NATURAL SCIENCES AND TECHNOLOGY

TERM 3
GRADE 6

ENERGY AND CHANGE

TEACHING PLAN

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Technology : The design process format
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Natural Science: The Scientific Method

Use this format to follow the scientific method for your experiments

Question to investigate

What will my experiment answer? _____

_____

Hypothesis

What do I think the results of this experiment will be? _____

_____

Materials

What do I need to conduct this experiment? _____

_____

Method

How will I conduct this experiment?

Step 1 _____

Step 2 _____

Step 3 _____

Step 4 _____

Step 5 _____

Results and conclusions

What are the results of my experiment?

_____

_____

Was my hypothesis correct? [ ] Yes [ ] No

Discussion

How can the results of my experiment be used? _____

What other questions does my investigation raise? _____

Technology: The design process

Use this format to follow the design process for your technology projects

Investigate

What must my product do? _____

_____

Design and plan

Specifications: What are the specifications? (e.g. instructions, design brief)

_____

_____

_____

Constraints: What are the constraints? (e.g. materials, time, tools)

Materials: What materials am I going to use? _____

Equipment: What tools do I have? What tools will I need? _____

Final drawing (What will my product look like?)

How am I going to make my product?

Step 1_____

Step 2_____

Step 3_____

Evaluate

Does my product work properly? [ ] Yes [ ] No

Does my product look like my drawing? [ ] Yes [ ] No

How can I make my product better? _____

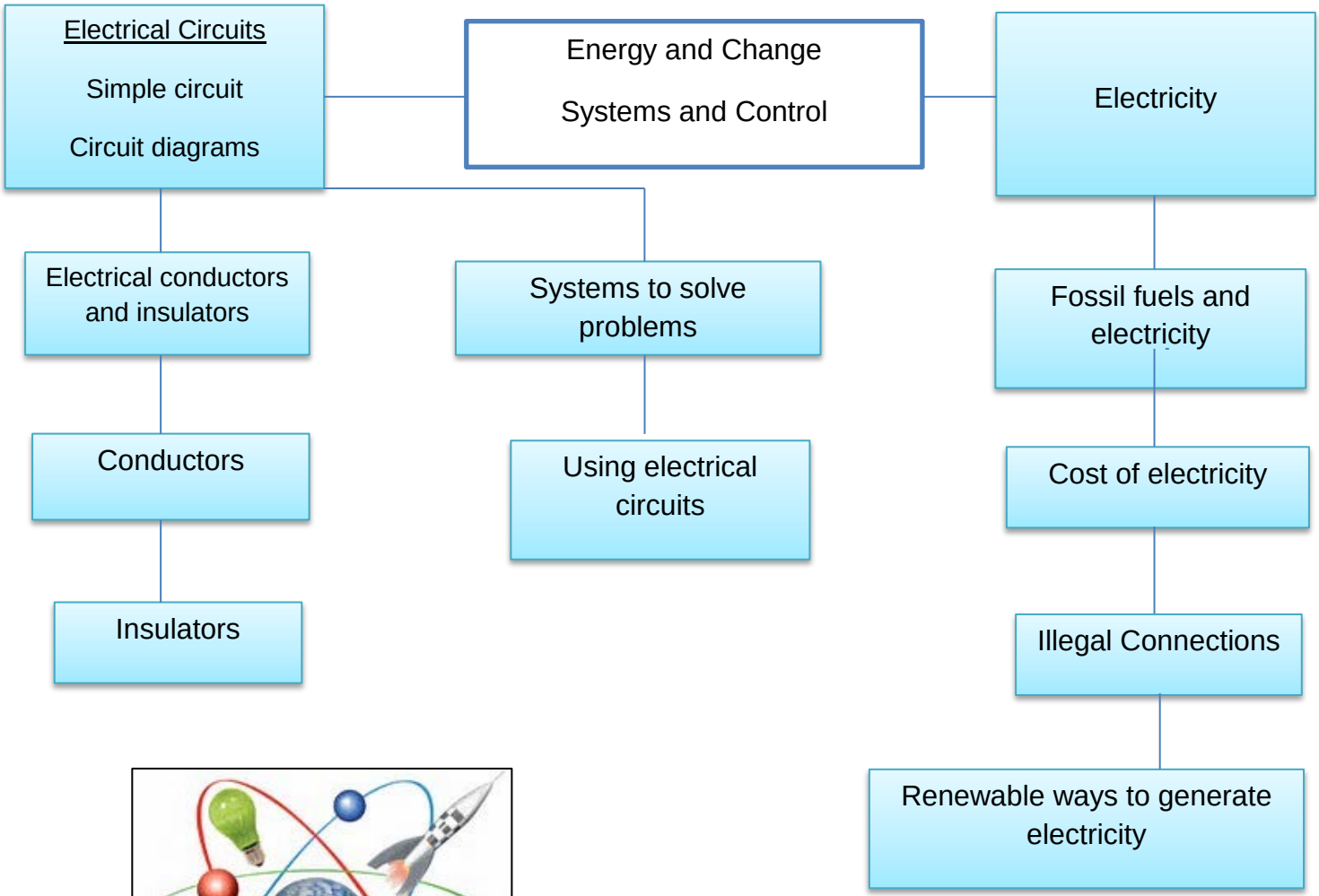
Natural Sciences & Technology

Grade 6 Term 3

Strand 3

Natural Sciences: Energy and Change

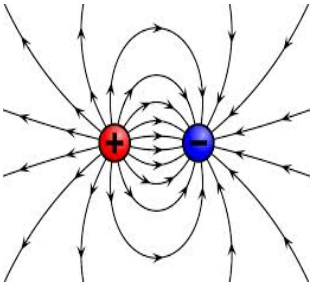
Technology: Systems and control



Unit 1 - Electric Circuits: Simple Circuits

Lesson 1

Electric Charge



