily can also be very wasteful over long periods of time.
   b. These are some ways in which we can reduce our electricity usage:
   c. switching off appliances when they are not in use
   d. drying clothes on a washing line instead of a tumble drier
   e. closing doors and wearing warm clothing instead of using heaters.
   f. The more electricity we use, the more coal we need to burn to produce more electricity. The more coal we burn, the more we pollute the air around us through the emission of carbon dioxide and other fumes. This contributes to global warming and has a negative impact on the environment.
   g. We should not only use appliances that use less electricity, but we should also consider alternative appliances that do not use any electricity. For example, we could use candles instead of lights when we do not need too much light.
   h. Alternative appliances or systems can also be used to reduce electricity.
   i. For example, solar heating panels can be used to heat water in homes.
3. Show learners Resource 36: ‘Solar water heater diagram’.
4. Explain the following to the learners:
   a. Solar heating panels can be used instead of electric geysers.
   b. No electricity is needed to heat up the water, and the cost of electricity is reduced.
   c. Many solar heating panels have been installed in low cost housing to assist people who cannot afford electricity costs.
   d. Solar heating panels use renewable energy from the Sun to heat water.
   e. Special solar energy collectors collect the heat energy from the Sun and heat water in a tank by convection.
   f. Remember convection is the heating of water or air because of warmer particles moving up and cooler particles sinking, thus forming convection currents.

Checkpoint 1

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

a. How do solar heating panels heat water?
b. Why are solar heating panels useful for saving electricity costs?

Answers to the checkpoint questions are as follows:

a. They use the energy from the Sun.
b. Solar heating panels do not use electricity to heat water and can be used instead of electric geysers. This reduces the quantity of power used, which reduces electricity costs.

E CONCEPTUAL DEVELOPMENT

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

ACTIVITY

1. List some possible ways in your home to reduce electricity costs.
2. Why is it a good idea to use less electricity other than to reduce our electricity costs?
3. How does a solar heating panel reduce electricity costs?

TASK 1

Answer questions 1-2.

TASK 2

Answer question 3.

2. Explain Task 1 to the learners as follows:
   a. Work on your own.
   b. Complete Task 1 by answering questions 1-2.
3. Give learners some time to complete Task 1.
4. Ask learners to share their answers to Task 1 with the class.
5. Write the answers on the chalkboard.
6. *Model answer: Task 1*

1. Any of the following:

- *Switching off appliances when they are not in use*
- *Drying clothes on a washing line instead of a tumble drier*
- *Closing doors and wearing warm clothing instead of using heaters*
- *Using candles instead of lights*
- *Opening windows and doors and wearing light clothing, when it is hot in summer, instead of using air conditioners*
- *Decide what you want to take out of the fridge before you open it*
- *Any others that are valid.*

2. *The more electricity we use, the more coal we need to burn to produce more electricity. As we burn more and more coal, the more we pollute the air around us through the emission of carbon dioxide and other fumes. This contributes to global warming and has a negative impact on the environment.*

7. Next, get the learners to do Task 2.
8. Explain Task 2 to the learners as follows:
   a. Work on your own.
   b. Answer the question in Task 2.
9. Give learners some time to do Task 2.
10. Ask learners to share their answers to Task 2 with the class.
11. Discuss the answers with the learners.
12. *Model answer: Task 2*

3. *Solar heating panels use the renewable energy from the Sun to heat water. Special solar energy collectors collect the heat energy from the Sun and heat water in a tank by convection. They do not use electricity to heat water.*

Checkpoint 2

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

a. True or false? Reducing electricity usage will reduce our cost of electricity.
b. True or false? Solar heating panels and incandescent light bulbs are examples of appliances or systems that help us to save energy.

Answers to the checkpoint questions are as follows:

a. True
b. False. Solar heating panels and fluorescent light bulbs are examples of appliances or systems that help us to save energy.

