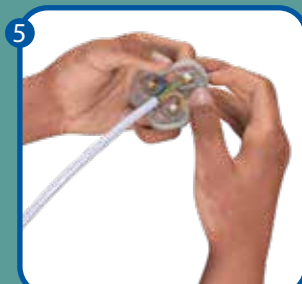


# The value of our electricity

Senior Phase (Grade 9)

Learner activity sheet

Natural Science



- 1 Trim wire insulation
- 2 Twist copper wire strands
- 3 Remove the plug cover
- 4 Unscrew plug pin screws
- 5 Insert wires into correct pin holes
- 6 Tighten pin screws
- 7 Check cord is gripped by arrestor clips
- 8 Replace plug cover



## How to save energy



Dear Learner,

Electricity is produced from the fuel such as coal, water, diesel and uranium which are limited resources. Building new power stations to increase the supply of electricity is costly, time consuming and is only one of the possible solutions towards producing more electricity. Increased use of electricity means we use up our limited natural resources and means we pollute more.

An immediate solution is to change the way in which we use electricity – that is using electricity wisely without wasting.

Eskom kindly asks you, the learner, to please put into practice different ways of using electricity wisely. You are going to learn a lot in energy education. Some of the things you will learn are:

- the changes in technology (use energy-saving lights instead of the traditional old lights),
- how to use technology more wisely (using the switch to switch off remote controlled appliances instead of the remote),
- other energy-wise saving tips,
- and how using energy wisely helps to care for our environment – our earth.

Do not worry, the energy education will be part of your school work. Be alert and become an example of how to use energy wisely. Share all that you learn with your friends, family and community. Remember to be energy-wise wherever you are – at home, at school and in other places.

**Thank you for taking care of our earth.**





## **Strand: Energy and change**

### **Topic: Safety with electricity**

#### Content: Safety practices

- Parallel connections can cause overload on the mains circuits.
- Circuit breakers, fuses and earth leakage systems are used as safety devices in electrical circuits.
- Many appliances have a 3-pin plug as a safety device to connect to the main circuit.
- The 3-pin plug has a live wire, neutral wire and an earth wire.
  - The earth wire is connected to the metal case of the appliance, such as in a kettle.
  - The earth wire is connected via the wall plug to an earth cable in the ground
  - the earth cable has almost zero resistance, so if the metal casing of an appliance becomes charged due to a fault, the charge is safely discharged to the ground.
- Illegal connections to the ESKOM mains supply can be dangerous, and regarded as energy theft.





## Activity 1: Safety practices

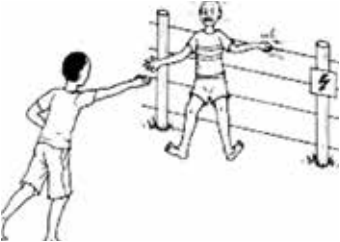


1. Identify the dangers/incorrect behaviour related to electricity in the following pictures and then write down the correct behaviour.

|    | Picture                                                                             | dangerous/<br>incorrect<br>behaviour | Correct behaviour |
|----|-------------------------------------------------------------------------------------|--------------------------------------|-------------------|
| 1. |    |                                      |                   |
| 2. |   |                                      |                   |
| 3. |  |                                      |                   |
| 4. |  |                                      |                   |
| 5. |  |                                      |                   |



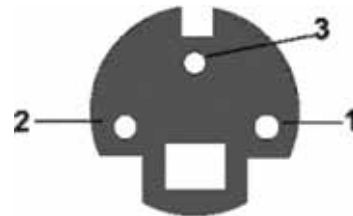
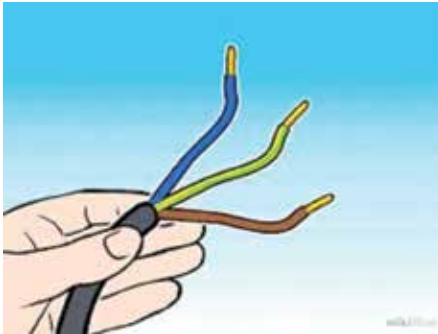


|                                                                                                                 | Picture                                                                                                                                           | dangerous/<br>incorrect<br>behaviour | Correct behaviour |
|-----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-------------------|
| 6.                                                                                                              |                                                                  |                                      |                   |
| 7.                                                                                                              |                                                                  |                                      |                   |
| 8.                                                                                                              |                                                                 |                                      |                   |
| 9.                                                                                                              |                                                                |                                      |                   |
| 10.                                                                                                             |                                                                |                                      |                   |
| 11.                                                                                                             | <p>A person trying to pull another person getting shocked</p>  |                                      |                   |
| Note: It is not safe to use electrical appliances during a lightning storm – switch off appliances like the TV. |                                                                                                                                                   |                                      |                   |





