The value of our electricity

Senior Phase (Grade 7)

Learner activity sheet

Natural Science

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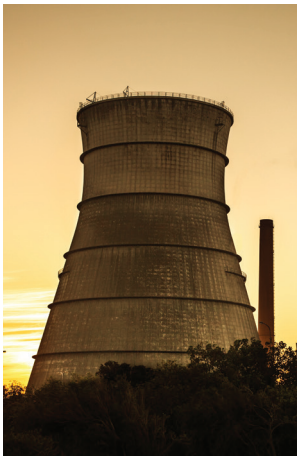


How to save energy

Dear Learner,

Electricity is produced from 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: Sources of energy

Content: Renewable and non-renewable sources of energy

- Energy is needed to make everything work, move or live.
- A source of energy has stored energy waiting to be used, or energy that is needed to make something happen.
- Non-renewable sources of energy cannot be replenished once used i.e. the resource cannot be used again. Non-renewable resources take a long time (hundreds or thousands of years) to form e.g. fossil fuel like coal.
- Renewable sources of energy are continually replenished i.e. the resource can be used again. Renewable resources do not take a long time to form but is available e.g. sunlight.

Activity 1: Renewable and non-renewable resources

Read the introductory notes given on renewable and non-renewable resources and then do the activity.

1. The table below shows a list of different resources that can be used to drive dynamos (generators) to generate electricity for the national grid. Some of the resources are renewable and some non-renewable.

1.1. You must research (find out more about) each alternative source of energy given in the table below. Classify the resource as renewable or non-renewable by placing a tick in the correct column. Explain why you to ticked the resource as renewable or non-renewable.

Alternate Source of energy	Renewable or	Non-renewable	Explanation
1. Wind			
2. Waves in the sea			
3. Falling water (Hydro-electric)			
4. Solar (Sunlight)			
5. Fossil fuel (Coal)			
6. Nuclear Fission (Nuclear energy)			
7. Fossil Fuel (Natural Gas)			

8. Biofuel (fuel usually made from plants – wood)			
9. Fossil fuel (Oil)			

1.2 For each of the resources given in the table, get pictures from old magazines and newspapers and stick them in. Label them as renewable or non-renewable.

2. Read the fact sheet below and answer the questions

Some interesting facts:

South Africa depends largely on coal to produce most of its electricity. Tonnes of coal are burnt to provide the initial energy for the production of electricity.

For every kWh of electricity produced Eskom uses:

- 1,27 litres of water
- 0,49kg of coal

For every kWh of electricity Eskom (through the burning of coal) produces:

- 132,62g of ash
- 0,29g particulates (fine particles of ash in emissions)
- 7,56g SO_2 (sulphur dioxide)
- 3,55g N_2O (nitrous oxides)
- 0,89g CO_2 (carbon dioxide)

2.1 Is water a renewable or non-renewable resource?

2.2 Is coal a renewable or non-renewable resource?

2.3 Give reasons why it is important to use electricity wisely.

3. Here is a challenge for you. (It would be good to work in groups of four for this challenge).

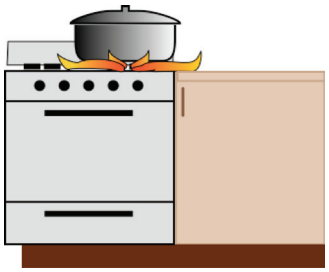
- Get a small torch bulb.
- Build a little windmill or get a small solar panel.
- See if you can get the torch bulb to switch on using these renewable sources.
- You will need other components as well e.g. connecting wires, a little motor.

Strand: Energy and change

Topic: Insulation and energy-saving

Content: Insulating materials

- Heat can be 'lost' through conduction, convection and radiation from our bodies and objects.