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Cost of electrical power	174-177
Solutions for all	Cost of electrical power	237-247
Spot On	Cost of electrical power	138-142
Top Class	Cost of electrical power	193
Via Afrika	Cost of electrical power	158-163
Platinum	Cost of electrical power	192-193
Oxford Successful	Cost of electrical power	162-163
Pelican Natural Sciences	Cost of electrical power	300-315
Sasol Inzalo Bk B	Cost of electrical power	191-192

G ADDITIONAL ACTIVITIES/ READING

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

1. http://www.eskom.co.za/sites/idm/SchoolYard/Documents/EducatorguideScienceGr9.pdf [How to save energy]
2. https://www.youtube.com/watch?v=NsCZD1MZPPo (1min 25sec) [My Energy: How Solar Heaters Work]

9 C

Term 3, Week 9, Lesson C
Lesson Title: Careers in the energy sector
Time for lesson: 1 hour

A POLICY AND OUTCOMES

Sub-Topic	Careers in the energy sector
CAPS Page Number	76

Lesson Objectives

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

- List some careers involved in the energy sector
- Explain the role of these careers in the energy sector.

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

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

TOPIC: Cost of electrical power

B POSSIBLE RESOURCES

For this lesson, you will need:

IDEAL RESOURCES	IMPROVISED RESOURCES
N/A	

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 should we consider using solar heating panels instead of geysers to heat water?

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.

Electric geysers have a very high power rating and contribute greatly to the cost of electricity. A solar heating panel does not need electricity to heat up the water, and it reduces the cost of electricity. Solar heating panels also use renewable energy and are less harmful to the environment.

D ACCESSING INFORMATION

1. Write the following information on the chalkboard (always need to do this before you start the lesson):

CAREERS IN THE ENERGY SECTOR

1. Many careers that can be followed for maintaining and improving appliances and energy systems.
2. Electricians install, repair and maintain electrical components. They also wire homes and other machines.
3. Electrical engineers study electricity, electronics and **electromagnetism**. Engineers also study ways in which electricity can be saved. They invent appliances and electronic devices that are more energy efficient.
4. Artisans build the electronic components, appliances, machines or systems that are needed in the energy sector.
5. Information technology (it) specialists mainly work with computers and technology. They design, build and test software. They ensure that all the electrical systems work efficiently and effectively.

2. Explain the following to the learners:
    a. There are many careers that can be followed that deal with maintaining and improving appliances and energy systems so that they are more energy efficient and less costly.
    b. Electricians install, repair and maintain electrical components. They also wire homes and other machines.
    c. Electrical engineers study electricity, electronics and electromagnetism. Engineers also study ways in which electricity can be saved and used efficiently by inventing appliances and electronics that are more energy efficient.
    d. Artisans build the electronic components, appliances, machines or systems that are needed in the energy sector.
    e. Information Technology (IT) specialists mainly work with computers and technology. They design, build and test software. This ensures that electrical systems work efficiently and effectively.
    f. It is important for people to follow these careers. Without such skilled people, we would not be able to improve the function and use of our power supply.
    g. They are constantly looking for new technologies and methods of improving the living conditions of people.

Checkpoint 1

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

a. Why is it important for people to be involved in careers that relate to electricity and electricity use?
b. Which career is involved in the designing of software that ensures that electrical systems work efficiently and effectively?

Answers to the checkpoint questions are as follows:

a. All the current electrical inventions that we have were once invented by people that followed these careers. In order to improve our technology and reduce the cost of electricity, we need people to constantly come up with new technologies.
b. IT specialists

E CONCEPTUAL DEVELOPMENT

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

ACTIVITY

In manageable groups, discuss the following two tasks.

TASK 1

Write a sentence explaining the purpose of each career in the energy sector.

