Lighthouse - series

Natural Sciences

Grade 7 Learners Guide

ACSI Association of Christian Schools International

INSTITUUT VIR CHRISTELIKE ONDERWYS

Natural Sciences

Grade 7

Learner's guide

The ICO Waterstroom series has been translated into English by Anchorage Curriculum Solutions

Index

TERM 1: Life and living things

TERM 2: Matter and materials

TERM 3: Energy and change

TERM 4: The Earth and space

Term 1

Life and Living things

Values

View of God: (Who is God?)
God is the Creator. Only He controls life and death. He is a God of order. We can see this in nature.

View of man: (Who am I?)
Man is the crown of God's creation, made in His likeness. He knew me already since I was just a bunch of cells inside my mother's womb.

View of creation: (What must I do?)
God created heaven and Earth and all that is in it. It is a fact and not a theory. God has not revealed to us how he did that exactly. From the cultural mission, we know that man should prayerfully examine the works of creation, research and reflect on it, and humbly honour God for it.

Knowledge

→ **New words:**
- You can find the meanings of new words in the dictionary or on the internet.

→ **Scientific knowledge:**
- You learn what it takes to survive on Earth and what the Earth is made of.
- How and why animals and plants are classified.
- The reproduction of plants
- Differences in people

Skills

→ Examine plants, vertebrates and invertebrates.

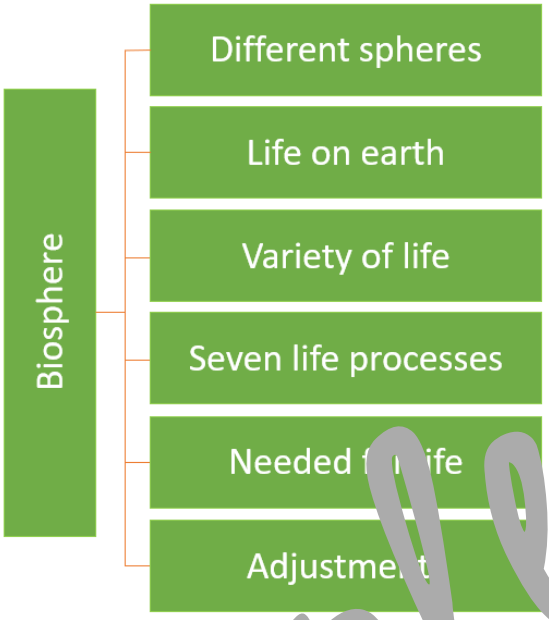
→ Research results processed into bar graphs and pie charts.

→ Form an opinion on gender.

→ Dissect the flower.

→ Build a timeline of your own life.

Unit 1: The biosphere



Activity 1: The biosphere

1. Why is there life on Earth a d n on oth anets?
2. When is something aliv ?
3. What do a ng thin s ed fr m their enviro ment?
4. What spheres the E rt d u know, besides the biosphere?
5. Where do we find e b st biodiversity in the biosphere?

In this unit, we discover exactly where on earth life occurs. We also discover what the characteristics are that all living things share. We also look at which spheres the Earth consist of and which sphere on Earth we live in.

The word biosphere comes from the Greek words bios and sphaira. Bios mean life, and sphaira mean sphere (circle). The biosphere is the sphere in which life exists.

The biosphere is all the parts of the Earth where life is found. The biosphere extends from the upper parts of the atmosphere to the deepest oceans and includes all living organisms.

Figure 1: The biosphere

Our biosphere is unique. No other planet has a biosphere like that of the Earth. The more you learn about this, the more you will be amazed by how intelligent and creative God created it all and that we may be part of it as the crown of creation.

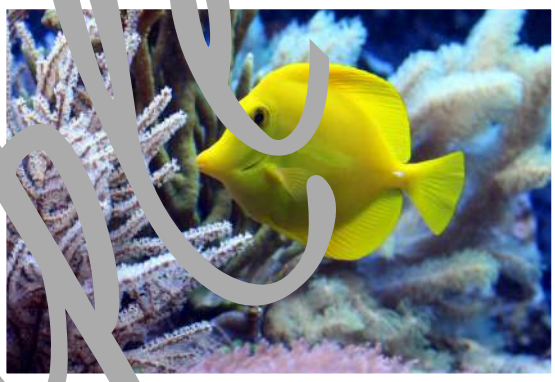
Activity 2: Where do we find life on Earth?

1. Look at the pictures below.

   a. Describe what you see in each picture.

   b. Do you think there is life in that area? If s[illegible]ive e[illegible]mples of living things.

A



B

C

D

E

F

After doing this activity, we can come to the conclusion that life is present everywhere on Earth, from the highest mountain peaks to deep in the oceans. Where living conditions reaches extremes, less life is present. The upper parts of the atmosphere have fewer gases and very low temperatures, while the deepest parts of the oceans are dark and cold. Only a few animals can adapt to these conditions. Therefore, most life is present in the parts in-between.

1.1 Different spheres

The biosphere consists of different parts: the atmosphere, hydrosphere, and lithosphere. All the spheres in the biosphere are connected and overlap.

Figure 2: The atmosphere

1.1.1 Atmosphere

The atmosphere is the layer of air that surrounds the Earth. It seals the pla[illegible] space, consisting of a combination of g[illegible]. These gases do not [illegible]ppear i[illegible]space because the earth's g[illegible]ity att[illegible]hem. The further you move up fr[illegible] the [illegible]'s [illegible]face, the thinner the atmosphe[illegible] bec[illegible]s.

The atmosphere plays a vital r[illegible]le in life on Earth. It protects us from the electromagnetic and ultraviolet radiation from the sun. Meteorites will largely or entirely burn out in the atmosphere to not hit the Earth. The atmosphere also keeps the Earth's temperature stable.

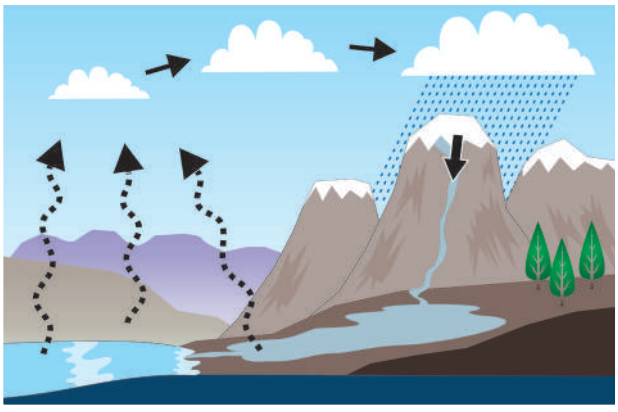


Figure 3: The water cycle

1.1.2 Hydrosphere

The Earth's water forms the hydrosphere. The water is found in the air (as water vapor), on the Earth's surface, under the ground and in all living organisms. The largest part of the Earth's surface is covered with water, and all living organisms are dependent on water.

1.1.3 Lithosphere

The outer part of the Earth consists of a sturdy and non-flexible rock shell called the lithosphere. In certain places, such as mountains, the lithosphere is thick, and in other places, like under the oceans, the lithosphere is not so thick.

Most life on Earth is present on and inside the Earth's surface. The Earth's surface is essential for life on Earth because plants can grow in the fertile soil. Plants are the beginning of all the food chains on Earth and take their food out of the ground.

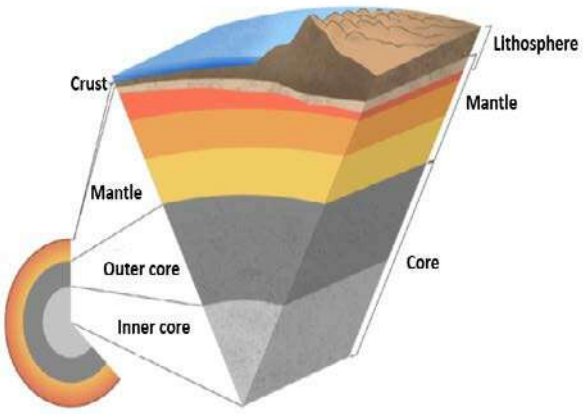


Figure 4: The lithosphere

Activity 3: The spheres

1. What spheres does the Earth consist of?
2. What sphere on Earth do we live in?
3. In what sphere on Earth (do you think) does most life occur?
4. What important role does the atmosphere play for the Earth?
5. In grade 6, you learned about the three states of matter. Look at the water cycle diagram on the previous page and identify in which three states of matter water occur.
6. Look at the three pictures below. How are the organisms dependent on the lithosphere?

A

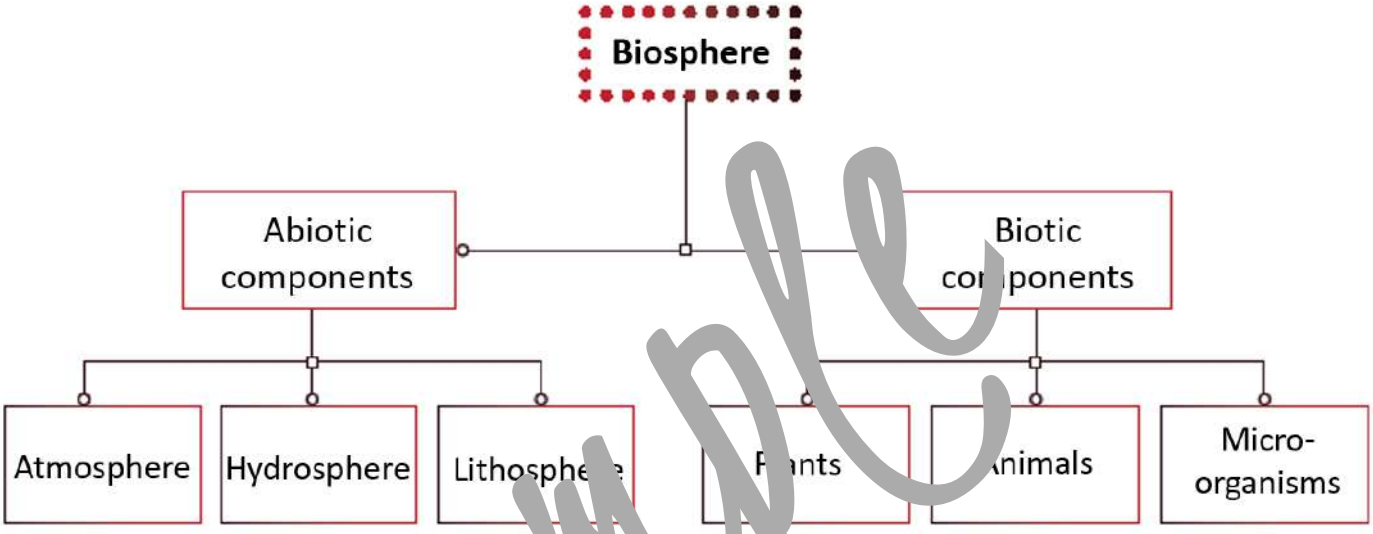
B

C

1.2 Life on Earth

The biosphere consists of non-living (abiotic) and living (biotic) components. The non-living components are the atmosphere (air), hydrosphere (water) and lithosphere (rocks).

The living components in the biosphere are plants, animals and microorganisms. Microorganisms are tiny organisms that can only be seen through a microscope, for example, bacteria.



Dead organic material is also part of the biosphere. When living organisms die, it forms dead organic material in the soil. Organic material is produced by microorganisms (bacteria and fungi) that decompose it to very fine particles. They act as nutrients and mineral salts and return to the soil or become part of the hydrosphere or atmosphere. Plants and other living organisms absorb the nutrients.

1.3 Variety of life

There is a very large variety of life on Earth. It is also called a large biodiversity. In each layer of the biosphere, life occurs.

→ Atmosphere: Birds and insects can fly through the air. Pollen and plants can spread through the air.

→ Hydrosphere: Plants and animals live in fresh or saltwater. Plants like seaweed and algae, animals like fish and many crustaceans, and microorganisms like plankton and amoeba live in water.

Figure 5: Variety of life

→ Lithosphere: A large variety of animals live in and on the ground. Rabbits and warthogs make their homes in the ground. Fungi, bacteria and microorganisms break down the dead organic matter, and the roots of plants are anchored in the ground.

Activity 4: Biodiversity

Complete the table below.