Recap	
Conduction: Conduction is the transfer of heat energy between matter (materials) that are in direct contact with each other. Some materials are able to conduct heat better than others. The closer the particles of material are arranged, the quicker heat moves or is transferred by conduction. For example: A pot on the stove.	
Convection: Convection is the transfer or movement of heat by the actual movement of the warmed matter e.g. water or air. The movement is usually in a circular pattern. Convection occurs in liquids and gases. For example: When water is boiled the hot water rises and the cold water sinks, this continues until all the particles are heated.	
Radiation: Radiation is the transfer of energy by electromagnetic waves. Radiation does not rely upon any contact between the heat source and the heated object the heat source and the heated object. No medium (air or liquid) is needed.	

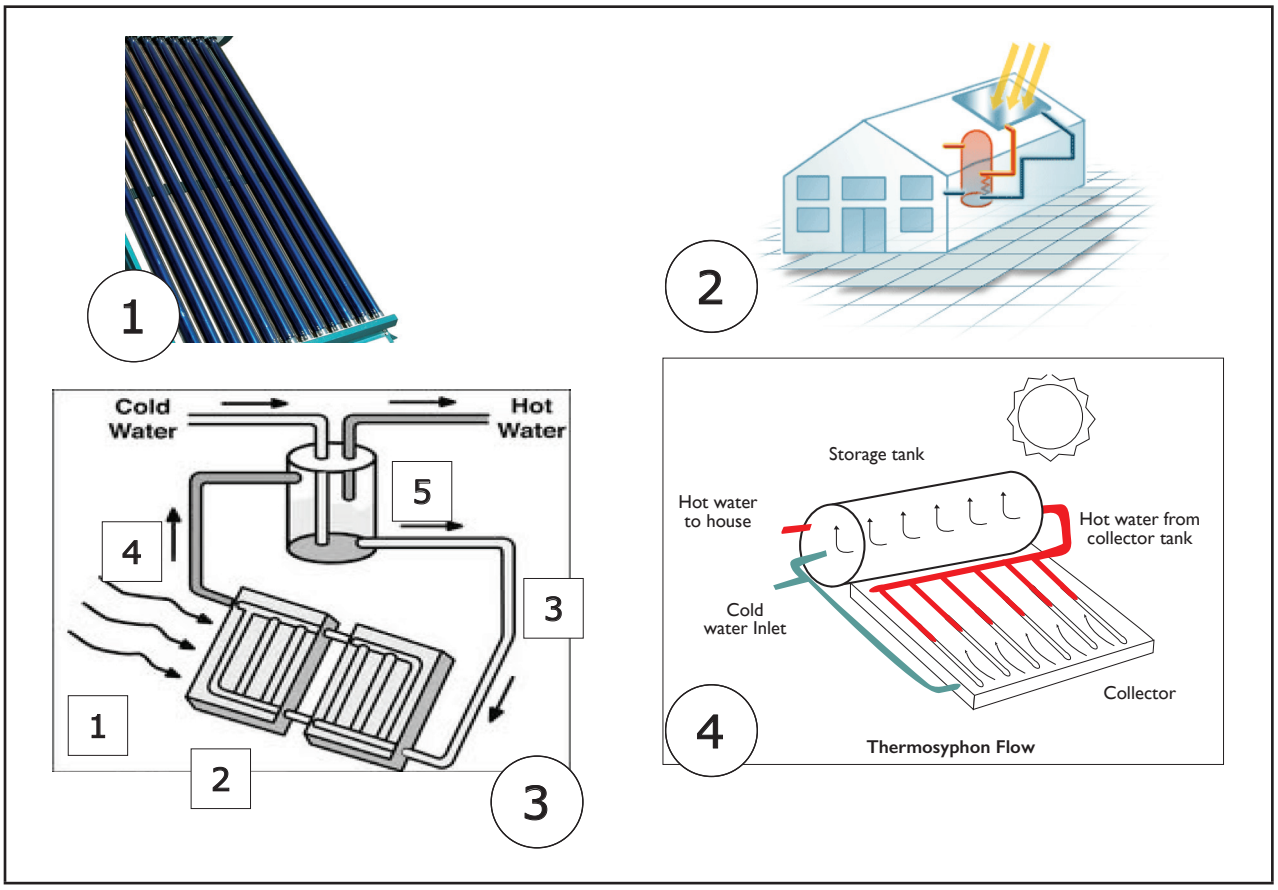
- Heat can also be gained through radiation, conduction and convection, for example solar water heaters.