TASK 2

1. Which career in the energy sector do you like the most and why?
2. Present your answers to the class.

2. Explain Task 1 to the learners as follows:
   a. Work in your groups.
   b. Complete Task 1 by answering questions 1.
3. Give learners some time to complete Task 1.
4. Ask learners to share their answers to Task 1 with the class.
5. Write the answers on the chalkboard.
6. *Model answer: Task 1*

- *Electricians install, repair and maintain electrical components. They also wire homes and other machines.*
- *Electrical engineers study electricity, electronics and electromagnetism. Engineers also study ways in which electricity can be saved and used efficiently by inventing appliances and electronics that are more energy efficient.*
- *Artisans build the electronic components, appliances, machines or systems that are needed in the energy sector.*
- *Information Technology (IT) specialists mainly work with computers and technology. They design, build and test software. They ensure that electrical systems work efficiently and effectively.*

7. Next, get the learners to do Task 2.
8. Explain Task 2 to the learners as follows:
   a. Work in your groups.
   b. Answer the questions in Task 2.
9. Give learners some time to do Task 2.
10. Ask learners to present their answers to Task 2 with the class.
11. Discuss the answers with the learners.
12. Model answer: Task 2

2. Answers will differ depending on learner preferences.

Checkpoint 2

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

a. Which career is involved in the repairing of electrical components and ensuring correct and legal wiring has been done in houses?
b. Which career would attempt to improve the design of a geyser to make it more energy efficient?

Answers to the checkpoint questions are as follows:

a. Electricians
b. Electrical engineers

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

F REFERENCE POINTS FOR FURTHER DEVELOPMENT

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

NAME OF TEXTBOOK	TOPIC	PAGE NUMBER
Step-by-Step	Cost of electrical power	174-177
Solutions for all	Cost of electrical power	248-250
Spot On	Cost of electrical power	138-142
Top Class	Cost of electrical power	193-194
Via Afrika	Cost of electrical power	158-163
Platinum	Cost of electrical power	193-194
Oxford Successful	Cost of electrical power	163
Pelican Natural Sciences	Cost of electrical power	300-315
Sasol Inzalo Bk B	Cost of electrical power	193-194

G ADDITIONAL ACTIVITIES/ READING

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

1. http://www.eskom.co.za/sites/idm/SchoolYard/Documents/EducatorguideScienceGr9.pdf [How to save energy]
2. https://www.youtube.com/watch?v=L5OSflBilXU (5min 43sec) [Electrical Engineering: What can you do with your degree?]

NATURAL SCIENCES

ASSESSMENT
GRADE 9 TERM 3

GRADE 9 ASSESSMENT

- This section presents the CAPS assessment requirements for this grade for this term.
- See your prescribed textbooks for examples of the required assessments.

CAPS Assessment

Assessment is a continuous planned process that involves identifying, gathering, interpreting and diagnosing information about the performance of learners.

Assessment involves generating and collecting evidence of learner achievement and progress, and using this information to understand and provide assistance to the learner during the process of teaching and learning.

Assessment should be both *formal* and *informal*:

a. ***Informal Assessment*** involves regular checking of learners' class work and practical tasks; asking questions; discussions; informal classroom interactions; and giving constructive feedback. Informal assessment marks do not need to be recorded, but the teacher can make notes for future reference.

b. ***Formal Assessment*** provides teachers with a systematic way of evaluating how well learners are progressing. Formal Assessment consists of selected assessment tasks. These tasks are stipulated by CAPS and the marks need to be recorded. These tasks are done throughout the year, and include practical / investigations, project, tests and examinations.

i. Tests and Examinations

The weighting of the marks should reflect the time allocated to each section in the curriculum content. Tests and exams should consist of a range of questions that cover different cognitive levels: recall; understanding; application; evaluation; analysis; and synthesis. CAPS aligned tests and examinations, with accompanying memoranda, are provided with these lesson plans.

ii. Practical / investigation tasks

Practical / investigation tasks give learners the opportunity to demonstrate knowledge, skills and understanding. They form part of the activities included in these lesson plans. Each term, one practical / investigation task has been selected for assessment. A rubric is provided to conduct the assessment.

iii. Poject

Projects give learners the opportunity to demonstrate knowledge, skills, understanding and application. The project can be given in any term but must be recorded for term 4 assessment.