We get electricity because all matter has positive and negative particles. The particles have electric charges. Particles with the same charge repel each other. That means that they push away from each other. A particle with a positive charge will repel another particle with a positive charge. Particles with opposite charges will attract each other. That means that they will move closer together. A positive particle will attract a negative particle.

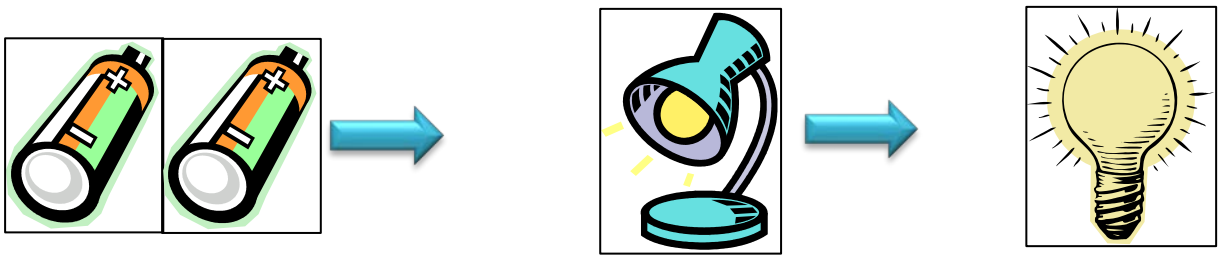
Electric Current

When electric charges move through a conductor, we have an electrical current. The electric charges come from an energy source such as a battery. When the charges move in a closed loop, we call the path an electric circuit.

A system for transferring energy

A system is made up of many parts. These parts work together to perform a special function, such as a kettle, heating water. Electricity needs a continuous path to flow. We call this kind of path an electrical circuit. The role of a circuit is to send electricity from the source to the device. The device then changes the electricity (or electrical energy) into useful output energy, such as light. All electrical systems have an input source, a device and an output. A system will not work without these three stages.

Example:



Batteries = Source

Lamp = Device

Light bulb = Output Device

Components of a Simple Circuit

An electrical circuit is always made up of the following components:

- A source of energy
- Conducting material
- Device

Source of Energy

The source is where the device gets its energy. The source of energy for electrical devices can be the mains electricity or a cell (or many cells, such as a battery). Only when the source is connected to the other parts of the system can the electrical energy be used.

Conducting Material

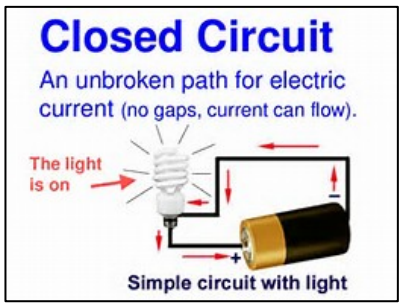
Many materials conduct electricity. Most systems use wires as the conducting material. Many different types of wires can be used. Most electrical cables use copper wires.