Activity 2: Insulating materials – A solar water heating system

Solar water heating systems are an alternative source to using electricity to heat water like in geysers.

- Solar energy is known as a "clean" form of energy. Using solar energy will reduce the environmental impact of burning coal.
- Solar energy is a renewable energy source compared to coal which is a non-renewable resource.

There are many different designs of solar water heating systems. The diagrams below show such designs.



1.1 Redraw diagram 3.

1.2 Explain the solar water heating system on the diagram using your knowledge of heat transfer through conduction, convection and radiation.

Activity 3: Conservation of heat energy in homes and buildings

- People use insulating materials to help minimise heat loss in winter or heat gain in summer.
- Insulating materials slow down heat transfer (heat loss or gain) through conduction, convection and radiation. Insulators are used for making things such as "cool boxes", in the ceilings of buildings, for clothing (such as coats, jerseys, woolly hats) and blankets.
- Conservation of heat energy in homes and buildings can be improved by minimising heat loss in winter and heat gain in summer.
- Many indigenous, traditional homes and technologies in South Africa are designed for our climate and to be energy-efficient.

The diagrams below show typical heat loss from homes. How can the design of the home be improved to become more energy-efficient:

1. To conserve heat in winter.
2. To keep cool in summer.

- Think of ideas that do not use electricity.
- Include behaviours that we can also put into practice to conserve energy to keep warm in winter and to keep cool in summer.

Activity 4: Insulating materials – Designing a "hot-box/wonder cushion"

Insulating materials slow down heat transfer (heat loss or gain) through conduction, convection and radiation. Insulators are used for making things such as "cool boxes", in the ceilings of buildings, for clothing (such as coats, jerseys, woolly hats) and blankets.

Insulation – Insulation is the containing of heat by trapping air inside and around a device/object and by reflecting thermal radiation back into a device (object). Thermal energy is any energy that comes from a heat source for example fire, the sun, a hot stove.

Task: Designing, making and testing a system ("hot box/wonder box/wonder cushion") which uses insulating materials to keep food hot for a longer period or to keep ice cold.

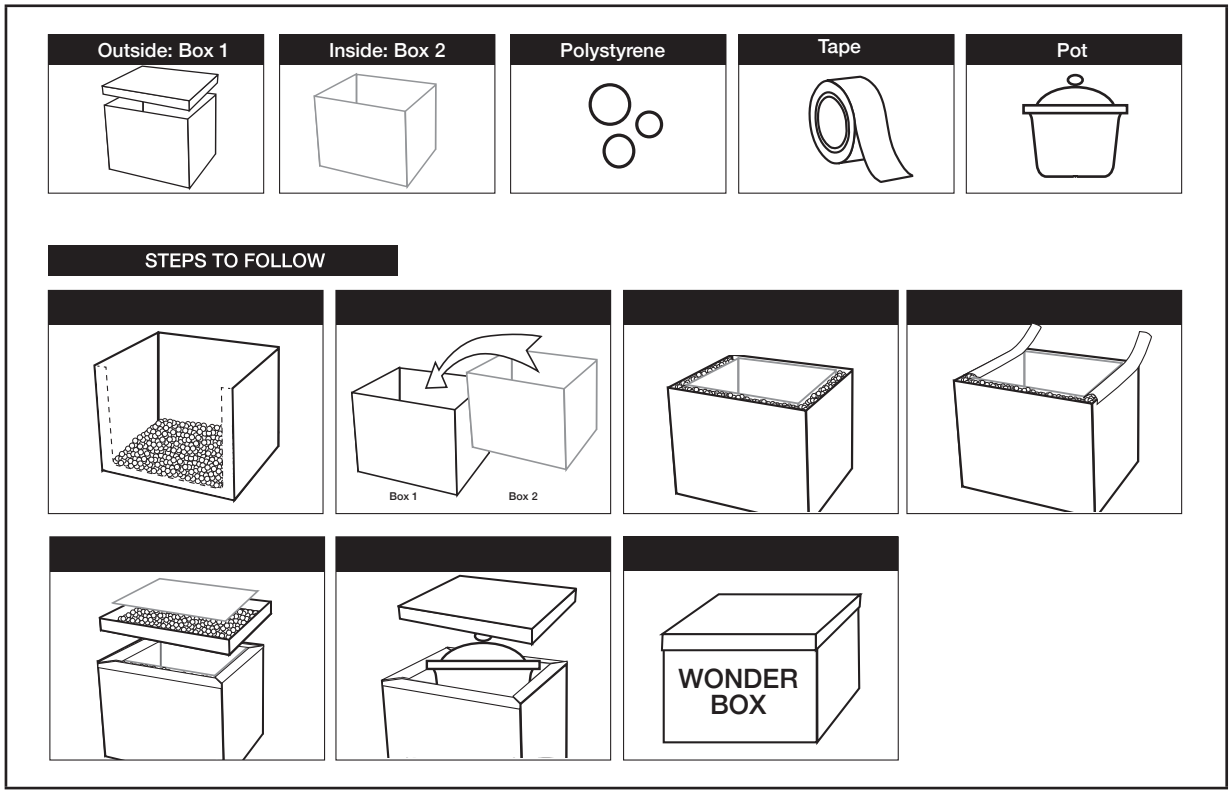
A wonder cooker/wonder cushion/wonder box also helps in cooking or keeping your food warm. Wonder cushions work on the principle of insulation. Insulation means to retain or keep the heat in. Be as innovative as you can to make your own wonder cushion.