Component of biosphere	Challenges for organism	Example of an organism	How is the organism adapted?
Atmosphere	Move through the air.	Fish eagle 	Large and powerful wings. The heart and lungs can handle the ox n deficiency high in the air.
Atmosphere			
Atmosphere			
Hydrosphere	Move underwater.	nguin 	Streamlined bodies, heavy legs to tay under water, and equipped ith webbed feet.
Hydrosphere			
Hydrosphere			
Lithosphere	Move through the ground.	Earthworm 	Streamlined, round bodies with fine hairs that help them move through the ground.
Lithosphere			
Lithosphere			

1.4 The seven life processes

The unique creation ordinances and order of God can also be seen in living organisms. Because of these unique characteristics, man can also order and name them. Living organisms distinguish themselves from non-living things through the seven life processes they can perform.

1.4.1 Nutrition

Figure 6.1: Nutrition

All living organisms need nutrition for energy. All humans and animals get food though eating other living organisms. Most plants produce their own food through the process of photosynthesis. Plants absorb carbon dioxide and water by using the energy of sunlight and then convert it into nutrition for the plant.

Figure 6.2: Metamorphosis of butterflies

1.4.2 Growth

Any living organism can grow from birth. Some animals undergo a complete metamorphosis. Other animals show a gradual change as they grow. Most plants grow from seeds to seedlings. Other plants, such as ferns, grow from spores.

1.4.3 Reproduction

Figure 6.3: Reproduction

Living organisms can produce offspring through the process of reproduction. Animals can lay eggs or give birth to living offspring. Plants reproduce by spreading their seeds which shoots roots and new plants begin to grow. Bacteria reproduce through cell division, and animals such as sponges can 'germinate' babies like buds growing out of the parent's body.

Figure 6.4: Photosynthesis

1.4.4 Respiration

Living organisms need oxygen to extract energy from their cells. Oxygen responds to sugar in our cells, and through this, energy is released. The process of energy production is called respiration. Humans and animals take in oxygen and get rid of carbon dioxide by breathing. Plants take up the carbon dioxide and releases oxygen.

1.4.5 Excretion

Excretion is the process of excreting the waste products produced as a by-product in our bodies. Our waste is excreted by breathing, sweating and urinating. Animals excrete waste products with their lungs and kidneys. Plants excrete waste products through pores in their leaves.

Figure 6.5: Excretion

Figure 6.6: Movement

1.4.6 Movement

Living organisms can move parts of their bodies or their whole body. Movement enables animals to find or capture food, escape from enemies or find shelter. Plants are rooted in one place but can grow in different directions, and their flowers can open and close. Unlike animals, plants have no muscles, and their movements are much slower.

1.4.7 Sensitive to the environment

Your senses tell you what is happening in the world around you. Any living organism can sense what is happening around them and respond to it. This way it can adapt and survive.

Figure 6.7: Sunflowers turn their head to the sun

1.5 What living things need

Now that we can determine whether something is alive or not, we can look at what living things need to survive. We call it the requirements to sustain life.

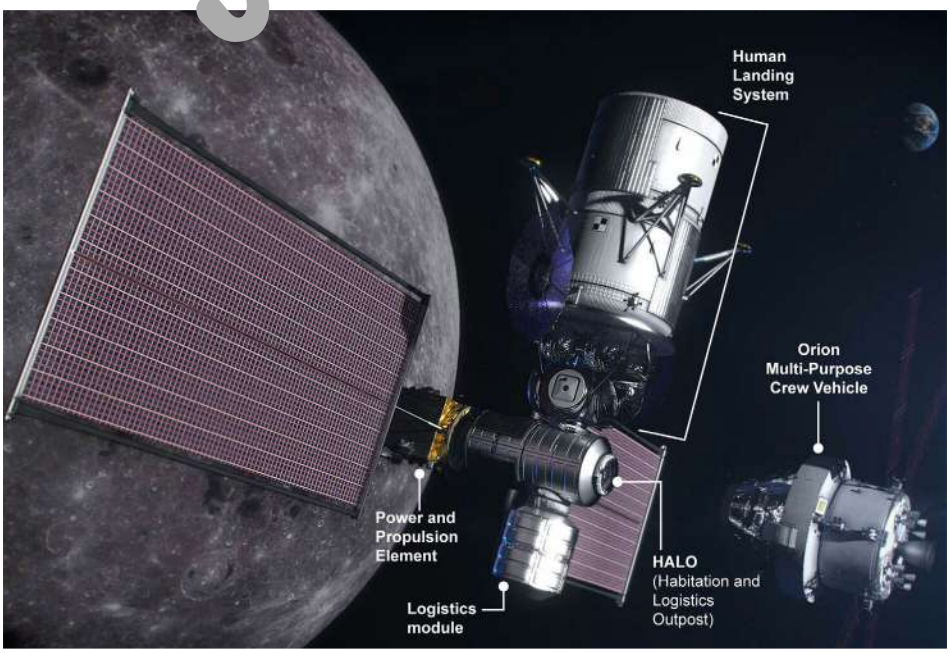


Figure 7: Future lunar station (Source: NASA)

Activity 5: Requirements for life

1. NASA has decided to build a lunar station where people can go to live permanently. You are part of the design team for the lunar station. The most important considerations to think about are: What do astronauts and plants need to survive on the moon? Try to list the five most important requirements. Work in groups of four learners. You have five minutes to list the five requirements.
2. Discuss the answers in class.

1.5.1 Energy

In Psalm 19, David sings of the wonderful creation and mentions the sun. The whole creation, yes, also the sun, testifies of God's omnipotence and His faithful care. Without the sun, life on Earth would not be possible. The sun's energy sustains life on Earth. Green plants absorb the energy and make their own food from it. In return, all humans and animals are dependent on energy from plants.

1.5.2 Gases

Oxygen and carbon dioxide are some of the gases that living things need. People and animals need oxygen which releases energy in our cells to use. Plants need carbon dioxide to produce food during the process of photosynthesis.

The gas that is most present in our atmosphere is nitrogen. Living things need it because it is present in many cells, such as proteins and our DNA, and it plays a role in the processes that take place in our bodies.

1.5.3 Water

All living organisms need water for survival. All living organisms that need oxygen also need water. Water helps in the respiratory process. Fish can only breathe in water. Water can help organisms keep their temperature stable.

1.5.4 Soil

Soil has properties that are necessary for vegetation. Plants convert the chemical elements inside the soil so that humans and animals can absorb them. Plant roots grow in the soil. Soil also contains worms, beetles, fungi, as well as bacteria. Soil thus provides plants with the necessary nutrients. Plants are needed to sustain life on Earth, and without soil, plants will not grow. We can see that the Creator prepared the Earth down to the finest detail to be home for man.

1.5.5 Favourable temperatures

Temperature is the intensity of heat and cold. Many living things cannot function properly without the right temperature and will not survive. Temperature can affect the metabolism, reproduction and growth of animals and plants.

Activity 6: Practical investigation

In this investigation, you are going to germinate seeds. You will investigate and test the requirements for the germination of seeds.

Step 1: Purpose of the investigation. What do we want to find out?

1. Examine what seeds need to germinate.

Step 2: Form a hypothesis

A hypothesis is your idea/answer or prediction of what will happen and why.
The hypothesis can be tested through an experiment.

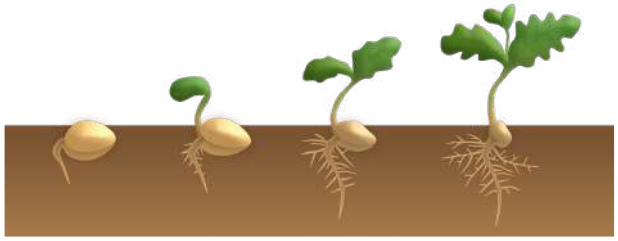
2. Write the hypothesis.

Step 3: Design the experiment

The experiment does something that will help you test whether your hypothesis is correct. Plan how you are going to do your research. Think about what requirements you are going to test for and how you will take away those requirements. In this experiment, the method is already planned for you.

Method:

1. Collect five equally sized containers in which the seeds will germinate.
2. Number each container from 1 to 5.
3. Container 1 is the control. This means that this container will meet all the requirements for germination. All the other containers can be compared with the control because it has the right conditions for germination. Make sure that for 14 days, this container stands in a sunny place, the seed is in fertile soil, and it is watered every second day.
4. Containers 2 to 5 are going to be the trials.
5. Remove sunlight from container 2 by placing it in a dark closet.
6. Remove water from container 3. Place it next to container 1, but do not water it.



Activity 6: Practical investigation (continues)

7. Remove gases from container 4. Place the container on a glass plate. Cover it with a glass bell and seal the edges with Vaseline.
8. Remove soil from container 5. Place the seed in water.
9. Compare the germination of the seeds with each other after 14 days.

List of apparatus and materials you will need for the experiment:

→ Seeds
→ Five containers
→Potting soil
→ Glass plate
→ Glass bell
→ Black marker
→ Water

Step 4: Record your observations

Record your observation in the table below

Plant	Length of seedlings	Description of the plant after 14 days
1: Control		
2: No sunlight		
3: No water		
4: No carbon dioxide		
5: No soil		

Step 5: Make conclusions about the observations recorded in the table.

Was your hypothesis right or wrong?

_____

What conclusion can be drawn about the need for sunlight, water, gases, and soil to germinate seeds?

_____
_____

1.6 Adaptions of living things

Living things are adapted to the environment they live in. This enables the living organisms to better survive. Adaptions can be in the form of behaviour or the organism's physical properties.

Polar bears will hibernate to survive the long, cold winter. Birds will migrate to other countries to avoid the coldest temperatures. The same goes for many marine animals that travel long distances to warmer water.

Figure 8: Hibernation of polar bears

Plants will lose their leaves, or their above-ground parts will die during the winter while their roots stay alive.