Devices

There are many types of different devices that change electrical energy into useful output energy. Output energy can be heat, sound or movement.

An Unbroken Pathway of Electricity

When you connect all the different components (source, conductor or device) you make a system, which allows electricity to flow throughout it. The electricity flows along a pathway. This pathway is closed. When a pathway is closed we say it is unbroken and complete. We call this pathway a circuit.



Vocabulary

Source – where a thing comes from or starts

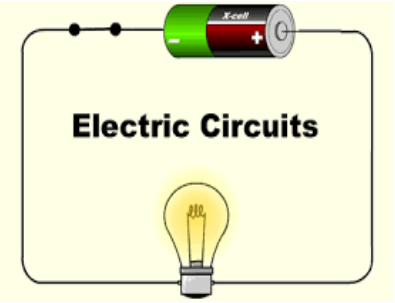
Device – something that changes one type of energy into a different type of energy.

Output energy – energy after it has gone through a device

Components – different parts of something

A Broken Pathway of Electricity

If a completed circuit is connected to an energy source, the electricity will flow continuously. Many things stop or break the flow of electricity through a circuit. A switch is one such thing. It is a very useful component as we can deliberately stop the flow of electricity when it is not needed. When switches are on (closed), they allow the electricity to flow in a circuit. When switches are off (open) they stop the flow of electricity in the circuit.



Switches

A torch contains a switch. When you switch the torch on the electricity starts to flow around the torch circuit. When you switch the torch off the electricity stops flowing.

The switch controls the flow of electricity. When the switch is turned to "off", it stops the flow of electricity through the circuit. We say it breaks the circuit. When we turn the switch on, the circuit is complete and electricity flows again.

Summary

An electric circuit is made up of different circuit components. A battery provides electrical energy to a circuit. Wires connect the circuit components so that the circuit forms a closed loop. Bulbs change electrical energy to light energy. Switches are used to control the flow of electric current in a circuit.

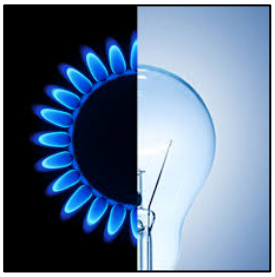
Activity 1: Investigate Electrical Pathways

Aim – In this activity you will make a simple pathway.

Hypothesis – Write your own hypothesis for this experiment

You will need:

- A 1,5 V light bulb
- A 1,5 V light bulb holder
- A 1,5 cell holder



- Masking tape
- Copper wire

1 – Place the light bulb on the holder.

2 – Cut the wire into two equal lengths.

3 – If the wire is insulated, expose 1 cm of the copper wire at each end.

4 – Predict what will happen to the light bulb after you attach the ends of the first wire to the battery and the light bulb holder.

5 – Attach the ends of the first wire to the battery and the light bulb holder with masking tape.

6 – Attach the ends of the second wire to the light bulb holder and the battery.

Questions

1. Explain why the light bulb did not shine after step 5.
2. Explain why the bulb lit up after step 7.
3. Draw your simple circuit.

Unit 2 – Electrical Circuits: Circuit Diagrams

Lesson 2

Circuit Diagram

Electricians use simple diagrams to show electrical circuits. Instead of drawing a cell or a bulb on their diagram, they use symbols. This is far easier than drawing the actual circuit.

Electrical Circuit Symbols

Electrical circuits are made up of the following components:

Electricity source (cell or battery)

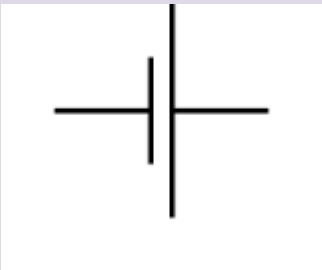
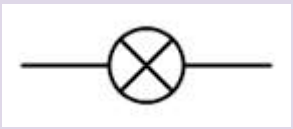
Copper wire

Device (light bulb)

Switch, that can be open or closed.

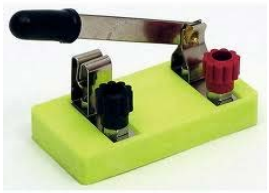
Each component has a simple symbol. The symbol represents that component in a circuit diagram.