Here is how you can make your own wonder cushion.

1. You can use a cardboard box or you can sew up a wonder cooker cushion using cotton material.
2. You need to create a pocket all around the inside of the box or bag and at the bottom of the bag of box.
3. Fill the pocket with polystyrene chips. The chips should be tightly packed.

Note: * Polystyrene is the rubbery type substance that is placed in boxes to protect items being transported. Sometimes they are in the form of "chips" or can be found in the form of small round balls.

4. Close the pocket with tape or sew it closed if cloth is used.
5. The lid of the box or the bag should also have a pocket which is to be filled with polystyrene chips.



6. Test your wonder cushion by recording the temperature as shown in the table below. You will need a thermometer. Caution: Take care when using warm water.

	Action	Temperature
1.	- Place a pot of warm water inside the cushion. - Record the temperature.	
2.	- Leave the pot in the cooker cushi on for a hour. - Record the temperature.	
3.	Write down your observations. [The water remained hot].	
4.	Explain your observation.	

7. Study the picture and answer the following questions.

1. What is the basic principle on which the wonder cushion is made?
2. Why are polystyrene chips used to fill the bottom, inside and top cover pockets of the wonder cushion?
3. Why should one never leave the wonder cushion on a metal surface while in use?
4. Find ways in which you can further insulate your wonder cushion (while still making it appear presentable).
5. Explain why using a wonder cushion is an energy-efficient way of cooking or heating food.