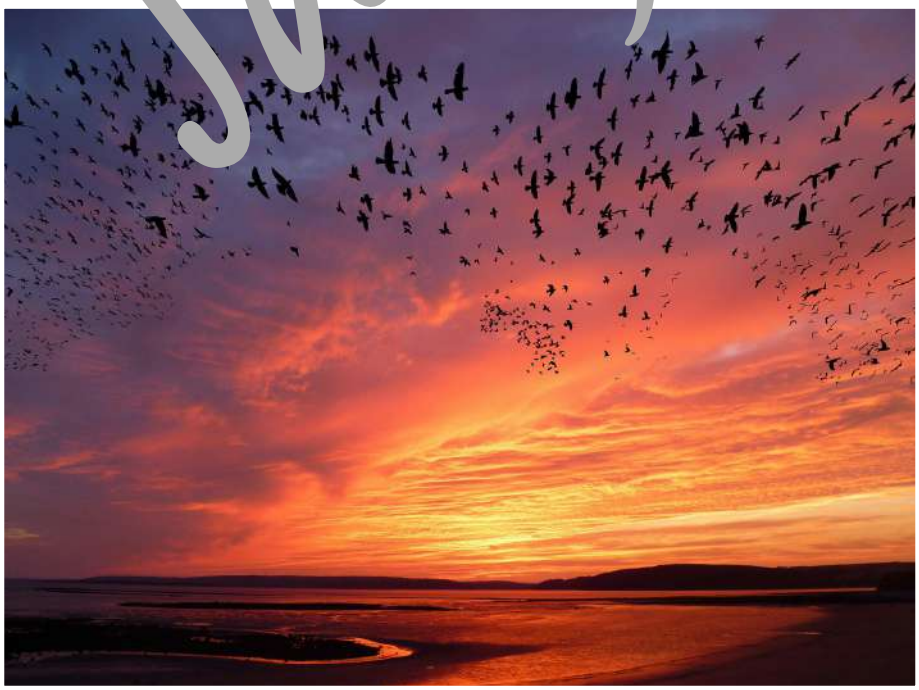
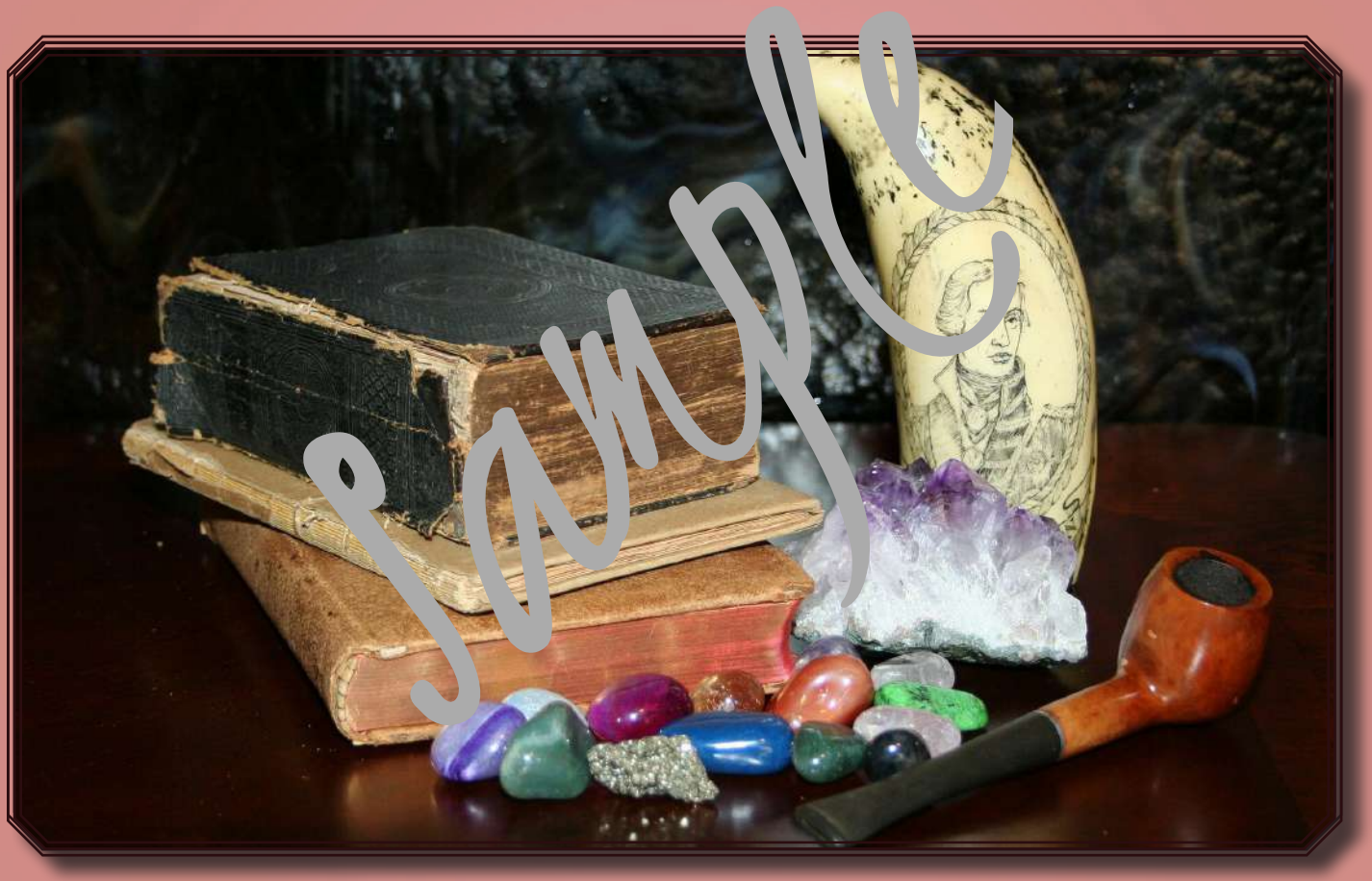


Figure 9: Migration of birds

Term 2

Matter and materials



Values

- **View of God:** God is omnipotent and in control of all things. He determines all things in, on and under the earth. He is also the Provider of all that man needs and reveals his omnipotence in it.
- **View of man:** Man was created in such a way that he could distinguish between the Creator and the creation. The Creator is worshiped, not the creation. God created the laws of nature so that man can clearly observe the boundary between the Creator and the creation.
- **View of creation:** We were created with m rial n ds. The Lord provides for it. With the materials, we can build houses, he t ood a d so on. We need to find a balance between using and abusing these m t rials d ruli g responsibly over what He has provided. Creation must be dilige ly an caref lly explored.

Knowledge

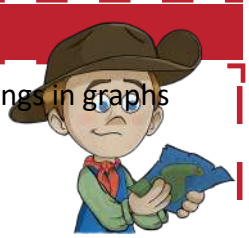
New words:

- New concept a explai e in th textbook or b your teacher. When you are unsure, you ca consul a d ctionary, other source or the internet.

Scientific knowledge:

- You learn the physical roperties of materials, their advantages and disadvantages, and their impact on the environment.
- You learn about the different types of mixtures, how they are separated, sorted and recycled, and how waste is managed.
- You learn about acids, bases and neutrals, as well as their properties and how you can identify them using indicators.

Skills



→ Examine the strength of materials and boiling and melting points. → Record readings in graphs

→ Separating mixtures

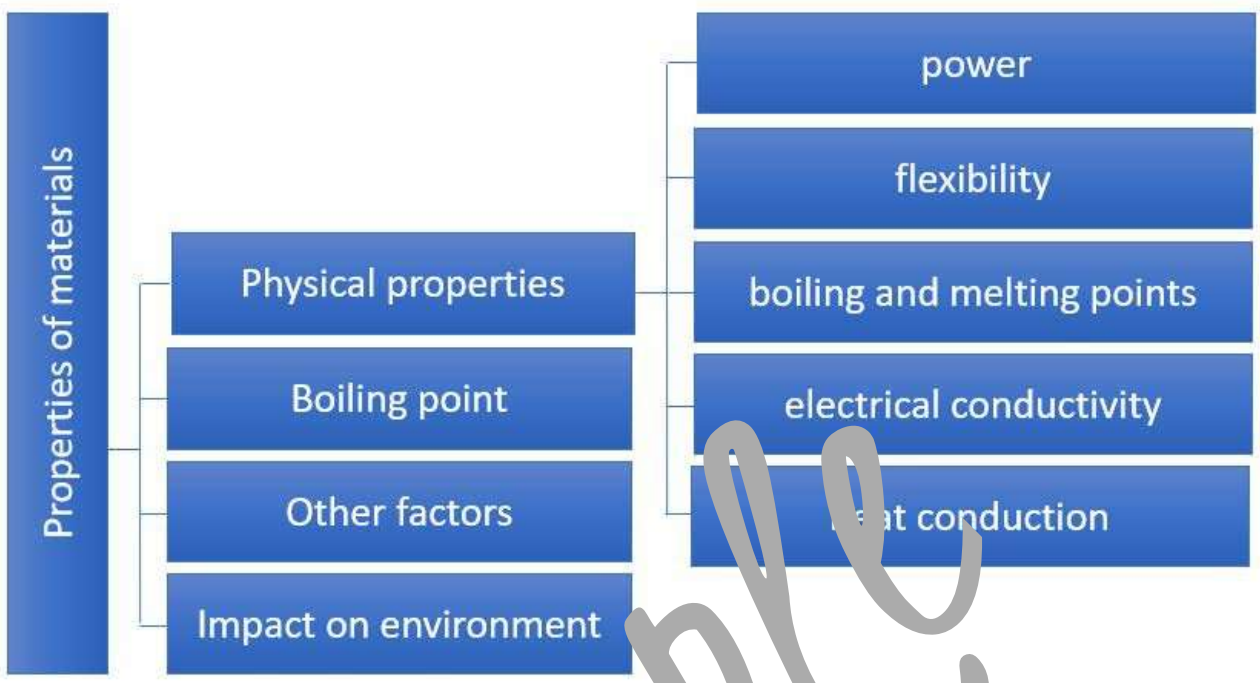
→ Calculate your carbon footprint

→ Tasting and recognizing acids and bases

→ Test of acids & bases

→ Draw pH scale

Unit 1: Properties of materials



Everything you use is made of materials. Each material has certain properties that make it suitable for a specific purpose. In this t[opic] you will learn more about materials and their properties.

It is important to choose the right materials for the right goal. The choice of, for example, the material of the book you are reading, the bicycle you are riding and the chair you are sitting on have been well thought out.

Figure 1: Different materials

A bicycle is not made of paper, and a book is not made of metal. The properties of paper (e.g. flexible) are not useful to use for the bike. The properties of a metal are that it is strong and durable, but the properties make it unsuitable for a book.

The properties of materials are measured and studied to know for what purpose the material can be used.

Figure 2: Pot on the stove

1.1 Physical properties

Different materials have different properties.

WHAT IS A PHYSICAL PROPERTY?

It is any property which can be measure or observed without changing the material.

We use our senses to perceive and gather information. You can see, hear, feel, taste or smell. For example, you can feel the texture of the material with your hands.

Other physical characteristics can be measured using an instrument. For example, a thermometer measures the temperature.

- Examples of observable physical properties are colour, texture, size, shape, hardness and flexibility.
- Examples of measurable physical properties are volume, weight, temperature, conductivity, freezing point, boiling point and melting point.

The features we look for in this unit are strength, flexibility, boiling and melting points, electrical conductivity and heat conductivity.

The properties of a material determine how suitable it is for a specific use.

Activity 1: Properties of materials

Look at the pictures below and describe the following for each one:

1. What material is the product made of?
2. What are the properties of the type of material from which it is made?
3. Why is it suitable for this use?

There are many more properties of materials than those mentioned in the textbook. Try to describe it first with the features mentioned in the textbook. Then see if you can think of other features.

- The structure of a car
- Coins
- Bath toys
- Ruler
- Lightning conductor
- Teapot

1.1.1 Strength

STRENGH OF A MATERIAL

The strength of a material is the ability to withstand stress without breaking.

In other words: the material will not break when force is applied to it. When we talk about how strong a material is, we refer to the maximum force exerted on it before it breaks.

The strongest materials in the world are diamonds. D[illegible]ond[illegible]e therefore not only used in engagement rings. Dentists use it at the tip of the dril[illegible]o fix h[illegible]s in your teeth. The large drills used on the oil fields rely on diamonds to get thro[illegible]n the [illegible]w ro[illegible]ks, and even in computers, diamonds are used because they ar[illegible] res[illegible]tant to [illegible].

Figure 3: The tips of dental drills contain diamond pieces

Figure 4: Diamonds are also used in computers

Activity 2: Strength

In this investigation, we are going to compare the strength of materials by dropping weights on them.

Step 1. Purpose of the investigation.

Formulate a question and write it down. The answer given to this question is the outcome of the experiment.

Activity 2: Strength (continues)

Step 2. Form a hypothesis.

A hypothesis is an answer to the research question. Even if you are not sure which material is perhaps the strongest/weakest, you will have a suspicion. Write it down.

Step 3. Design the experiment

This experiment does something that will help you test whether your hypothesis is correct. The method has already been devised for you.

Follow the steps below and complete the table.

1. Cut out the different papers in squares/rectangles of the same size.
2. Copy the table below in your workbook.
3. Collect different weights with which you can te[illegible]he m[illegible]erial, for example, an eraser, a pen, a bottle with some water, a bottle full of w[illegible]t[illegible]r, et[illegible]
   Weigh the weights so that you know how heavy [illegible]a[illegible]h we[illegible]ht is i[illegible] grams.
4. Two learners will have to hold the corners of the m[illegible]terial. Mak[illegible] sure the fabric is taut without pulling on it.
5. Let one learner drop the weights from a heig[illegible]t o[illegible] app[illegible]oximately [illegible]50cm.
6. Start with an object that weighs little[illegible]nd ther[illegible]s[illegible] a hea[illegible]ier o[illegible]ject each time until the material tears. Record the conclu[illegible]s[illegible] the ta[illegible]

List the apparatus a[illegible]d m[illegible]ateria[illegible]s y[illegible] wil[illegible] need for the ex[illegible]eriment:

- Aluminium foil
- Newspaper
- Photocopy paper
- Wash paper
- Toilet paper
- Different weights
- Scale

Figure 5: Different type papers

Activity 2: Strength (continues)

Step 4. Record the observations.

Record your observations in the table below

Material	Weight it can carry in grams
Aluminium foil	
Newspaper	
Photocopy paper	
Washing paper	
Toilet paper	

Step 5. Make conclusions about the observations recorded in the table.

Answer the questions below in your workbook.

1. Was your hypothesis right or wrong?
2. Which material is the strongest?
3. Which material is the weakest?
4. Arrange the types of material in order from weak to strong.
5. For what is the strongest material that have been used? Is it important that this material is strong?
6. For what is the weakest material used?
7. Why is newsprint so thin and therefore not very strong?

1.1.2 Flexibility

FLEXIBILITY OF A MATERIAL

The flexibility of a material describes the ability of a material to bend without breaking and bending back to its original size/shape after it was bend.

Examples of easily bent materials are elastics, electric wire, and some rulers.