A minimum mark allocation is prescribed in CAPS for, practical / investigation, projects, tests and examinations for each grade. These are summarised, by grade, in the table below:

GRADE 9 ASSESSMENT

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

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

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

There are two assessments included:

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 9
Project

Information and instructions for the teacher

NOTE TO THE TEACHER

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 NUCLEAR ENERGY.
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 50 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 9
Natural Sciences
Project

Topic: Nuclear Energy
50 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:

- Complete the answers to the questions in your workbook.
- Submit evidence of all your interviews as proof of work. These can also be completed in your workbook.

Step-by-step:

- Write the heading “Nuclear energy project” on paper or at the back of your workbook.
- Complete the tasks and questions below:

GRADE 9 ASSESSMENT – PROJECT TERM 3

The questions and instructions:

1. Research and explain how nuclear energy is generated.
2. Explain what the advantages and disadvantages of nuclear energy are?
3. Read the passage below. It is a shortened version of an article that appeared in Fin24 on 22/03/2019. Read the article at least twice and then answer the following questions:
   - 3.1. Do you think nuclear energy is a suitable energy source for South Africa? Justify your answer with quotes from the article.
   - 3.2. What other possible sources of renewable energy could be a suitable solution for South Africa? Give reasons for your answer.

Zuma says nuclear could've solved load shedding

Former president Jacob Zuma, whose term in government has been blamed for SA's current power outages, has said the power crisis could have been avoided if the country had built nuclear power stations.

In an interview with the Business day newspaper on Friday, Zuma said the expensive nuclear build programme he supported during his presidency could have "solved our problems, once and for all."

Zuma, who resigned as president in mid-February 2018, said the Russians would have been the most trustworthy country to carry out the project, because of their support in the struggle against apartheid.

Plans put forward to build a second nuclear power station, with a cost thought to be around R1 trillion, were criticised as unaffordable during Zuma's presidency.

A person from the Democratic Alliance said, "Our country is in a much worse economic (money) position than we were a few years ago, we…cannot afford nuclear. We need to use different energy sources by bringing renewable energy to the grid".

Zuma's spokesperson… did not immediately reply to a request for a comment on Friday. The former president, however, told Business Day he is convinced nuclear is the right way to go.

South Africa has been experiencing rolling blackouts for the past week as Eskom struggles to generate enough power to supply demand. According to Eskom, the shortages have been caused by a lack of diesel supplies, scheduled and unscheduled outages at generation units, and the devastating effect of the cyclone that hit lines from Mozambique.

A High Court in 2017 stopped the country's nuclear plans, ruling that the processes to buy nuclear were unlawful. This application to the High Court was brought by environmental activists.

In July 2018, President Cyril Ramaphosa told Russian president Vladimir Putin that South Africa could not afford new nuclear reactors.

4. Using the questions that follow, interview 5 adults. DO NOT go to a stranger's home alone. Try to interview neighbours, family members or people you know. Include the interview sheets as proof that the work has been completed thoroughly.

    4.1. What do you know about nuclear energy?

    4.2. What do you think the benefits of nuclear energy are?

    4.3. What do you think the disadvantages of nuclear energy are?

    4.4. Do you think nuclear energy is a good energy source for South Africa? Why/why not?

5. Using the information from your interviews, write 1-2 paragraphs discussing your findings? Use the questions below to guide your thinking:

    5.1. Did your interviewees know a lot about nuclear energy?

    5.2. Did your interviewees know the benefits and disadvantages of nuclear energy?

    5.3. What is the opinion of your interviewees about nuclear energy?

    5.4. Do you think there is enough information available about nuclear energy for people to make informed decisions about nuclear energy?