Strand: Energy and change

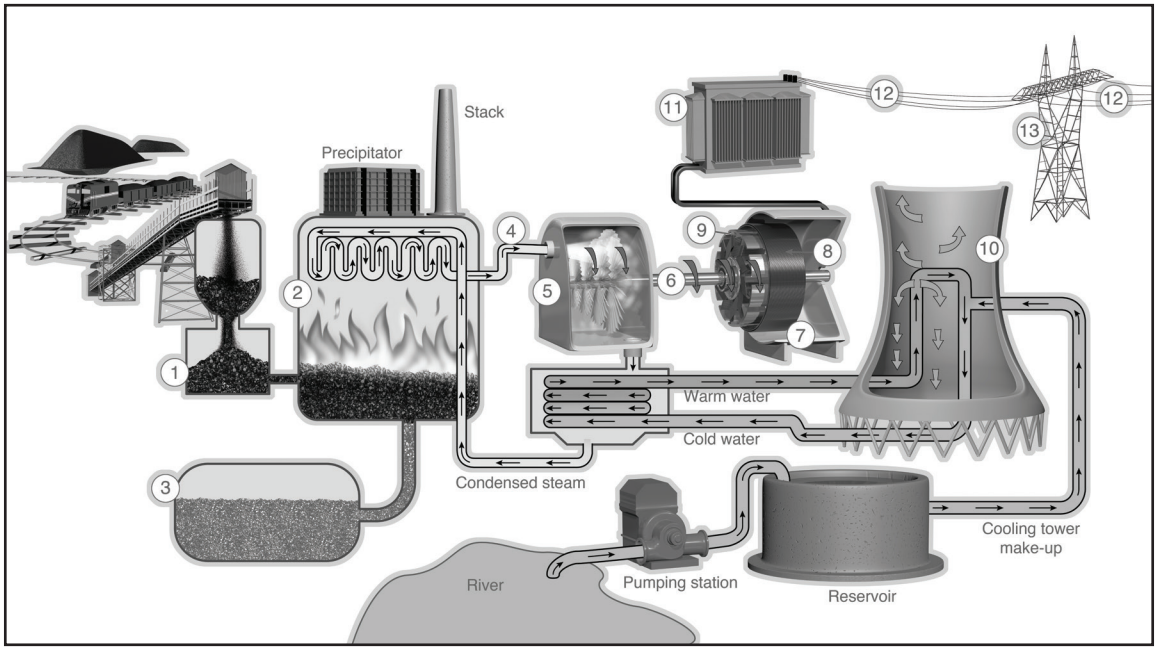
Topic: The national electricity supply system

Content: Energy transfer in the national grid

- The national electricity grid is a system (circuit) or network of interacting parts.
- The electricity is supplied in the following sequence:
  - Energy from sources such as coal, oil, gas, nuclear fuels, falling water and wind, is transferred to turbines
  - Turbines transfer energy to a generator
  - The generator changes energy from mechanical movement energy into electricity and transfers the electricity into the wires/cables of the national electricity supply grid
  - The wires transfer energy to the electrical appliances and lights.
- The electrical energy that is generated is transmitted through electrical cables (or wires). The electrical energy moves through a network of interacting parts called the National Electricity Grid. However, energy is also "wasted" as it passes through the grid.
- Dynamos are small generators, which also change energy from mechanical movement to electricity. Dynamos are used in some bicycle lights and mine helmets, and in wind-up torches and radios.

Activity 5: Energy transfer in the national grid

- Study the diagram that shows how electricity is produced and conducted.



1.1 Provide labels for numbers 1 to 13 on the diagram.

1. Coal pulveriser (coal mill)
2. Boiler
3. Ash (burnt coal)
4. Water to steam
5. Turbine
6. Rotating shaft linking the turbine and generator
7. Generator made up of a spinning rotor
8. Coil of copper wire
9. Magnet inside a coil of copper
10. Cooling tower
11. Step-up transformer
12. Transmission cables/lines
13. Pylon

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1.2 Use a flow diagram to explain how electricity is produced and gets to the home.