List of Symbols

Component	Picture	Symbol
Cell or a battery – the short lines show negative terminals. The long lines show positive terminals.		
Insulated Copper Wire – we use arrows to show the direction of electricity flow. The electricity flows from the source (input energy) to the device.		
Light Bulb - (lamp)		
Switch		

Activity 2

Draw the symbols of the following electrical components

1. 	2. 
3. 	4. 

Vocabulary

Diagram – simple drawing or sketch

Symbol – simple sign which represents something else

Insulated – covered in protective substance such as plastic

Summary

We can draw an electric circuit diagram so that anybody can understand or use it. This is because the same symbols are used all around the world.

Unit 3 – Electrical Conductors

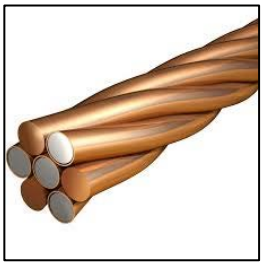
Lesson 3

Materials that conduct Electricity

Electricity can pass through some materials but not others. If an electric current can pass through a material, the material is an electrical conductor.

Most metals are good electrical conductors. That is why parts of electrical objects that need to let electricity pass through are always made of metal.
For example: we use copper wire in electrical circuits to conduct the electrical energy.

Copper as a Conductor



Copper, silver, gold and aluminium all conduct electricity. We use copper as a conductor of electricity because it is:

- A very good conductor
- Not expensive

Gold and silver are very expensive, which is why we do not use them to conduct electricity in our houses. Aluminium is cheaper but is does not conduct electricity well.

Did you Know

If you had a light bulb on the Moon and the switch in your bedroom, it would take only 1,26 seconds for that bulb to light up, even though the Moon is 384 403 km away

Summary

Conductors make it possible for us to use electricity.

Unit 4 – Electrical Insulators

Lesson 4

Some materials do not allow electricity to pass through them. These materials are known as electrical insulators. Plastic, wood, glass and rubber are good electrical insulators. That is why they are used to cover materials that carry electricity.

Electrical insulators are used whenever there is danger of someone getting an electric shock from a conductor.

Non-metals as Insulators

Insulators are used to protect us from getting an electrical shock. Electricity can be very dangerous and people can die from touching a live wire with bare hands. Our bodies conduct electricity, so if we touch a live wire, the electricity will flow through us. Materials that do not allow electricity to flow through them act like shields for us when we work with electricity. These materials or insulators are all non-materials. Some examples include: glass, plastic, rubber, wood and ceramic.

Plastic as an Insulator

Electric wires are always covered in plastic or other insulators that do not allow electricity to flow through them. We say these wires are insulated.

People use materials that insulate electricity in many different situations.

Examples:

- Rubber gloves
- Ceramic insulators
- Plastic-coated pliers
- Plastic-covered adaptors
- Glass insulators

 Plastic Covers	 Plastic coated pliers
 Porcelain spark-plug	 Rubber Gloves

Vocabulary

Insulator – materials that do not allow heat/electricity to pass through them.

Live wire – wire with electricity running through it.

Porcelain – a type of pottery clay

Activity 4

Topic Revision

Choose the correct word from the box to complete each sentence

Charge	Current	Output	Bulbs	Circuit	Diagram	Symbols	Conductor	Insulator

1. A drawing of an electric circuit using _____ is known as a circuit _____.
2. An electric _____ results when an electric charge flows through matter.
3. When a body's electric particles are unbalanced, it has an electric _____.
4. When a material allows electricity to flow through it, it is a _____ of electricity.
5. When a material does not allow electricity to flow through it, it is an electrical _____.
6. _____ convert electrical energy into light energy.
7. Bulbs are an example of _____ devices.

Unit 5 - System to Solve Problems: Using Electrical

Lesson 5

Circuits

A system is something that is made of two or more parts that work together. An electric circuit is also a system. It is made up of electrical components. Each component does something different but they all work together. Complicated circuits have been designed to solve problems that require energy.

Table 1 shows what some of these problems are and

how electrical circuits have solved them.