Project Assessment Rubric

Name or learner: _____

Date: _____

	Excellence achieved	Achieved	Mostly achieved	Was not submitted	Total
Score	10-8	7-4	4-1	0	
Question 1	A full and detailed explanation of how nuclear energy is generated including fuel. radioactivity, fission and generation.	Explanation is correct but lacks all details.	Explanation is incorrect, contains errors or is incomplete.	Work not submitted	
Question 2	At least 3 advantages are discussed in detail. At least 4 disadvantages are discussed in detail.	At least 2 advantages are discussed in some detail. 2-3 disadvantages are discussed in some detail.	At least 1 advantage is discussed in some detail. 1-2 disadvantages are discussed in some detail.	Work not submitted	
Question 3	A strong argument is made with quotes from the article. At least two suitable sources of renewable energy are named with logical reasons.	A reasonable argument is made with quotes from the article. At least two suitable sources of renewable energy are named with some reasoning.	An attempt at argument is made at least one reference to the article. At least one suitable source of renewable energy is named with some reasoning.	Work not submitted	
Question 4	All 5 interviews were conducted. Interviews are detailed and thorough. Information is organised and orderly.	All 5 interviews were conducted. Interviews show some detail. Information is organised.	All 5 interviews were conducted. Interviews lack detail.	Work not submitted	
Question 5	Clear and logical conclusions are drawn from the interviews. Opinions are logical and justified with evidence drawn from the interviews.	Some conclusions are drawn from the interviews. Opinions show logic and an attempt has been made to reference the interviews.	An attempt to draw conclusions from the interviews has been made. Opinions are expressed without referencing interviews.	Work not submitted	
					50 marks

Natural Sciences
Grade 9
Practical Task
Term 3

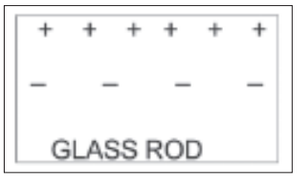
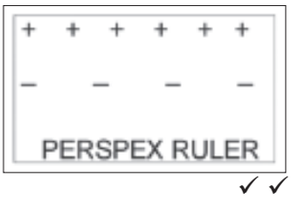
20 Marks
Time allocation: 40 minutes (15 minutes preparation, 25 minutes task time)

NOTE TO THE TEACHER:

1. This practical activity will be completed as part of Section E of lesson 2B.
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. Should there be insufficient equipment, this can be done as a demonstration lesson.
9. The following equipment will need to be collected before the lesson:
    - a plastic ruler
    - a Perspex ruler
    - tissue or toilet paper sheets
    - a glass rod
    - string
    - a woolen jersey/ sock or similar
10. Ensure that all the materials have been collected before the practical lesson. This may take a few days. Allow enough time for this.
11. The learners should complete the drawings/ graphs with a sharp pencil and the written answers should be completed in pen.

Grade 9
Natural Sciences
Term 3
Practical

Memorandum

CAPS Topic	Task	Expected answer(s)	Marks
	1		
Forces	1.1	repel ✓ attract ✓	2
Forces	1.2	positively ✓	1
Forces	1.3	gains ✓	1
Forces	1.4	Paper was attracted to the ruler. ✓	1
Forces	1.5	The ruler and paper have different charges. ✓	1
Forces	1.6	Paper was attracted to the ruler. ✓	1
Forces	1.7	The rule of attraction states that like charges will repel each other ✓ and unlike charges will attract each other. ✓	2
Forces	1.8	Neutral ✓	1
	2.		
Forces	2.1	They attracted each other. ✓ The Perspex ruler has a positive charge ✓ and the plastic ruler has a negative charge. ✓	3
Forces	2.2	  ✓ ✓	2
Forces	2.3	They repelled each other. ✓ The perspex ruler has a negative charge and the glass rod has a negative charge. ✓ Objects with the same charge will repel each other.	3
Forces	2.4	  ✓ ✓	2
			TOTAL 20

Grade 9
Natural Sciences
Term 3
Test

40 Marks
80 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 What is the unit used to measure force?

a. Joules

b. Newtons

c. Tons

d. Metrics

You have answered correctly if you have circled (B)

QUESTION 1: MULTIPLE CHOICE [4]

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

1.1. Which one of these is NOT an example of a resistor?

a. bulbs

b. motors

c. rheostats

d. copper wires

1.2. Which of these statements is false?

a. An atom consists of a nucleus with a cloud of positively charged electrons spinning around it.

b. Inside the nucleus there are positively charged protons and neutral neutrons.

c. The protons and neutrons are held together by very strong forces.

d. Atoms are electronically neutral unless electrons are added or removed.