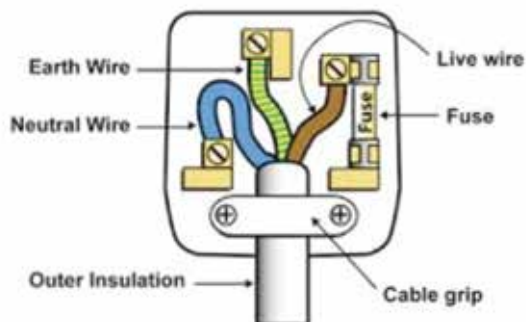
2. There are usually 3 colours of wire in appliances that require a 3-pin plug – brown (live wire), blue (neutral wire) and yellow/green (earth wire).



Label the diagram of the plug to show how to correctly wire the 3-pin plug. Remember the open end of the plug is facing you. [Hint: Brown – the r can stand for right hand side/Blue – the l can stand for left hand side].

3. Appliances (or some plugs) generally have a fuse. A fuse is a short length of wire designed to melt easily.

Why do you think a fuse is important in an electrical circuit or appliance?



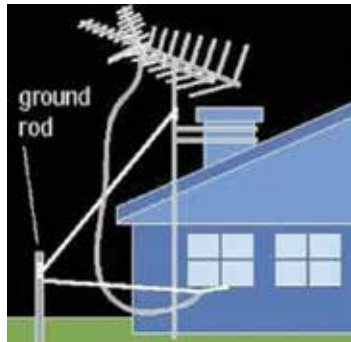
What is the function of a fuse?

- To prevent short circuit that can cause fire and damage to electrical appliances
- A short circuit occurs when there is a low resistance and a large amount of current flowing in the circuit





4. An earthing system or grounding system is circuit which connects parts of the electric circuit to the ground.



- 4.1 Why do you think it is important for the earthing rod to be connected to the television aerial?

A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or a short circuit.

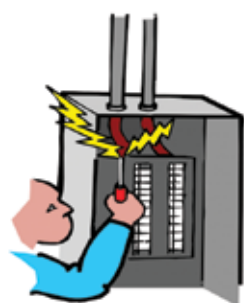
A circuit breaker monitors and controls the amount of current in a circuit. Its function is to detect a fault condition and interrupt current flow.

An earth leakage refers to the unwanted flow of electrical current from the live wire (red wire) to the earth wire (green or yellow wire). Earth leakage in uncontrolled amounts can be potentially dangerous. It can damage the appliance. To detect and control ground leakage, electricians install an earth leakage circuit breaking device. If a leak is detected, the device automatically cuts off the power supply to the appliance.

- 4.2 On a separate sheet of paper, draw a floor plan of house with 2 bedrooms, a kitchen and a lounge. In the plan show how you would wire the house to take into account electricity safety just in case there is an overload of the circuit or an electrical fire.



## 5. Read the extracts below.



1.

This little girl woke up on her first day of school, excitement and nervousness in her belly. Sadly, she never made it to school that day, because an exposed electrical wire took her life, [www.operationkhanyisa.co.za](http://www.operationkhanyisa.co.za)

Not only is it illegal, it is also dangerous. Vandalised electricity meters and illegal connections do not only drive up the cost of electricity, but could also kill children, Eskom has warned.

2.

The Khanyisa campaign will contain a simple, direct and hard-hitting message that aims to mobilise community attitudes against the illegal use and theft of electricity by isolating and exposing criminal elements and their behaviour. The campaign aims to change consumer behaviour and encourage the legal use of power. The word “khanyisa” means “enlighten” or “light up” in isiZulu.

3.

Electricity theft costs South Africa R4,4 billion annually in lost revenue. Municipalities, collectively lose another R3,2 billion and Eskom R1,2 billion - Eskom

4.

“All South Africans should begin to own the problem and stop pointing to government when something goes wrong,” said Makwana (Eskom spokesperson)

5.