Figure 6: Flexible ruler

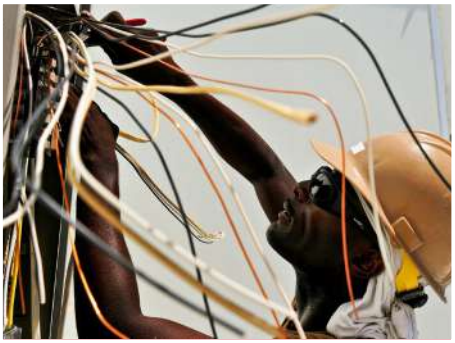


Figure 7: Electricity wire

Before we learn about boiling and melting point, it is important to first review the phases of matter: solids, liquids and gases.

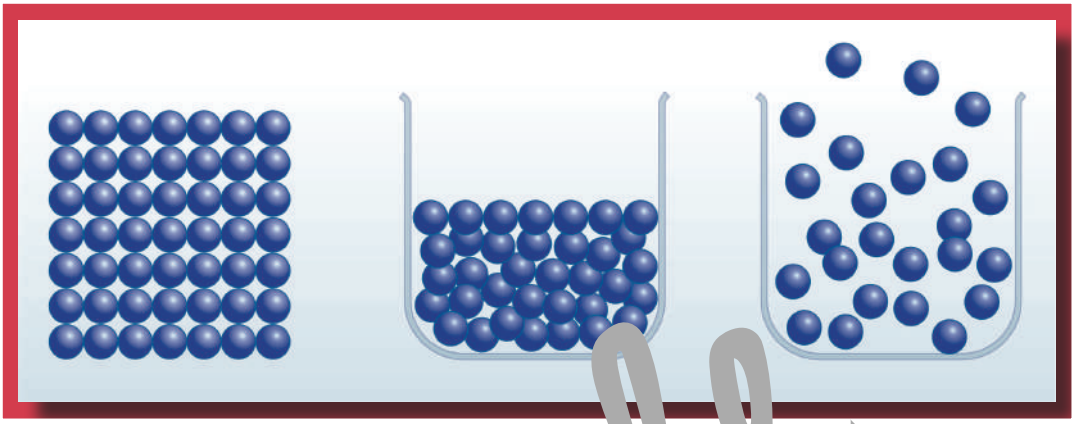


Figure 7: Phases of matter

BOILING POINT AND MELTING POINT OF MATTER

The boiling point is the temperature at which a liquid change into gas.

Figure 9: Boiling point

Figure 10: Melting point

The melting point is the temperature at which a solid change into a liquid.

We all know that water turns into a gas (evaporates) when it gets hot. It is the boiling point of water. When ice is heated, it turns into a liquid, namely water. It is called the melting point. Each substance has its own melting point and boiling point.

The melting point and boiling point can be measured with a thermometer. It is properties that cannot be observed but must be measured.

Every material has its own unique melting and boiling points.

The atoms in a solid are tightly packed. When a solid is heated, the atoms get more energy. The energy causes the atoms to start moving side by side, and the solid will turn into a

liquid. As the liquid heats up further, the atoms get even more energy. The atoms will move apart and turn into gas.

When the force between the atoms is very strong, much more heat is needed to move the particles. It means that the boiling and melting points will be higher. Thus, the boiling and melting points of materials differ.

Remember
Atoms are the smallest particles that make up all matter.

Figure 11: Atom

Activity 3: Boiling point of water

In this practical investigation, you will investigate water's melting and boiling point.

Step 1. Purpose of the investigation

Formulate a question and write it down. The answer given to this question is the outcome of the experiment.

Step 2. Form a hypothesis.

A hypothesis is your answer to the research question. Even if you are not sure which material is the strongest/weakest, you will have a suspicion. Write it down.

Step 3. Design the experiment

This experiment does something that will help you test whether your hypothesis is correct. The method has already been devised for you. Follow the precautions and steps below and complete the table.

Precautions

- Remember: you will work with heat (fire) and boiling water. It can cause burns when you come in contact with it. Be careful and follow your teacher's instructions and the steps below carefully.
- The thermometer is used for temperature readings. It can break easily when you stir with it or when it touches the bottom or sides.

Activity 3: Boiling point of water (continues)

Steps

1. Set up the experiment as shown in figure 12. When in doubt, ask your teacher to make sure everything is set up correctly before starting the experiment.
2. Fill the glass beaker with crushed ice.
3. Place the thermometer in the glass cup, read the temperature and record it on the table.
4. Use the clamp stand to keep the thermometer upright.
5. Ask your teacher to help with the next step. When the ice has [illegible] you can light the Bunsen burner. Make sure the flame stays small.
6. Take temperature readings every three minutes until the ice has melted.
7. Record when the ice has started to melt and when everything has melted.
8. Take temperature readings every three minutes until the water boils and you have three constant readings.

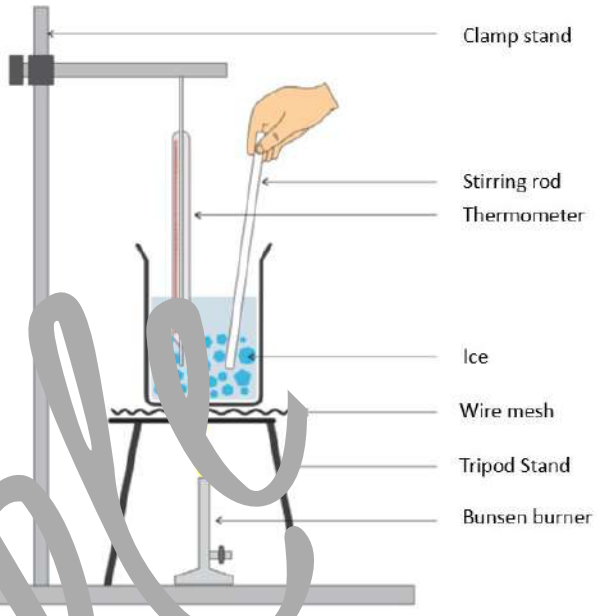


Figure 12: Example of an experiment

List the apparatus and materials you will need for the experiment

- Clamp stand
- Bunsen burner
- Tripod stand
- Wire mesh
- Glass cup
- Thermometer
- Ice (broken)
- Graph paper / rough work paper

Activity 3: Boiling point of water (continues)

Step 4. Record the observations

Time in minutes	Temperature in °C
0	
2	
4	
6	
8	

Expand the table as your measurements continue.

1. Record the readings on a graph, on graph pape
2. Put the time on the horizontal line (X-axis) and the temperature on the vertical line (Y-axis).

Step 5. Make conclusions about the observations recorded in the table.

1. What is the melting point of water?
2. What is the boiling point of water?
3. What do you observe about the temperature when the water starts to boil?
4. What is happening to the water at this stage?

DID YOU KNOW?

The boiling point of water on top of very high mountains can be as low as 71 ° C. The atmospheric pressure affects the boiling point. The higher the atmospheric pressure, the higher the boiling point. The atmospheric pressure is lower in the mountains, so the boiling point also becomes lower.

DID YOU KNOW?

The boiling point of water on top of very high mountains can be as low as 71 ° C. The atmospheric pressure affects the boiling point. The higher the atmospheric pressure, the higher the boiling point. The atmospheric pressure is lower in the mountains, so the boiling point also becomes lower.

Figure 13: Gallium

Activity 4: Boiling and melting points

As you can see in the table below, there are significant differences in the boiling and melting points of the different materials.

Material	Boiling point in °C	Melting point in °C
Salt	1413	801
Water	100	0
Ethanol	78.3	-114
Paraffin	220	57
Iron	2862	1538
Koper	256	1084
Gold	2856	1064
Silver	2162	961.78
Lead	1749	327.46
Helium	-268.9	-272.2
Tungsten	5900	3410

1. Which substance has the highest boiling and melting points?
2. Which substance has the lowest boiling and melting points?
3. Why do the substances have different boiling and melting points?
4. In which phase will water be at 25 °C?
5. In which phase will iron be at 1 200 °C?

The boiling and melting points of matter can be used to test how pure the substance is. The boiling and melting points will change when even a small amount of another substance is added to the original substance.

Only water will boil when it is 100 °C, while seawater (which contains salt) will only boil when it is 102 °C.

Figure 14: Melted iron

1.1.4 Electrical conductivity

WHAT IS ELECTRIC CONDUCTIVITY?
Electrical conductivity is the ability of an electric current to flow through a material.

Certain materials such as metals will conduct an electric current very well. It is what we call good electrical conductors. Materials such as plastic and wood will not conduct electricity. These are called insulators.

For electricity to move from one point to another, electricity wires are used. Electric wires are made of copper wire which is a good conductor. The copper wires are encased with plastic, which prevents electricity from flowing where it is not needed or where it can be dangerous.

How does it work?

Everything is made up of atoms. The atom consist of electrons, protons and neutrons. Electrons are charged particles that can move around inside an atom and can also move from one atom to another. When many electrons move in the same direction from atom to atom, electric charge flows as water can flow through a pipe.

1.1.5 Heat conduction

WHAT IS HEAT CONDUCTION?
Heat conduction is the transfer of heat within an object or between two objects that are in contact with each other.

In other words, it is the transfer of energy in the form of heat due to a difference in temperature in a material or between materials. Heat will always flow from a higher temperature to a lower temperature.

Good conductors of heat are, for example, metals and are used in saucepans so that food can be heated. Weak conductors of heat are wool, rubber and wood.

1.2 Other factors

Other factors to consider before selecting a material for a particular purpose are:

- Cost
- Colour
- Texture

The examples below make it clear why cost, colour and texture need to be considered.

- Gold is a very good conductor of electricity but is not used for electrical wires. The cost is just too high.
- Certain colours will be tied to fashion trends, and people will only like them for a few years.
- When you wear clothes, the texture is very important because you will 'feel' it on your body all day. Do you think it is comfortable to wear rubber pants? Texture is also important for a surface such as a table, the kitchen counter and a desk. These surfaces will need to be smooth and nicely level. It will be very impractical if a kitchen counter is made of coarse wood.

Figure 15: Gold

Figure 16: Fashion trends

Figure 17: Texture of a kitchen countertop

1.3 Impact on the environment

The earth has just as much space and resources for all the organisms that live here. People often forget that the earth is shared with many other organisms. As believers, we have received a very specific command from the Lord to cultivate, inhabit, and preserve the earth. The Lord has given us the earth with wonderful resources we must and may exploit. We are also stewards with a mandate to use it in such a way that we do not deplete or damage the earth. What we (think) we need and take from our environment can potentially threaten other life on earth.

Everything we need to survive, in other words, our needs and everything we want, our desires, comes from the earth. We cut down trees and build houses and make furniture with them. We drain lakes and underground dams to have enough water to drink, clean environments, factories and houses, and irrigate agricultural crops.

The extraction of coal, oil, and natural gas makes it possible to use cars, cell phones, and computers, but habitats can be destroyed in the process of extraction. We are turning large nature areas into agricultural land or new residential areas.

Everything we do affects the world around us. Many of the materials we use are first mined and then manufactured into usable products. The mining and manufacturing process has an impact on the environment. Look at the pictures below and answer the questions about them.

Metals

Metals are mined through mining. When mining take[s] p[l]ace, it can significantly impact the environment. It affects t[h]e air and water quality, destroys the habitat of animals and o[th]er living organisms and can cause erosion (substa[nc]es containing poison are taken into the air by the wi[nd] o[r] carried away by the water, causing them to spread [to] o[th]er areas).

Figure 18: Metal

However, the mining o[f] metals is [an] impor[tan]t pa[rt] of our economy.
South Africa is the worl[d's] largest pro[du]cer of chromium, m[a]nganese, and platinum and is one of the largest gold and iron o[re] p[ro]du[ce]rs.

- The advantages of me[t]als a[re] that they can conduct heat and electricity very well. It is a very strong mate[ri]al and can be formed into any shape to make it useful for a specific purpose.

Plastic

The raw materials for today's plastics come from many different sources (some even use salt!) But most plastics are made from materials found in nature, such as natural gas, oil and coal.

Figure 19: Plastic

Advantages of plastic:

- It is lightweight, water-resistant, durable, strong and resistant to rust.

Disadvantages of plastic:

- It pollutes the environment and is a great danger to wildlife.
- Artificial or natural processes cannot destroy plastic. It can only be recycled to obtain a new product.