Table 1:

Problem	Electrical Circuit (Solution)
Many car accidents happen at night because people cannot see in the dark.	 Streetlights makes the road easier for drivers to see at night
Buildings get destroyed and people get injured because fires are not noticed sooner.	 Fire alarms warn people of danger quicker than people can.
Cars get stolen when drivers leave them to open their gate at home.	 Electric gates can be opened without getting out of the car.
Too many cars obstruct roads. This prevents emergency vehicles, such as ambulances and fire trucks from getting to an emergency in time.	

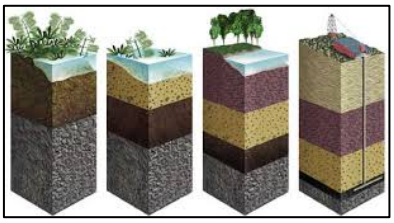
	Traffic lights control traffic.
Machines such as computers get hot when they run. Sometimes they get so hot that their parts stop working or even melt.	 Fans cool down machines while they run.
The winter months are very cold for many people in South Africa. Cold weather also makes people sick.	 Heaters help to keep us warm during winter.

Not all electrical circuits solve problems. Many are used for entertainment, such as toys, model trains or video games.

Summary

If some components were removed from a system, it would fail or stop working. Energy is transferred in an electrical system for the battery to other components in the system.

Unit 6 – Mains Electricity: Fossil Fuels and Electricity



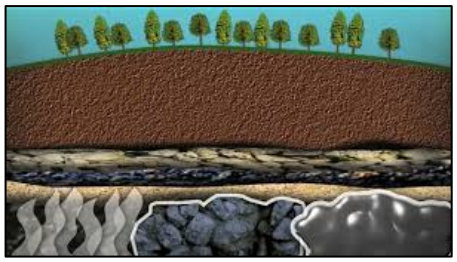
Lesson 6

- The energy in plants comes from the Sun.
- This energy is transferred from the sun to plants.

Most energy that we use is produced from fossil fuels. Fossil fuels are fuels that come from ancient plant and animal matter. That means that we burn things like, oil, petrol, diesel or coal to obtain the energy that is released from them.

How Fossil Fuels were formed

Fossil fuels were formed in the Earth's crust millions of years ago. They are a source of energy that comes from plants and animals that once lived. When the sand, rocks and mud hardened, they compressed the dead plants and animals. The pressure and heat were so strong that they were able to change the once living plants and animals into fossil fuels, such as coal, oil and natural gas.



These fossil fuels are found all over the world under the sea. When microscopic plants and animals died, they fell to the ocean floor, forming layers of rich mud. Ove
r millions of years these layers of mud were compressed by sand, soil, stones and rocks and turned into oil and natural gas.

Fossil fuels are sometimes found near the surface of the Earth. The oil and natural gas moves upwards through the cracks in the Earth's crust. These fossil fuels are easily collected and used. However, most of the fossil fuels are found deep under the Earth. Mines are used to dig for the

fossil fuels. Sometimes fossil fuels, mainly oil and natural gas, are found buried deep beneath the ocean floor. Huge structures called oil rigs are used to drill oil and natural gas.

Activity 6

Explain how fossil fuels are made

- Draw a flow diagram of how fossil fuels are made. Make sure to include the following steps:
  - ✓ Plants and animals die
  - ✓ Soil, rocks and water compress.
  - ✓ Pressure and heat build-up.
  - ✓ Millions of years pass.
  - ✓ Fossil fuels.