An article appearing on Independent Online tells the story of Duduzile Hlanganani, a Diepkloof resident who spent at least 20 nights without electricity because of illegal connections, [www.operationkhanyisa.co.za](http://www.operationkhanyisa.co.za)

6.

“We need to move away from the bad culture of illegal connections. We have to work hard on changing the mindset of our communities so that people know that they have to pay for the electricity they use at all times,” Mokonyane told media after a meeting with Eskom chairperson Mpho Makwana and CEO Brian Dames – Eskom.

You are a qualified electrician. A person you know from a nearby settlement asked you to please draw electricity from a power box close to his house. He was prepared to pay you a fee. Explain why you would do the connection or not do the connection.



## **Strand: Energy and change**

### **Topic: Energy and the national electricity grid**

#### Content: Electricity generation

- A power station is a system for generating electricity.
- Most power stations in South Africa use coal as a fuel to boil water.
- The steam from the water turns a turbine which turns a generator, which in turn produces electricity.
- 
- There are other alternative sources of energy besides coal that can be used to drive turbines and generators. These sources include wind, falling water (hydroelectric), sun-heated steam, nuclear fission and waves in the sea.





## Activity 2: Electricity generation

- I. Most power stations in South Africa use coal (a natural resource) in the process of producing electricity.



- I.1 Discuss the following question in groups of three: Explain how electricity is generated using coal?



- I.2 Put to: Write down your ideas on a sheet of paper. You can use flow diagrams, pictures or drawings to show the process on your sheet of paper. Here is a bank of words to help you.

|                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Coal pulveriser (coal mill)</li><li>• Boiler</li><li>• Ash (burnt coal)</li><li>• Rotating shaft linking the turbine and generator</li><li>• Coil of copper wire</li><li>• Magnet inside a coil of copper</li><li>• Cooling tower</li><li>• Step-up transformer</li></ul> | <ul style="list-style-type: none"><li>• Water to steam</li><li>• Turbine</li><li>• Generator made up of a spinning rotor</li><li>• Coil of copper wire</li><li>• Magnet inside a coil of copper</li><li>• Transmission cables/lines</li><li>• Pylon</li></ul> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

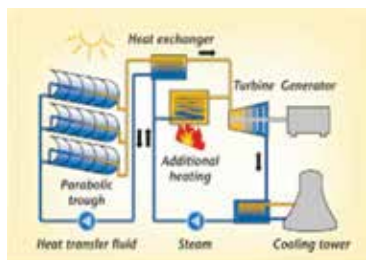
- I.3 One learner from the group will need to present the group's ideas to the class.



## Activity 1: Alternative sources of energy



There are other alternative sources of energy besides coal that can be used to drive turbines and generators. These sources of energy include:

|                                                                                                                                                                   |                                                                                                                                                       |                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>Falling water (hydroelectric)</li> </ul>  | <ul style="list-style-type: none"> <li>Wind</li> </ul>               | <ul style="list-style-type: none"> <li>Waves in the sea</li> </ul>  |
| <ul style="list-style-type: none"> <li>Sun-heated steam</li> </ul>              | <ul style="list-style-type: none"> <li>Nuclear fission</li> </ul>  | <ul style="list-style-type: none"> <li>Natural gas</li> </ul>      |

### Nuclear power in South Africa

- A nuclear power station such as Koeberg in the Cape, uses radioactive fuel, the radioactivity produces heat by nuclear fission. The heat is then used to boil water to produce steam.
- The steam from the water turns a turbine which turns a generator. Electricity is produced in the generator.
- The electricity is then channelled into the national electricity grid.
- Spent nuclear fuel (nuclear waste) is still radioactive and remains so for many hundreds of years, therefore it needs to be properly disposed of not be a danger to life for years to come.



The table below shows a list of alternate sources of electricity that can be used to drive the dynamos (generators) to generate electricity for the national grid.

Conduct research (find out more about) each of the alternate resources.  
Evaluate each alternative resource in terms of sustainability and environmental impact.

Sustainability in simple words means using the resources we need in a way that ensures future generations will also have sufficient of the resources for their needs.