Fuel

Fuel (oil, gas, and coal) is stored deep in our earth. The world we live in today is very dependent on these raw materials. For example, when you use electricity, it will be generated mainly by burning coal.

Figure 20 Fuel

Advantages

- It is easily available
- It is not expensive

Disadvantages

- It increases carbon dioxide emissions and causes climate change.
- Burning coal causes acid rain
- Its exploitation and transport can pose dangers.
- Oil pollutes marine life.
- Oil, coal and gas are not renewable

Activity 5: Impact on the environment

Write a short report on a product you use daily.
Investigate what materials the product consists of and where the materials come from.
Use the questions below to write a complete report.

1. What material/materials does this product mainly consist of?
2. How is this material made?
3. Where is the raw material for this material found?
4. How is it mined? Where is it mined?
5. What impact does it have on the immediate environment?
6. Why was this product made from this particular material? (What are the properties of this material that make it suitable for this product?)
7. Can it also be made of another material? And what material choice would you suggest that might have a smaller detrimental impact on the environment.
8. Why do you think it is important to develop alternative materials? Do you think Christians have a specific command in this regard?

Term 3

Energy and change

Values

View of God: God is an almighty God and created the earth with energy sources so that man could use it wisely.

View of man: Man can distinguish between good and evil, so he can also apply his knowledge and skills of energy correct and wrong. Since the Lord has appointed man as a steward, his commission is to make good use of energy sources without depleting the earth.

View of creation: As stewards, we are given a responsibility of tending the earth. By making more use of renewable energy sources, we can fulfil this command.

Knowledge

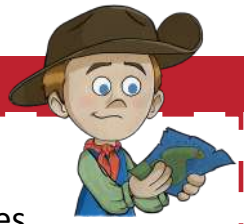
→**New words:**

- New concepts are explained in the textbook by your teacher. When you are unsure, you can consult a dictionary, other sources or the internet.

→**Scientific knowledge:**

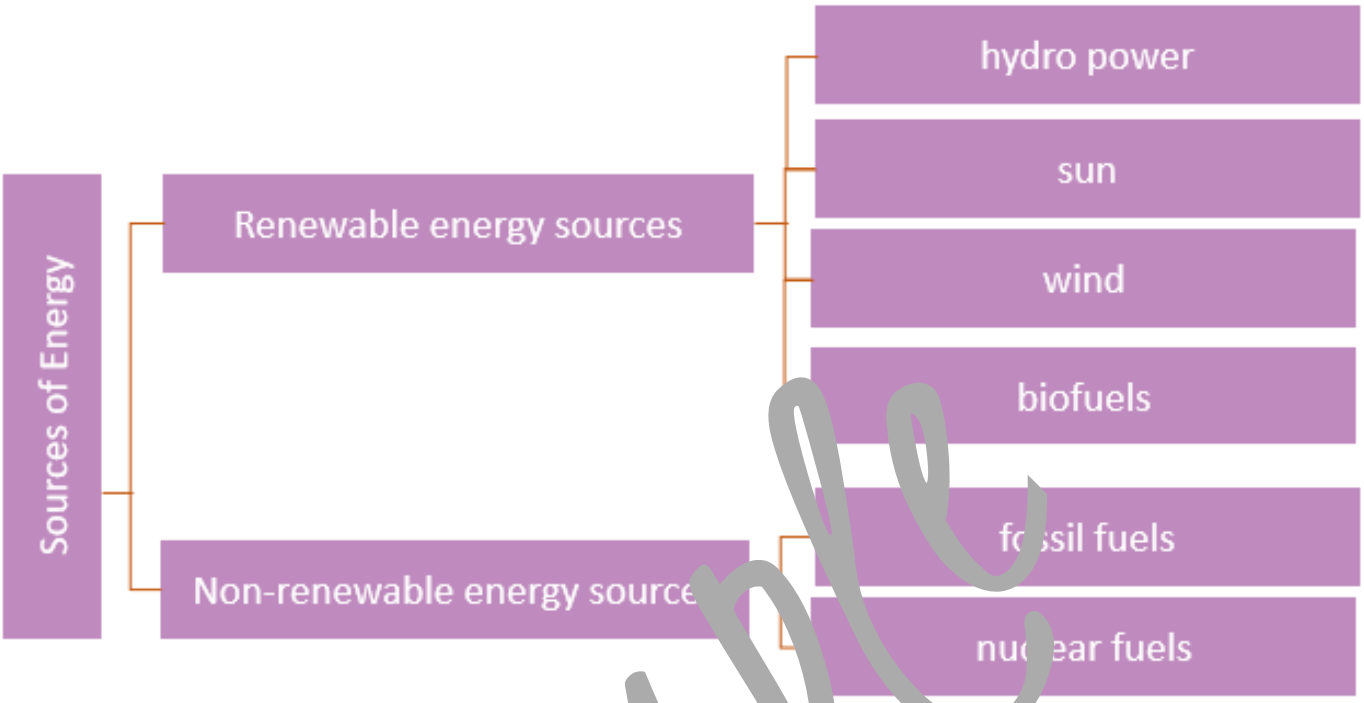
- You learn about the emergence of non-renewable and renewable energy sources and how they are used correctly and incorrectly. You also learn what potential and kinetic energy are and how it is transmitted in systems. You will also learn more about heat transfer and what materials can be used for insulation and energy saving.

Skills



→ Distinction between non-renewable and renewable energy sources.
→ Develop insight into the advantages and disadvantages of energy sources.
→ Design and construct a 'Rube Goldberg machine' in which energy transfer is visible.
→ Testing of materials for heat transfer.
→ Examine insulation material.
→ Build and test a well-insulated house.

Unit 1: Sources of energy



When children run around during breaks, we say they have a lot of energy. When someone starts yawning, we say he has little energy. When someone eats and drinks something, we say they get new energy again. But what is energy?

It is not easy to describe what exactly energy is. Energy comes in many different forms. You need energy to do your homework, play rugby, shop or make artwork. Vehicles need energy to move, and a lamp needs energy to burn. How then could we define energy?

Activity 1: Energy

Discuss the following questions in groups.

1. What is energy?
2. Give examples of non-renewable and renewable energy.
3. Which energy sources are mainly used in South Africa?
4. Which renewable energy sources will we be able to utilize more/better?

WHAT IS ENERGY?
Energy is the ability to perform work.

All people, animals and plants need energy to be able to live. Without energy, your body cannot function. To breathe, you need energy, and your heart needs to pump without stopping to move the blood through your body. Your body works day and night, and for that, it needs energy. The more energy you have in your body, the more you will be able to get done.

But where does energy come from, and what sources of energy are available to us?

1.1Sources of energy

WHAT IS A SOURCE OF ENERGY?
A source of energy is stored energy waiting to be used.

Let's use coal as an example. It is a source of energy. A lot of energy is stored inside coal. That energy can be extracted when we burn coal.

Energy sources can be divided into two groups:

- **Non-renewable energy sources**
  Non-renewable energy sources cannot be replenished. There is a limited amount, and it may run out.
- **Renewable energy sources**
  Renewable energy sources are constantly replenished and will not run out.

Activity 2: Non-renewable and renewable energy

The pictures below show different energy sources. Answer the following questions about the pictures:

1. Draw a table with two columns in your workbook. Write above the first column: "non-renewable energy sources" and above the second column: "renewable energy sources". Complete the table.
2. Would you say that more non-renewable or renewable energy sources are used in South Africa to generate electricity? Why do you think this is so?

Activity 2: Non-renewable and renewable energy (continues)

A. Coal

B. Wind

C. Uranium

D. Gas

E. Sunlight

F. Hydropower

G. Wood

H. Oil

1.2 Non-renewable energy sources

Non-renewable energy sources are also called fossil fuels. Most electricity is generated using fossil fuels. Fossil fuels are generally readily available, inexpensive, and efficient. The downside is that it runs out and releases a lot of carbon dioxide when burned, contributing to climate change.

Figure 1: Fossil fuel set harmful gases free

Coal, petroleum and gas consist of vegetation and remains of animals covered by landmasses.
The pressure of the layers of sand and rock and the heat of the earth turned the decomposing remnants into oil, coal and gas. Coal consists of the remains of plants. Oil and gas consist of the remains of plants and animals.

There are quite a few scientists and evolutionists who put forward all sorts of theories about the origin of coal, natural gas and oil. Their findings are mostly based on radiometric dating methods. Thus, it is "guessed" that the earth is, in all probability, 15 billion years old. To believe this means that we deny the creative wonders of God that we find in the earth and His omnipotence and majesty and that He is the Creator.

Coal, gas and oil are now simply seen as natural phenomena in which God had no hand.

In Genesis, we read of a profound event where vegetation and animals are buried and covered at once. This, of course, is the flood that lasted about a year.

As believers, we confess that the Word of God is true; therefore, we also know that the flood did take place because it was recorded in the Word. We also see clear signs in nature that this has taken place. About three-quarters of the earth's surface contain fossils in the sedimentary rock layers. Most of the coal formed due to plants and animals covered under tremendous pressure with water and sediments, and under great pressure, all oxygen was squeezed out. Thus, the plant and animal material were preserved before rotting or decomposing.

1.2.1 Coal

Coal is found in the earth's crust and is extracted through mining. In South Africa, most of our electricity is generated by burning coal. During the combustion of coal a lot of carbon dioxide is formed. It causes a lot of pollution. South Africa has large coal reserves.

Figure 2: Coal

COAL REMAINS SOUTH AFRICA'S LARGEST SOURCE OF ENERGY

Less than ten percent of all energy in the world comes from renewable sources. So now you wonder, "If renewable resources are so much better for the world and cannot run out, why don't we use them everywhere, always?"

Many renewable energy sources are very expensive to use, inefficient or have other disadvantages. For example, wind energy can work very well in an area that is windy all year round but will not work in an area with little wind.

In addition, coal is a relatively inexpensive source of energy, and South Africa has abundant coal reserves. The mining and sale of coal also contribute to economic growth.

However, there is some hope in the data of South Africa. The data show a slight increase in the use of solar and wind power as energy sources.

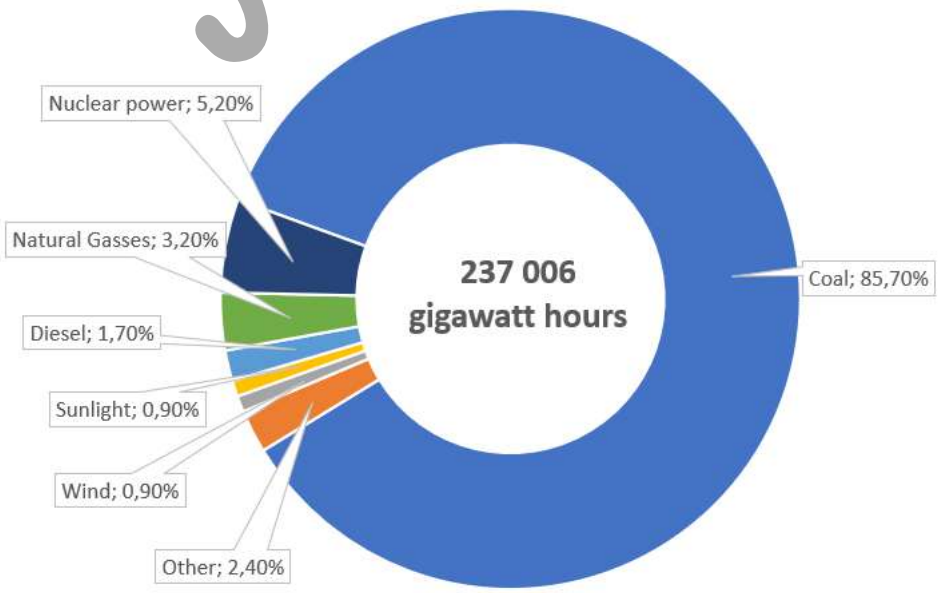
In 2013, coal accounted for 88.3% of South Africa's electricity supply. In 2016, it dropped to 85.7%.

Solar energy did not contribute to the electricity supply in 2013 at all, but in 2016 it contributed to the national grid. Wind power's electricity supply increased from 18 GWh in 2013 to 2126 GWh in 2016.

South Africa has some of the best sunlight of any landmasses. This national resource, as well as abundant wind, ocean and sustainable biomass are present but are not being used effectively.

The enormous economic value that can be achieved by using our renewable energy sources at all levels requires clear and urgent action.

Coal remains South Africa's primary source of energy The total amount of power generated by the source, 2016



Figures and graph processed from STATS SA

Activity 3: Coal as energy source

Answer the following questions.