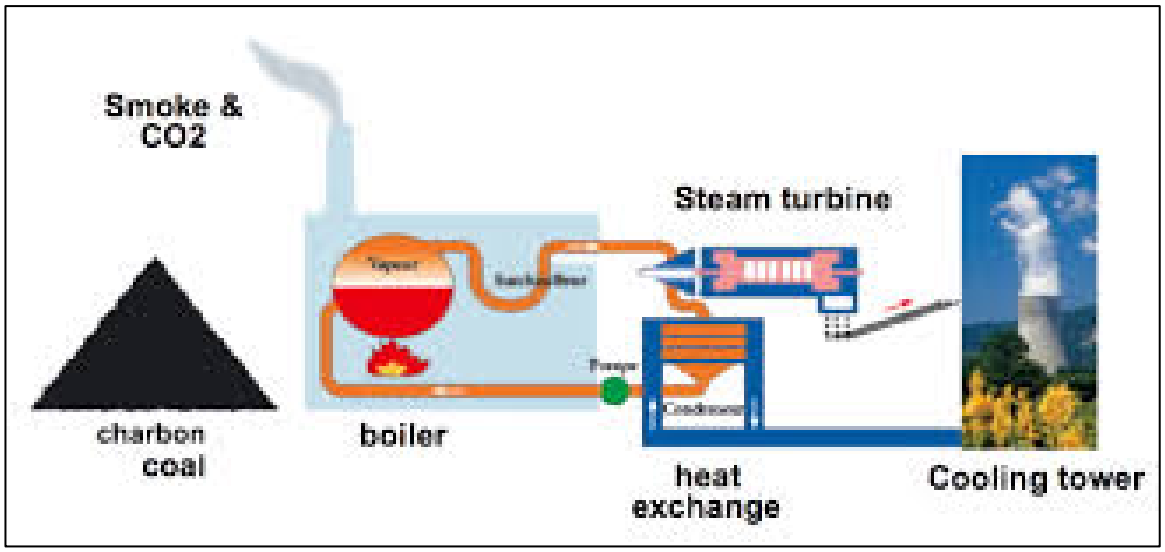
Coal in South Africa

South Africa has large deposits of coal, mainly in Mpumalanga. Coal is the main source of fuel for our power stations. Eighty percent of all our coal is used to make electricity.

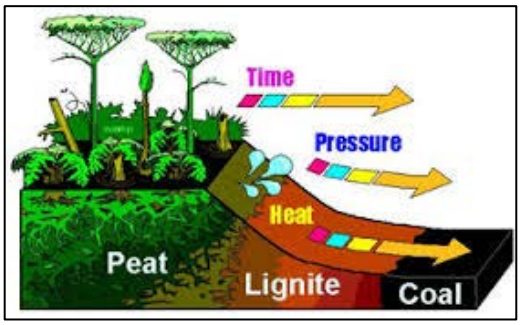
From Coal to Electricity

How can the energy in coal be used to provide electricity for us?

Power stations burn the coal. This heat is used to generate electricity for us to use. The steps in the following diagram explain how the Sun's energy is used to turn on our televisions.



Step 1	Energy from the Sun gets absorbed by plants.
Step 2	Plants die and turn into coal over millions of years.
Step 3	Coal is mined and then burnt in a boiler at a power plant to heat water into steam.
Step 4	The steam pushes a fan inside the wheels of a turbine.
Step 5	The turbine wheels power a generator, which changes the movement energy into electricity.
Step 6	The electricity is then sent to a step up transformer, which increases the power of electricity to send it over long distances.
Step 7	The step-down sub-stations receive the electricity, which decrease the power of the electricity to make it safe in our homes.
Step 8	Electricity runs from one plug through a wire into the television, which changes it into sound and light energy.



Fossil Fuels are non-renewable sources

Fossil fuels take millions of years to make. Once they have been used they cannot be replaced quickly or easily. We are not able to renew them in a short period of time. We say fossil fuels are non-renewable sources of energy

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Unit 7 – Mains Electricity: Cost of Electricity

Vocabulary

Boiler – device for heating water.

Turbine – machine with a large wheel, which turns because of steam and water.

Generator – a machine that produces electricity.

Non-renewable - something that cannot be made again very quickly.

Lesson 7

Most of our power stations use coal as a source of heat to generate electricity. It costs money to produce and supply electricity to homes, factories, businesses, schools and

other places. Electricity is very costly because it needs a lot of systems to make and deliver it.

The Cost of Coal Mines

Running coal mines is expensive because money is needed to:

- Pay mine workers
- Buy mining equipment
- Fix the current equipment

The Cost of Transport

Although most of our coal-fired power stations are near coal mines, transporting coal to the power stations is expensive.

The Cost of Power Stations

Building a new power station will cost billions of Rands. The biggest power stations, Medupi (in Limpopo) and Kusile (in Mpumalanga), will cost between R116 and R158 billion. By 2026 ESKOM will spend about a trillion rand on electricity in South Africa.

The Cost of Pylons, Substations and Wiring

To get the electricity to our homes, pylons, substations and wires criss-cross our country from the one end to the other. This grid system costs money, not only to construct but also to maintain.

The Cost of Running Electrical Appliances

Electricity power is measured in watts. Different appliances use different amounts of power. For example, a fridge uses more power than a television. The more electricity an appliance uses, the more you pay for electricity every month.