1.3. Which of these is an example of a field force?

a. compression force

b. tension force

c. electrostatic force

d. contact force

1.4. Which one of these statements is true?

a. Electrical energy is energy resulting from the storage of electrical charge.

b. A cell stores chemical substances as potential energy.

c. The electrical charge that moves from the cell along the conducting wires of a circuit has low kinetic energy.

d. Electrical energy is not a form of kinetic energy.

QUESTION 2: MATCH THE COLUMNS [4]

Instructions:

Match the sentences in COLUMN A with the words in COLUMN B.

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

COLUMN A	
example	Needed by all living things to survive
2.1.	A device that transfers kinetic energy to electrical energy.
2.2.	A device used to measure current.
2.3.	Unit of measure for current.
2.4.	ohm

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. Unit to measure resistance.

_____

3.2. An element used as fuel in the generation of electricity at nuclear power stations.

_____

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

_____

3.4. An element used as nuclear fuel in the generation of electricity at nuclear power stations.

_____

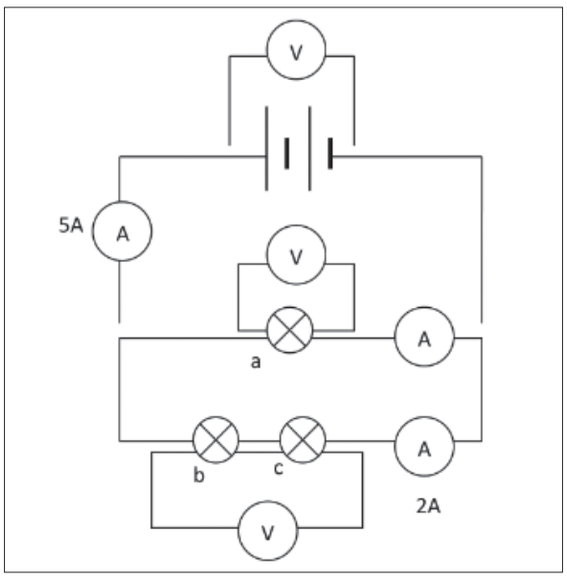
3.5. Devices that change the voltage of electricity.

_____

QUESTION 4 [6]

Look at the diagram below and answer the questions that follow:

NOTE: All the light bulbs and the cells in the circuit are identical. V stands for voltmeter and A stands for ammeter.



4.1. Write an equation that shows the relationship between voltmeters 1, 2 and 3.

_____

4.2. If the reading on ammeter 1 is 5A and the reading on ammeter 3 is 2A, what will the reading on ammeter 2 be?

_____

4.3. Which bulb will glow the brightest, a, b or c? Give a reason for your answer.

_____

4.4. If another two cells are connected in series to the existing cells, what will happen to the total voltage in the circuit?

_____

4.5. If the two cells are connected in parallel to the existing two cells, what will happen to the total voltage in the circuit?

_____

4.6. If the extra two cells are now added in parallel to the existing cells in the circuit, what will happen to the total voltage?

_____

QUESTION 5 [9]

Look at the information on the table below and answer the question that follow:

APPLIANCE	POWER RATING (Watts)
Electric kettle	2000
Electric iron	2100
Electric geyser	2200
Incandescent light bulb	60
Fluorescent light bulb	11

5.1. Draw a bar graph to show the power rating of the different appliances on the table above. The appliances must be represented on the X-axis and the power rating on the Y-axis.

5.2. How long would it cost in Rands to use the electric geyser for 5 hours continuously if the cost of electricity is 180c per kilowatt hour? (Show all calculations).