1. Why is so little use made of renewable resources?
2. Why does coal remain the largest source of energy in South Africa?
3. Which renewable energy sources are used in South Africa.
4. What is your opinion on the use of renewable energy sources? Does South Africa use it enough? Would you like it to be used more or less? Give reasons for your answer.

1.2.2 Gas

Natural gas describes the different mixtures of fire g s s tra p ed in underground rocks. It is trapped in rocks deep under h ear s crus and is often found with crude oil and extracted using a rilling ethod. Gas is a much purer fossil fuel than coal and pr duc s a out half of the carbon dioxide (CO_2) and only one-tenth of the a po uta ts when burned to generate electricity.

Figure 3: Storage tank for natural gas above ground

Gas has many practical uses and is one e most po ular fuels for heating homes, cooli e rinks cook fo t is a o used to manufacture products h as p as fe ilizers and mat ials.

South Africa has some natu l gas in he sea near Mossel B y. It is not enough to supply the hol f South Africa with gas. South Africa imports about 7 % of the natural gas.

Figure 4: Natural gas extraction at Mossel Bay

Large amounts of natural gas have been discovered off the coast of Mozambique, and infrastructure is currently being built to exploit them.

1.2.3 Crude oil

Oil is a liquid that is pumped out of the ground. Crude oil is purified and converted into petrol or diesel for vehicles. There are many items we use every day that contain oil. Oil is used to make plastic products and fertilizers. Stockings, crayons and lipsticks even contain oil. It's hard to get through a day without using products in which oil has not been processed. We are very dependent on oil in our daily lives.

Figure 5: Crude oil extraction

South Africa does not have oil reserves. Our country is a world leader in the processing of coal from petrol. However, the current demand is more than Sasol can produce.
Crude oil is transported by ship to South Africa, and Sasol refines (purifies) it before arriving at the various oil companies.

Figure 6: Uranium mining, Ezulwini project

1.2.4 Uranium

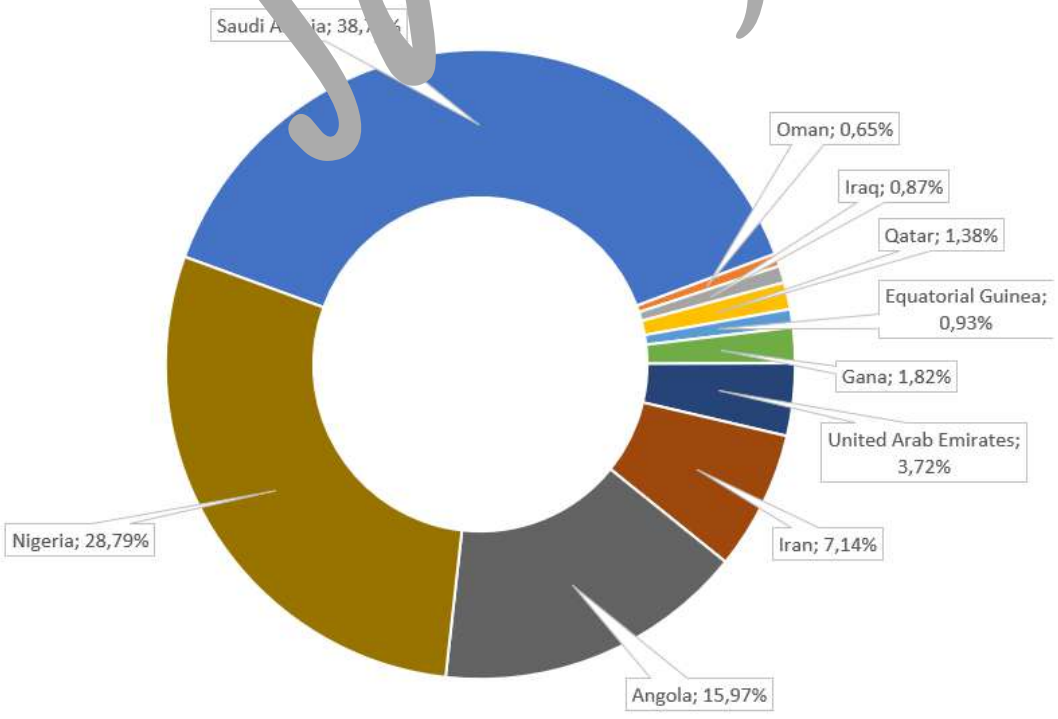
Uranium is a non-renewable mineral found in certain rocks.
It is the energy source used in nuclear power plants to generate electricity. The Witwatersrand in South Africa (where a lot of gold is mined) is one of the most important areas for uranium mining. The largest uranium project in Africa is the Ezulwini Project. It is managed from a mine in Randfontein in Gauteng.

Can you find uranium on the periodic table?

Activity 4: Crude oil as an energy source

Read and study the following and answer the questions.

Largest contributors to crude oil imports in South Africa (Jan 2010 to June 2017)



Figures and graph processed from South African Market Insights

Activity 4: Crude oil as an energy source (continues)

The oil reserves are not evenly distributed around the world. Most of them are in Saudi Arabia, Iraq, Iran, the United Arab Emirates and Kuwait. The Middle East boasts 65% of all oil reserves.

1. From which country do we import the most oil?
2. Which companies in SA process coal into crude oil?
3. What are the benefits of oil?
4. What are the disadvantages of oil?
5. Why do you think the oil price will sometimes be very high and sometimes very low?

1.3 Renewable energy sources

Because fossil fuels become depleted and their use can pollute the environment, we must switch to other energy sources, such as renewable energy sources. These are energy sources that are constantly replenished, such as sunlight, wind and water. It means that we can use them as much as we want and not have to worry about them being depleted.
In addition, renewable energy sources are usually much more environmentally friendly than fossil fuels. In general, they release very few chemicals such as carbon dioxide, that can harm the environment.

1.3.1 Sunlight

The sun radiates large amounts of energy every day.

Solar panels can capture the energy and can heat our homes and water or generate electricity. Apart from the fact that the sun provides us with direct energy, the sun is also the primary source of energy for all the other energy sources we use.

Figure 7: Solar energy is captured by solar panels

The wood we burn comes from a plant that grows due to sunlight.

Solar energy causes us to have wind on earth (hot air rises, and it causes wind), so we can use wind turbines. The sun's heat keeps the water cycle going, allowing us to harness the energy of moving water. Even the energy contained in fossil fuels is hidden from sunlight because they come from plants and/or animals.
The great advantage of sunlight is that it is available freely and almost everywhere.
It causes no pollution, and it can be small scale (use a solar panel to charge your phone) or large scale (solar panels on the roof of the house for generating electricity or heating water).

The disadvantage of sunlight is that the technology to capture sunlight is expensive, and sunlight can only be captured during the day when it is sunny.

1.3.2 Wind

Wind energy has been used for hundreds of years; for example, water is pumped from the ground using wind pumps. Today we use high wind turbines that use the wind to generate electricity.

The advantages of wind energy are that it is affordable and does not pollute the environment. Wind energy is not available always and everywhere and is also not constant.

ADDITIONAL INFORMATION

Watch this video to see how wind energy works:
https://www.youtube.com/watch?v=qSV...nprfqE

Figure 8: Wind energy

Figure 9: Windfarm in the sea

Figure 10: Windfarm in Jeffrey's Bay

DID YOU KNOW?

One wind turbine can provide enough electricity for 1400 households.

1.3.3 Hydropower

Hydropower is the electrical energy generated from falling or running water. The energy of river streams has been used for centuries using water wheels, which are turned by river water to grind grain.

A typical hydroelectric plant is a system with three parts:

- A power station where the electricity is produced.
- A dam that can be opened or closed to control water flow.
- A reservoir where water is stored.

The water behind the dam flows through an inlet and presses against the blades in a turbine, causing them to rotate. The turbine turns on a generator to generate electricity.

Hydropower has several benefits. Once a dam has been built and the equipment installed, the energy source - flowing water - is free. It is a clean fuel source that is renewed through snow and rainfall. Hydroelectric power stations can supply large amounts of electricity, and it is relatively easy to adapt to the demand for electricity by controlling the flow of water through the turbines.

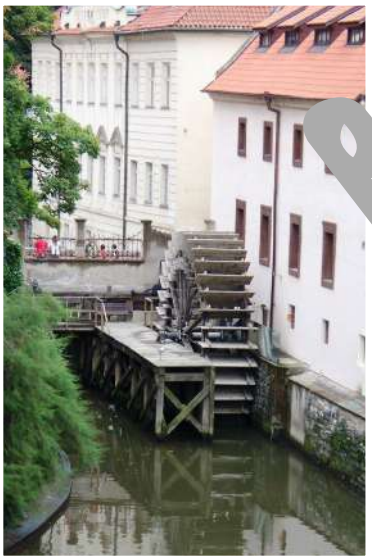


Figure 11: Historical waterwheel

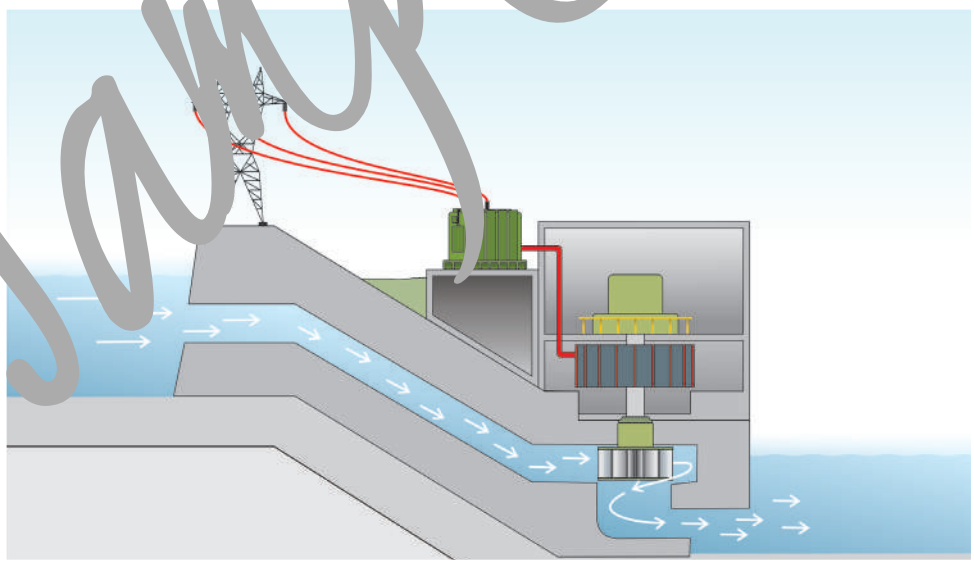


Figure 12: How hydropower work

ADDITIONAL INFORMATION
Watch this video to see how hydropower works:
https://www.youtube.com/watch?v=tpigNNTQix8

1.3.4 Biofuels

Biofuels produce energy from (waste) material of plants or animals. It can produce electricity, heat or fuel. Wood is an example of a biofuel. It is burned and gives us direct heat that we use to heat food, or we heat our homes with it. In South Africa, wood is the largest producer of biofuels.

Another example is the manure of animals. The waste is collected and fermented to form a gas (methane). The gas can be used as fuel for cars and to heat homes.

Biofuels reduce air pollution and greenhouse gases, and at the same time, waste materials are being used.