Impact on the environment means - how does the resource in the process of it being used affect the environment (plants, animals, people, the air, the ground...)?





| Alternate Source                    | Sustainability                                       | Impact on the Environment                                                                                     | Challenges, debates or difficulties of using the source.                                                                                                                                                |
|-------------------------------------|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Wind                             | - depends on the frequency of the wind               | - little impact – clean energy                                                                                | - turbines are costly<br>- may be insufficient for high demands                                                                                                                                         |
| 2. Waves in the sea                 | - sustainable                                        | - clean energy<br>- impact on life in the ocean                                                               | - costly<br>- may be insufficient for high demands                                                                                                                                                      |
| 3. Falling water (hydro-electric)   | - dependent on the availability of water /water flow | - clean energy<br>- impact on surrounding ecology                                                             | - may be insufficient for high demands                                                                                                                                                                  |
| 4. Solar (sun's) energy             | - suitable for countries with regular sunny days     | - clean energy<br>- impact during making of the panels                                                        | - costly<br>- may be insufficient for high demands                                                                                                                                                      |
| 5. Nuclear Fission (Nuclear energy) | - sustainable but debatable                          | - need to dispose spent waste which is radio active<br>- could be disastrous if there is a leak               | - debatable due to the risk to human, plant and animal life if there is a leak                                                                                                                          |
| 6. Natural gas                      | - fossil fuel- does not last forever.                | - burns cleaner than coal and oil<br>- also produces emissions<br>- need to drill deep in the earth's surface | - leakage of natural gas can have serious consequences as methane is more toxic than carbon dioxide.<br>- installation can be expensive<br>- “fracking” – digging into the earth's surface is debatable |

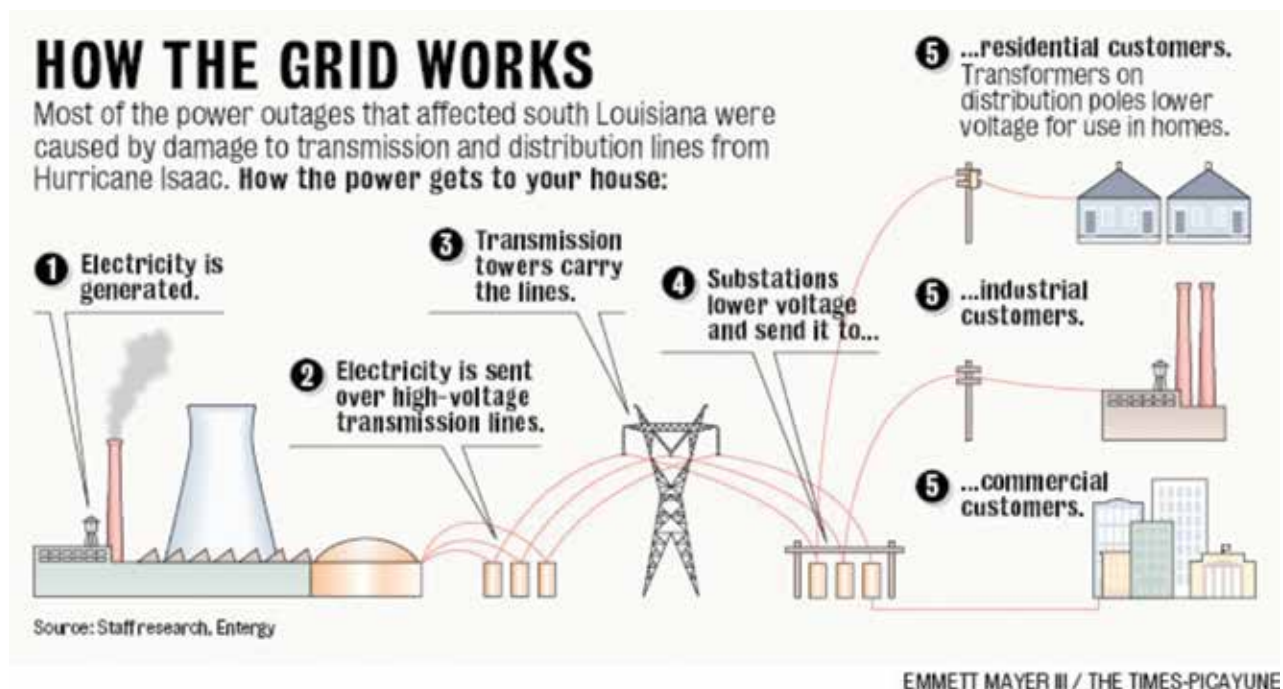


## Activity 3: National electricity grid

- The national electricity grid is a network of interacting parts (a system):  
A change in one part of the grid affects other parts of the grid.
- Power stations feed electrical energy into the national grid at high voltages.
- Power lines carry electricity at high voltages.
- Transformers step down the voltage for local distributors and consumers.
- 15% of energy is wasted due to heating of transmission lines and transformers.
- Power surges and grid overload can disrupt the power supply.