_____

5.3. Would you use incandescent or fluorescent light bulbs in your home? Give a reason for your answer.

_____

_____

QUESTION 6 [12]

6.1. Write a basic explanation as to how nucleur energy is produced.

_____

_____

_____

_____

_____

6.2. Name 1 disadvantage of nucleur energy.

_____

6.3. Name 1 advantage of nucleur energy.

_____

6.4. Considering all the forms of energy available to manufacture electricity, which two do you think are the most suitable for South Africa? Give a reason for your answer.

_____

_____

6.5. In your opinion, are coal fired power stations a good long-term solution for energy generation? Give a reason for your answer,

_____

_____

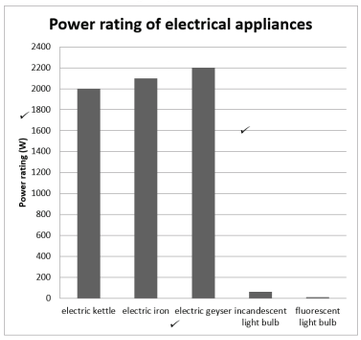
_____

Total: 40 marks

Grade 9
Natural Sciences
Term 3

Test
Memorandum

CAPS Topic	Questions	Expected answer(s)	Marks
	1		
Resistance	1.1	D ✓	1
Forces	1.2	A ✓	1
Forces	1.3	C ✓	1
Electric cells as energy systems	1.4	B ✓	1
	2.		
Electricity and the national electricity grid	2.1	B ✓	1
Series and parallel circuits	2.2	A ✓	1
Series and parallel circuits	2.3	C ✓	1
Resistance	2.4	D ✓	1
	3.		
Resistance	3.1	ohm ✓	1
Energy and the national electricity grid	3.2	uranium ✓	1
Energy and the national electricity grid	3.3	battery ✓	1
Series and parallel circuits	3.4	electron ✓	1
Series and parallel circuits	3.5	transformers ✓	1
	4.		
Series and parallel circuits	4.1	V1 = V2 + V3 ✓	1
Series and parallel circuits	4.2	3A ✓	1
Series and parallel circuits	4.3	a ✓	1
Series and parallel circuits	4.4	Lightbulbs b and c will share the current through the pathway ✓	1
Series and parallel circuits	4.5	The voltage will double ✓	1
Series and parallel circuits	4.6	The voltage will remain the same ✓	1

	5.		
Energy and the national electricity grid	5.1		3
Energy and the national electricity grid	5.2	2200W = 2.2kW ✓ 180c = R1.80 ✓ Cost = 2.2kW x 5hrs x R1.80 ✓ Cost: R19.80 ✓	4
Energy and the national electricity grid	5.2	(Answers may vary) Fluorescent light bulbs ✓ because they have a lower power rating and will be cheaper to use in my house. ✓	2
	6		
Energy and the national electricity grid	6.1	(Answers may vary) • Uranium is the element that is used in the power station. ✓ • Radioactivity produces heat during nuclear fission. ✓ • Nuclear fission is the splitting of atoms. ✓ • The heat released is used to heat water which produces steam. ✓ • This steam is used to spin a turbine which turns a generator which generates electricity. ✓	5
Energy and the national electricity grid	6.2	(Any one) ✓ • Produces radioactive waste • Expensive	1
Energy and the national electricity grid	6.3	(Any one) ✓ • Renewable • Produces large amounts of electricity • Does not produce greenhouse gasses	1

Energy and the national electricity grid	6.4	(Answers will vary) • Solar and wind. ✓ • South Africa has an plenty of sunlight and most homes can be fitted with a solar panel at a reasonable cost. ✓ • South Africa has large open spaces that are suitable for wind turbines. ✓	3
Energy and the national electricity grid	6.5	(Answers may vary) No. Coal is a non-renewable energy resource and is also responsible for large amounts of pollution. ✓ ✓	2
			TOTAL 40