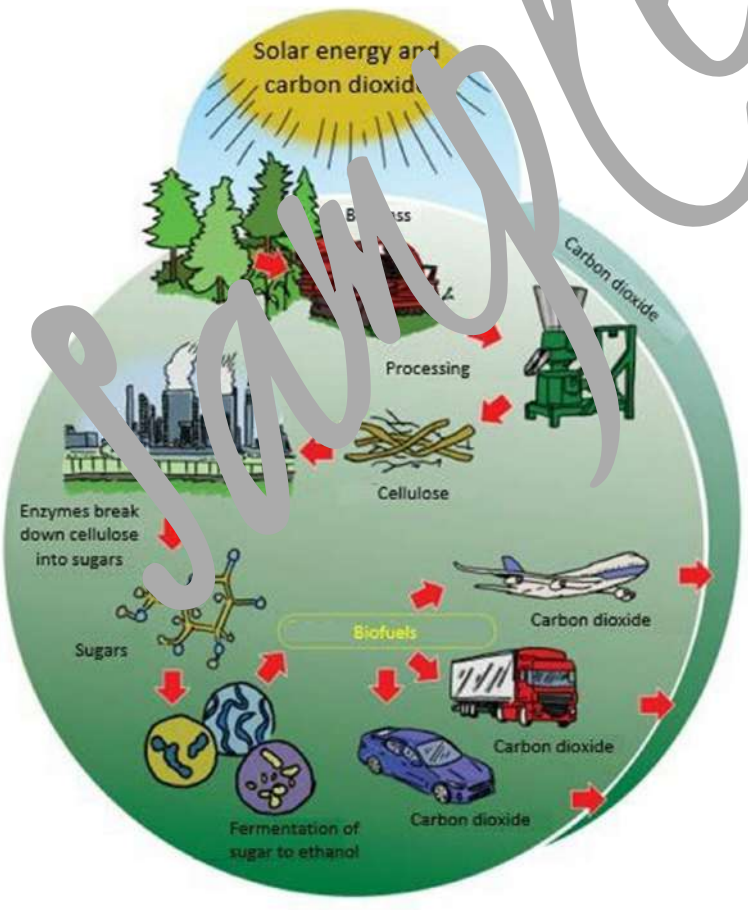


Figure 12: Biofuel

Figure 14: Nesjavellir geothermal installation in Iceland

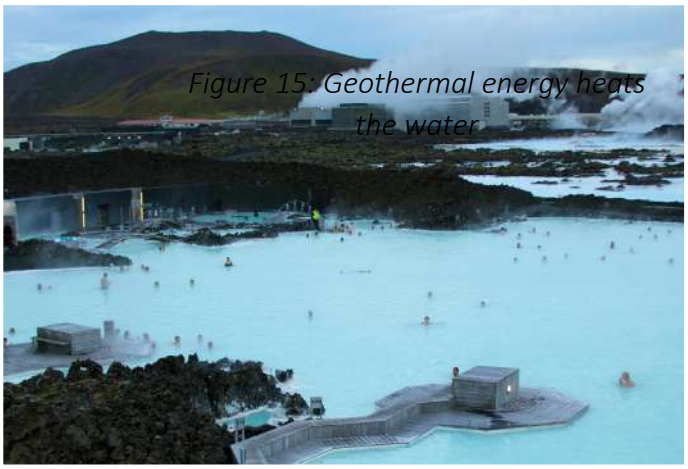


Figure 15: Geothermal energy heats the water

Figure 15: Geothermal energy heats the water

DID YOU KNOW

Iceland is the only country in the world that generates most of its energy from renewable energy sources. More than 99% of their energy is extracted from renewable energy sources.

Activity 5: Renewable energy sources

Answer the following questions

1. Why should we make more use of renewable energy sources?
2. Which renewable energy source in South Africa can be consumed much more?
3. What are the disadvantages of renewable energy sources?
4. Why do we say the sun, water and wind are 'renewable'?
5. Explain why we say that all energy on earth can be diverted to the sun.

Extra

6. Which energy source does Iceland mainly use?
7. Can we also use the energy source in South Africa? Motivate your answer.

Term 4

Planet Earth and space

Values

1. View of God: God Triune reveals Himself in His Word and works of creation. Without God's self-revelation, no man would ever know Him.

2. View of man: Man is a creature of God and everything, including the ability to gather knowledge, depends on God the Creator.

3. View of creation: Realize that God's creation, which includes space, is far more complex than we can know or comprehend with our human knowledge and science.
The knowledge of space shou[illegible]lso l[illegible] us to marvel at God's creation, for which we have m[illegible] rev[illegible]nce and respect.

Knowledge

→ New words:

- Use the resources you have at [illegible]our imm[illegible]ate dis[illegible]osal to write down the definition [illegible] words.
- Sources c[illegible]e famil[illegible]bject s[illegible]ecific book [illegible]ctionaries or the internet.

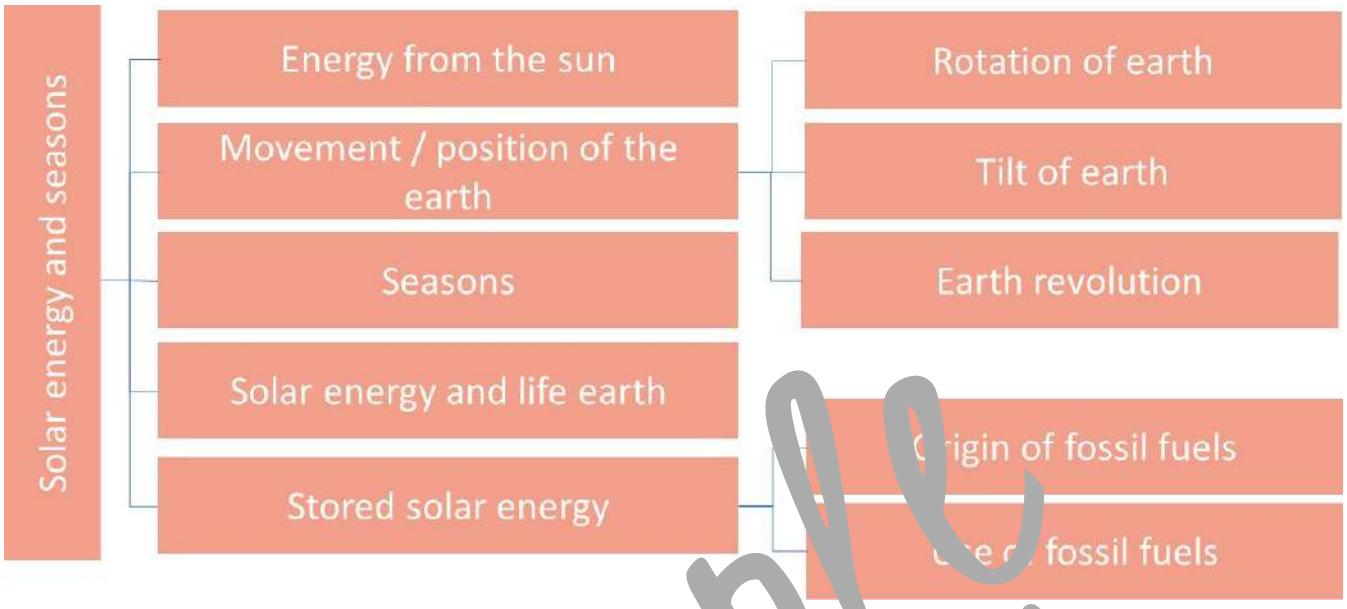
→ Scientific knowledge:

- Importance of [illegible]olar e[illegible]e[illegible]y.
- Origin and import[illegible]nce [illegible]seasons and tides, positions of the sun, earth and moon and their influenc[illegible]n earth.
- Influence of gravity on celestial bodies.
- Development of astronomy.

Skills

→ Demonstrate the movements of the earth and the moon and gravity.
→ You are researching a well-known scientist who played a major role in the development of astronomy.

Unit 1: Solar energy and the earth's seasons



Activity 1: The e

Aim: Try to apply know dge fr m pr vi us years and ne knowledge.

Try to do the activity below s fa possible by yourself. You are not expected to have all the knowledge. Where you ar not sure, you may consult your teacher.

You will need:

→ A ball the size of a soccer ball. For example, polystyrene or a beach ball.
→ Pens in different colours.
→ Skewers.

1. Make a simple globe and draw the following on the globe:
    a. The shape of the continents
    b. Equator
    c. North Pole
    d. South Pole
    e. Northern hemisphere
    f. Southern Hemisphere

Activity 1: The earth (continues)

g. Tropic of Capricorn
h. Tropic of Cancer

2. Use skewers to make the axis through the earth

1.1 Energy from the sun

The sun radiates heat and light in all directions, and it reaches the earth. Did you know that the temperature on the sun's surface is more than 5000 ° C, and in the sun's core, the temperatures are even much, much higher? As you have learned in the previous chapter, heat flows from hot to cold areas, and the heat moves from the core to the cooler surface of the sun.

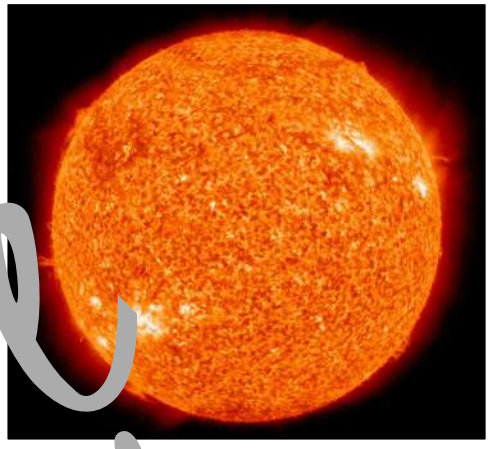


Figure 1: The Sun

Do you know how long it takes before the light emitted by the sun reaches the earth? Eight minutes.
The sunbeam that is now falling on your face started radiating out of the sun eight
minutes ago. The sun warms our bodies and, of course, our mood. However, there are far more significant benefits we can derive from the sun's energy.

1.2 Movement of the earth

God sustains everything through the power of His Word, so it is through the direct power of God that the universe continues to exist and function. In Col 1:17, we read how Christ holds all things together: " And he is before all things, and in Him, all things hold together."
For us, it means that the planets, stars and even the smallest atom are held together by the power of God. Gravity and electromagnetic forces are the words that describe how God holds the universe together.

1.2.1 Rotation of the earth

The earth rotates around its own axis. Rotation is when something rotates around a point in the middle. The earth has an imaginary axis (line) that starts at the top of the North Pole, goes through the center of the earth, and ends at the South Pole. The earth rotates from west to east around this axis. It takes the earth twenty-four hours (exactly one day) to orbit its axis once.

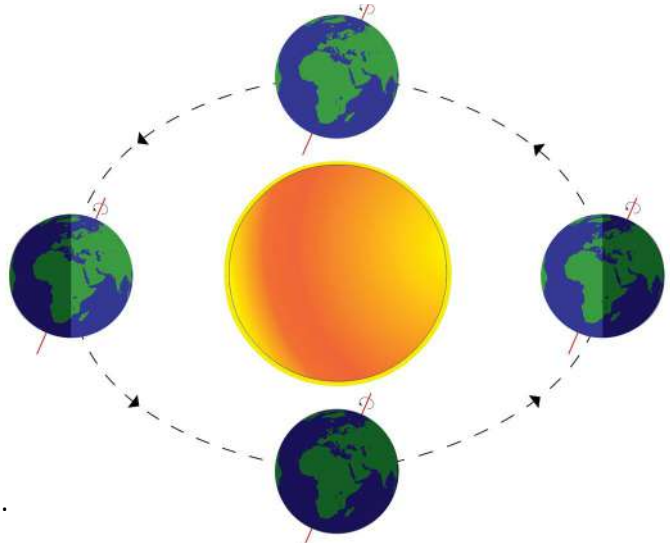


Figure 2: Rotation of the earth around the sun.

1.2.2 Tilting of the earth

Have you ever looked closely at a globe and seen that the North Pole and the South Pole do not point straight up and down? The whole earth is tilted a little at an angle of 23.5 ° to a vertical line. The earth remains constantly tilted up the same slope.

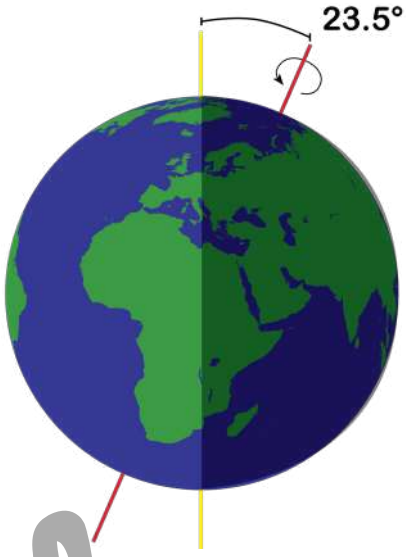


Figure 3: The earth is tilted at an angle of 23.5 °

1.2.3 Revolution of the earth

The earth revolves around the sun in orbit.
It takes the earth 365¼ days to orbit the sun once.

1.3 The seasons

As believers, we confess that God is omnipotent and created everything on earth. God is not bound to our earthly times, but He did create it for us. He reveals Himself in nature and His Word, and we read in Genesis 8:22 that He made promises regarding the regularity of the seasons. "From now on, all the days of the earth, sowing time and harvest time, cold and heat, summer and winter, day and night will not cease."