Activity 7

Copy the table into your workbook.

Appliances	Power use (watts)
Kettle	2000 watts

1. Examine the labels on appliances you have at home and record how many watts of electricity the appliance needs in order to run.
2. State which appliance uses the most power.
3. Name the appliance that uses the least amount of power.

Saving Energy

The more power we use; the more coal our power stations have to burn. Coal is a valuable and limited resource because it is non-renewable. We can protect this resource by using less electricity.

Solar Water Heaters

Geysers use a lot of electricity to heat water. To save electricity you can either turn the heating element on the geyser down or install a solar water heater. A solar water heater uses the energy of the Sun to heat up the water. It might use some electricity as a back-up, but there will be “free” hot water when the Sun is shining.

Energy Saving Light-bulbs

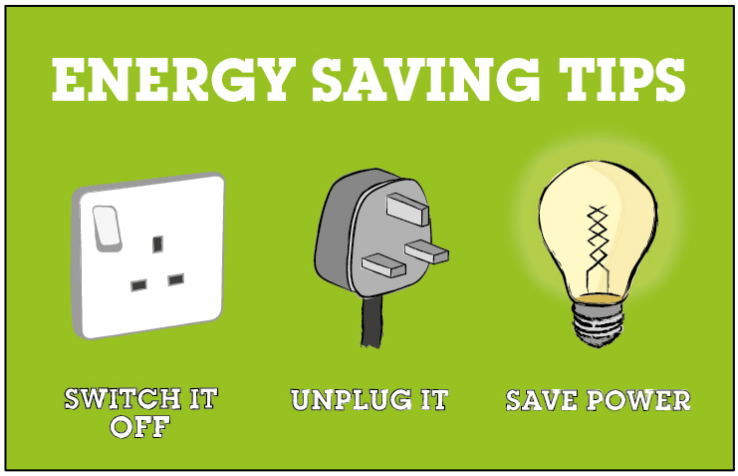
Light bulbs convert 20% of their electricity into light and 80% into heat. This wastes electricity as we do not use this heat. More recent light-bulbs, called compact fluorescent light-bulbs, convert 80% of their electricity into light and only 20% into heat. These bulbs cost more than other traditional lights but they last for much longer and they use less energy.

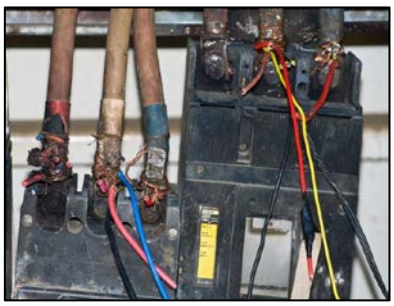
Heat Insulation

You already know that insulators stop the flow of heat. If a home is well-insulated it will not lose heat and you will pay less in electricity bills during winter seasons.

Energy-saving Hints

- ≈ Use less hot water. Shower instead of bathing.
- ≈ Switch off appliances when not using them.
- ≈ Cover pots when cooking.
- ≈ Use a kettle to boil water instead of a pot and only use as much water as you need.
- ≈ Do not use the oven or stove to heat the home. Use a gas heater.
- ≈ Turn off lights when no one is in the room.
- ≈ Use a geyser blanket to stop the geyser from losing heat.
- ≈ Turn off the geyser when not using it.





An illegal connection is when people make their own connections to a source of electricity. Usually they do this in a very unsafe way. We also call these connections, “electricity theft”. Electricity theft injures and kills many innocent children. Illegal connections are extremely dangerous because incorrect wiring is used, and wires running across floors, pathways or streets are often not insulated.

Dangers of Illegal Connections

Illegal connections are dangerous because they connect to the mains lines, sometimes before they have been stepped down by the sub-station.

Exposed wires can:

- Kill someone if they are touched.
- Burn and scar someone because of an electric shock.

Case Study: The Sol Plaatje hydroelectric power plant

The photograph shows the Sol Plaatje hydroelectric plant near Bethlehem in the Free State. It cannot produce large amounts of electricity because the “As River” is not large enough. Even a small amount of electricity produced from hydroelectric power is good, because this method produces almost no pollution. After the cost of building the plant have been paid for, electricity from a hydroelectric plan costs very little to generate. The energy that generates the electricity is flowing water, which is free and renewable. Hydroelectric power plants can damage the environment during construction and can prevent fish from moving freely after the power plants have been constructed.