1.3 Explain the energy transfers that take place during the process of producing electricity using coal.

1.4 Which numbers (labels) would you leave out if water was used as the source to turn the turbine?

1.5 Draw a flow diagram to show what happens after number 13.

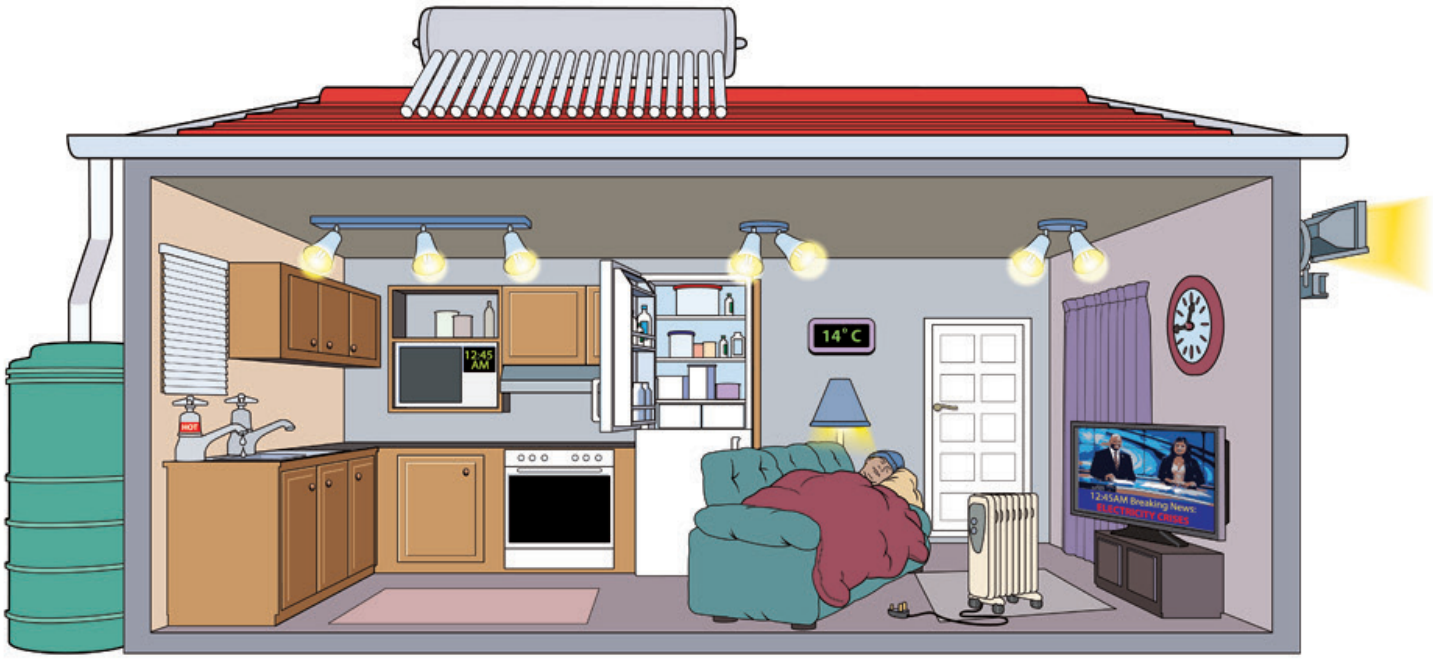
1.6 Keeping in mind that South Africa depends on coal for most of its electricity, why do you think it is necessary to use electricity wisely?

Activity 6: Conserving electricity in the home

- South Africa has a limited supply of electrical energy
- There are many different ways to use energy wisely and to save energy at home like by turning off lights and appliances, using energy-saving light bulbs, wearing warm clothing in winter instead of using the heater, stopping cold draughts, using energy-efficient appliances, matching the pot size to the stove plate and using a "hotbox" for cooking.

The wise use of electricity is a necessity. It is important that we recognise behaviour and correct practice of the unwise use of electricity. We need to also continue with behaviour that saves electricity.

Study the picture and answer the questions.



1. Put a tick next to each appropriate behaviour on the picture and put a cross next to the inappropriate behaviour. Number each cross as 1,2,3….

2. Explain why the behaviour is incorrect for each cross and state how the behaviour can be corrected.

No.	Practice that does not show energy-wise behaviour	No.	Correct behaviour
1.		1.	

2. What do you think is the attitude of the person in the picture towards the use of energy?

3. What do you think is the attitude of the person in the picture towards the environment?

4. Write down the golden rule for using electricity wisely.

5. Reflect how you are using electricity by looking at your own behaviour. Write down your incorrect behaviour and next to it the correct energy-wise behaviour. Put the correct behaviour into practice. This will help you to lead by example on how to use electricity wisely.

Notes:

For more information on the schools programme, please visit www.eskom.co.za/idm.