It means that regularity, consistency and uniformity would follow; therefore, one can also expect the laws of nature to remain consistent over time and space. This makes it possible for scientists and people like farmers to make predictions about the weather and weather conditions. The position of the planets, moons and asteroids can therefore also be studied to make such predictions.

Two consistent factors play a significant role in the origin of the seasons:
1. The earth is tilted at an inclination of 23.5 °.
2. The orbit around the sun.

Due to the inclination of the earth's axis, the intensity of solar energy (the amount of sunlight per surface area) changes over the course of the year depending on the different parts of the earth reached.

The different intensities of solar energy that reach the Southern and Northern Hemisphere throughout the year lead to the four seasons.

Figure 4: The four seasons - spring, summer, autumn and winter

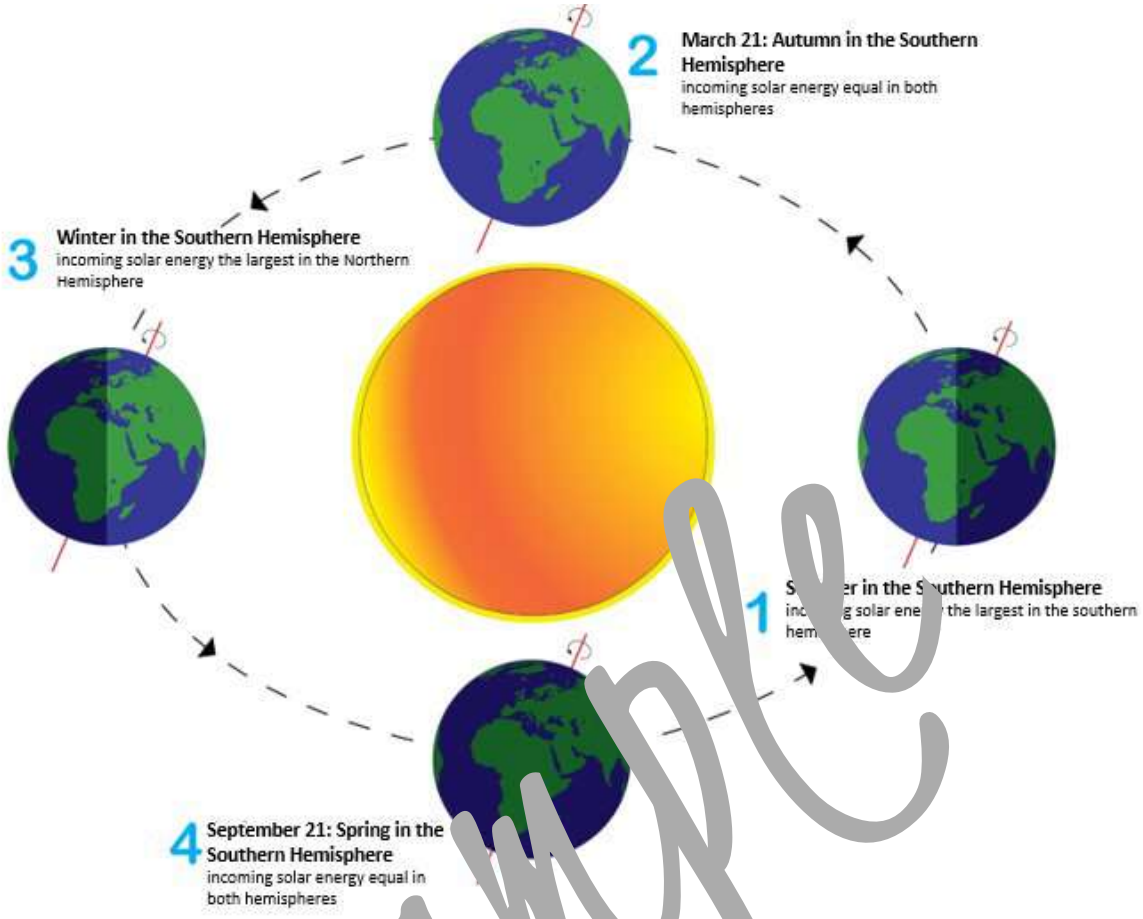


Figure 5: Seasons of the Earth

1.3.1 Summer in the Southern Hemisphere

At number 1 you see how the Earth's North Pole is tilted away from the sun. This means that the Northern Hemisphere (the upper half) receives less direct solar radiation than the Southern Hemisphere (the lower half). This causes the Northern Hemisphere to experience winter, while the Southern Hemisphere experiences summer.

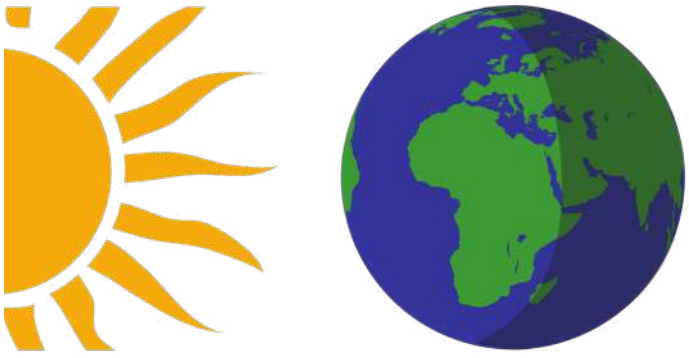


Figure 6: Summer in the Southern Hemisphere

Summer solstice:

- The sun shines perpendicular to the Tropic of Capricorn
- 21 December
- Longest day and shortest night

1.3.2 Winter in the Southern Hemisphere

At number 3, you see that the earth's South Pole is tilted away from the sun. It means that the Southern Hemisphere receives less direct solar radiation than the Northern Hemisphere. In other words, the sun's rays must travel a greater distance to reach the Southern Hemisphere. The Southern Hemisphere experiences winter, and the Northern Hemisphere experiences summer.

Winter solstice:
- The sun shines perpendicular to the Tropic of Cancer
- 21 June
- Longest night and shortest day

1.3.3 Spring and autumn in the Southern Hemisphere

At numbers 2 and 4, the Northern and Southern Hemispheres receive equal amounts of direct solar radiation. It is autumn and spring in the respective hemispheres.
- March 21 and September 21
- Day and night are equal

Summer is hotter because the daylight hours are extended and because of the way the sunlight hits the hemisphere. In summer, the sunlight hits the ground at an almost perpendicular angle, so it heats the ground very efficiently. The heat energy is concentrated in a small area and it becomes very hot.

On the other hemisphere, where it is winter, sunlight will hit the ground obliquely. The heat energy is distributed over a larger area, and it does not heat the soil very well.

Remember

The seasons on earth are determined by the angle at which sunlight strikes the earth.
In summer, the sun is higher in the sky, and the sunlight hits the earth directly.
In winter, the sun is lower in the sky, and the sun's rays hit the earth indirectly at an inclined slope. The seasons occur because the earth's axis is tilted relative to the sun's orbit.

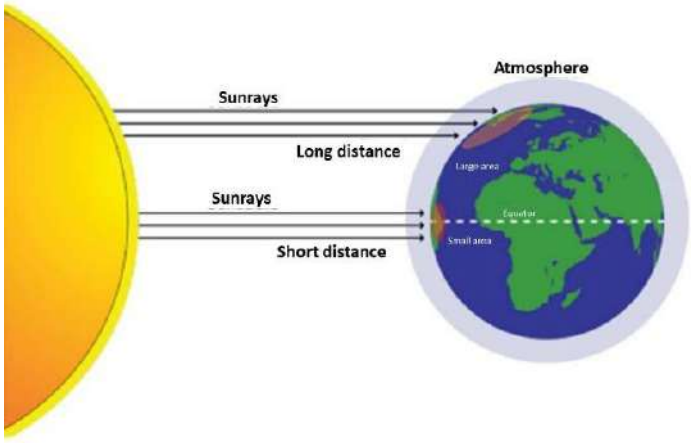


Figure 7

Activity 2: Sunlight and the earth

Purpose: You gain better insight into the earth's motion around its own axis and around the sun.

You will need:

→ The model of the earth of activity 1
→ A flashlight

1. Group member A rotates the globe in the right direction around its axis (from east to west).
2. Group member B shines with a flashlight (representing the sun) on the earth while group member A rotates the earth. See where it is day and night.
3. Keep the earth and sun (flashlight) in such a position that it is summer in South Africa.
4. Keep the earth and sun in such a position that it is winter in South Africa.
5. Keep the earth and sun in such a position that it is autumn in South Africa.

Did you know

In winter, the sun never rises at the North Pole and the South Pole, while in summer, the sun never sets at the North Pole and the South Pole.

1.4 Solar energy and life on earth

Nothing is more important to us on earth than the sun. Without the sun's heat and light (solar energy), the earth would be without life. The sun warms our oceans and seas, sets our atmosphere in motion, determines our weather patterns, and energizes the plants that provide food and oxygen for life on earth.
All life on earth is directly or indirectly dependent on the sun.

Ever since creation, humans have used solar energy in various ways. Today, we use solar energy, among other things, through solar cells that convert sunlight into electricity. It is used for calculators, clocks, houses, commercial buildings and even stadiums.

Figure 8: The Kaohsiung World Stadium in Taiwan has more than 8800 solar panels on the roof.

In South Africa, more and more people buy solar panels to heat the water in geysers.

1.4.1 Plants

Plants are directly dependent on the sun because they need it to grow and photosynthesize. The plant absorbs sunlight, water, and carbon dioxide during photosynthesis and converts it into glucose and oxygen.
Through photosynthesis, the sun's energy is stored in the food that the plant produces. Plants are also called producers or autotrophs because they are the only organisms that can produce their own food.

1.4.2 Humans and animals

Humans and animals depend on plants for food and oxygen and are called consumers. Consumers rely on nutrient producers. Humans and animals eat the food that plants produce. Energy from the sun is indirectly transferred to humans and animals.

1.4.3 The sun's energy sustains life on earth.

The bodies of plants and animals that die will be decomposed by decomposers such as bacteria, fungi and worms so that valuable nutrients are re-absorbed into the soil and available for new plants to grow. These new plants cannot grow without sunlight, so we are back at the source of all energy on earth, the sun.

1.5 Stored solar energy

Fossil fuels such as coal and natural gas are concentrated energy supplies formed from the remains of plants and animals.

How does the sun play a role in all this? As you learned in the previous unit, all plants and animals receive energy directly or indirectly from the sun. When plants and animals die, they are decomposed by decomposers and the energy released from them is taken up again by new plants growing from it.

1.5.1 Origin of fossil fuels

Coal, oil and gas consist of plants and/or animals that did not decompose but died in large numbers and were immediately buried below the mud. All of this was compressed by all the layers of mud and turned into coal, oil or gas. The energy of the sun is trapped in these fossil fuels. The flood is the only explanation for how it all happened.

Figure 9: God created everything.

However, people who do not believe that the Lord created the earth worked out another theory to explain how fossil fuels came into being.

Unbelievers, who support the theory of evolution, claim that fossils have been gradually covered by sedimentary layers over millions of years and are therefore millions of years old. After millions of years, dead plants and animals are transformed into coal, oil, and gas. It happens when layers of mud and soil cover the remains of dead plants and animals. The low pressure on these residues and more layers lead to increased pressure. This pressure over long periods then changes the residues into coal, oil or gas.

Believers believe that God created the heavens and the earth as recorded in Genesis and that fossils were created because of a catastrophic disaster (the flood) and, consequently, a "giant burial" that took place several thousand years ago. The organisms were not buried for a long time because scavengers or rot caused them to perish before they could fossilize.

1.5.2 Use of fossil fuels

Humans have found ways to exploit the fossil fuels that are often stored deep in the earth. We use fossil fuels very usefully for human consumption. The problem is that we use up the stored energy faster than it is formed.

With a growing population and industries growing larger and larger, we on earth need more and more energy. We have become dependent on fossil fuels. In South Africa, most of our electricity is generated by burning coal. The realization is already there that we will run out of fossil fuels and that we need to start looking at other ways to generate our energy.

Figure 10: Hendrina coal power station.

Activity 3

1. Explain the rotation of the earth.
2. Explain the revolution of the earth.
3. What are the two reasons for seasons on earth?
4. Draw a flow chart showing the energy of the sun to form fossil fuels such as coal, oil and gas.
5. How does the view of believers and unbelievers differ on the existence of fossil fuels?

Sample

Grade 7

Learners Guide

ACSI
Association of Christian Schools International

INSTITUUT VIR
CHRISTELIKE ONDERWYS