Activity 8

1. Why is it a concern to use coal to generate electricity?
2. Write down two benefits of using hydroelectric power to generate electricity.
3. What is the energy source that hydroelectric power uses?

Activity 9

1. Design /draw a poster that encourages people to stop illegal connections. Choose one of the following topics for your poster:

- **Illegal connections are dangerous.**
- **Illegal connections are against the law.**

UNIT 9 – Mains Electricity: Renewable ways to Generate Electricity

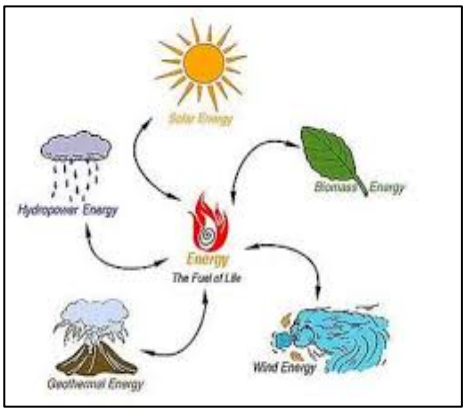
Lesson 9

Fossil fuels are coal, oil and natural gas. Electricity is generated by power plants using coal. We get energy from many different sources. These sources can be divided into two groups: non-renewable energy sources and renewable energy sources.

Non-renewable Energy Sources

Fossil fuel is a non-renewable energy resource. Coal, oil and natural gas take millions of years to make and cannot be remade quickly or replaced easily. After we use them we cannot recycle them in any way. They also cause pollution and there is only a limited supply of non-renewable energy sources. People use them because they are cheap.

Renewable Energy Sources



The Sun, wind and water are examples of renewable energy resources. Wind turbines use the wind to generate electricity. Solar panels use the energy from the Sun, while hydroelectric power stations use the energy in water to generate electricity. These forms of energy will not run out and are free to use. There is also no risk of pollution. However, the machines used to catch the energy are expensive and the weather is not reliable – sometimes the wind does not blow or the clouds block out the Sun or the rivers dry up.

Wind Energy

Huge blades called wind turbines use the energy of the wind and convert it to electricity. When there are many of these wind turbines placed together on large pieces of land it is called a wind farm. When the wind blows it

turns the blades. These blades then turn the turbines (which are like large wheels). The turbines then give energy to machines called generating, which generate electricity.

Farmers use wind energy to water their crops. Wind veins attached to a pump turn when the wind blows. This starts the pump, which brings up underground water to surface.

Solar Panels

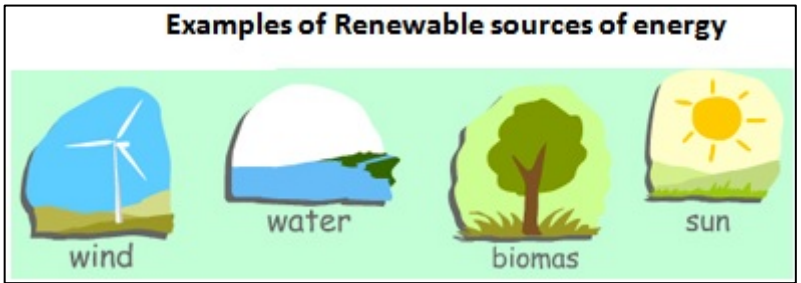
A solar panel is a device that uses the energy of the Sun. it collects the energy of the Sun. it collects the energy of the Sun and transfers (converts) the energy of the Sun into electricity or heat. This energy is then sent to our homes through conduction wires. Solar panels have to be carefully positioned to make sure that they catch as much sun as possible.

Hydro-Electric Powe

The energy in the water is used to generate electricity at hydroelectric power plants.

Activity 10

1. Research one of the following renewable energy resources:
   Wind energy, solar panels or hydroelectric power.
2. List the advantages and disadvantages of generating power using this method.
3. Explain how energy is generated using this method.



What are renewable resources?

1. When its source cannot run out (like the sun) or can easily be replaced (like wood, as we can plant trees to use for energy).
2. When their sources are carbon neutral. This means they do not produce Carbon compounds (such as other greenhouse gases).
3. When they do not pollute the environment (air, land or water).