A change in one part of the grid affects other parts of the grid. Study the diagram and answer the questions.





1. List some factors that can affect the electricity grid.
2. What are the possible causes of electricity grid-overload?
3. Explain what is meant by a power surge?
4. What are the possible consequences of electricity grid-overload?
5. Write down possible ways of how electricity grid-overload can be reduced by consumers of electricity?





## Strand: Energy and change

### Topic: Cost of electrical power

#### Content: The cost of power consumption

- Electrical power is the rate of electrical energy supply.
- Electrical power is measured in units called watts (W) or kilowatts (kW) [one watt of power is equal to one joule of energy supplied in a second (*1 watt = 1 joule per second*)].
- Consumers pay for the quantity of power they use.
- The quantity of electrical power used is measured in kWh (kilowatt hours).
- The cost to the consumer is calculated in the following way:  
*Cost = power rating of the appliance × the number of hours it was used × the unit price of electricity.*
- The energy consumption of different appliances (such as incandescent and compact fluorescent lamps) varies.
- Instead of using electricity as a source there are also other alternative sources/appliances/systems e.g. solar heating panels for heating water.

- Watt (W): Watt is a unit of power marked on the electrical appliance e.g. 100watts or 100W.
- We convert watts to kilowatts by dividing the Watt value by 1000 (1000W = 1kW)
- Kilowatt.Hour (kWh): kWh is the unit used to calculate how much of electrical energy has been used. Households are charged according to the kWh units used (e.g. R1.00 / 100cents per kWh)

Energy used (kWh) =

×



## Activity 4: Calculating the energy consumption (kWh) of different appliances



Study the information below and answer the questions which follow.

|                                                                                                              |                                                                                       |                                                                                                                 |                                                                                       |                                                                                                             |                                                                                       |
|--------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <b>1. Stove</b><br>         | <u>Watt rating:</u><br>1500 watts<br><br><u>Usage:</u><br>24 hours<br><br><u>kWh:</u> | <b>2. Refrigerator</b><br>     | <u>Watt rating:</u><br>1200 watts<br><br><u>Usage:</u><br>24 hours<br><br><u>kWh:</u> | <b>3. Television</b><br> | <u>Watt rating:</u><br>300 watts<br><br><u>Usage:</u><br>24 hours<br><br><u>kWh:</u>  |
| <b>4. Lights(CFLs)</b><br> | <u>Watt rating:</u><br>1500 watts<br><br><u>Usage:</u><br>24 hours<br><br><u>kWh:</u> | <b>5. Air-Conditioner</b><br> | <u>Watt rating:</u><br>3500 watts<br><br><u>Usage:</u><br>24 hours<br><br><u>kWh:</u> | <b>4. Geyser</b><br>    | <u>Watt rating:</u><br>2200 watts<br><br><u>Usage:</u><br>24 hours<br><br><u>kWh:</u> |

### Questions:

- Calculate the energy use of each of the appliances according to the information provided.

|    | Appliance       | kWh used |
|----|-----------------|----------|
| 1. | Stove           |          |
| 2. | Refrigerator    |          |
| 3. | Television      |          |
| 4. | Lights          |          |
| 5. | Air-conditioner |          |
| 6. | Geyser          |          |



2. List the appliances in order of their kWh usage starting from the lowest to the highest for the 24-hour period.
3. Why do you think it is scientifically correct to compare the kWh use of the appliances?
4. Work out what amount of pre-paid electricity one needs to buy for the month (30 days) to use the refrigerator and geyser if energy use costs R1.00 per kWh?
5. Discuss in groups how one can reduce the consumption of electricity through using each of the appliances in a wise way. Then write down your group's response for each appliance in the table below.

|    | Appliance       | Energy-wise tips |
|----|-----------------|------------------|
| 1. | Stove           |                  |
| 2. | Refrigerator    |                  |
| 3. | Television      |                  |
| 4. | Lights          |                  |
| 5. | Air-conditioner |                  |
| 6. | Geyser          |                  |





## This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



For more information on the schools programme, please visit [www.eskom.co.za/idm](http://www.eskom.co.za/idm).

