Energy Education
Intermediate Phase (Grade 4 - 6) (CAPS)
Educator Guide
Natural Science and Technology
Energy Education

The demand for electricity is growing. An alternative to building new power stations to supply the increase in demand for electricity is to use what we have more efficiently (i.e. without wasting), one of the ways is to change the way we use electricity. Eskom’s Integrated Demand Management (IDM) Energy Education programme motivates people to change the way they use electricity. Eskom has taken the approach of integrating energy education within the school curriculum.

The energy education programme is being introduced in the Intermediate Phase so that learners can see energy-saving as integral to their lives and put into practice as they grow. The activities are simple and can be adapted by the educator. The activities are within the context of the Curriculum and Assessment Policy Statement (CAPS) of the Department of Education (DoE).

The subjects in the Intermediate Phase (Grades 4, 5 and 6) are:
- Home Language
- First Additional Language
- Mathematics
- Life Skills
- Natural Science and Technology
- Social Science

Note: The Eskom guides are in English. The educator will need to translate them into the Home Language.

Educators need to consult the Department of Education’s CAPS policy guides for details of the skills, content and assessment within the relevant Phase and Grade.
Specific aims for Natural Science and Technology (CAPS, DoE, 2011)

There are three broad subject-specific aims in Natural Science and Technology which relate to the purpose of learning Science and Technology (CAPS, DoE, 2011). These are:

Specific Aim 1: Learning Science and Technology (investigating and problem-solving)

Specific Aim 2: Understand and connect ideas (knowledge of the subject content “theory”).

Specific Aim 3: Science, Technology and Society (understanding the practical use of Natural Science and Technology in everyday life, understanding the history of scientific discoveries and the relationship between indigenous knowledge and science).
For the educator to take note:

- The energy-wise message is integral to all the activities.
- You may use the activities as they are.
- You can adapt or change the activities.
- You can use other resources where you see appropriate.
- Adapt the activities to suit the grade you teach.
- Adapt the activities according to the level of the learners (consider language or any other barriers).
- Share and discuss the activities with other educators in the same phase and grade.
- You can use activities from different grades but adapt to suit the level of your learners.
- You can design your own activities for the additional resources or activity sheets that have been provided. These may not be mentioned in the activities.
- Practice the energy-saving behaviour so you become an example of what is expected.
- Share your knowledge and practice on energy-wise education with everyone at school, at home and in the community.

Thank you for taking care of our earth.
Energy-saving

Grade 4

The activity/activities which follow have reference to the extracts of content from the Department of Education’s (2011) CAPS policy document - Natural Science and Technology (Intermediate Phase Grades 4, 5 and 6).

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Content</th>
<th>Possible activities: investigation, practical work and demonstration</th>
<th>Resources for all activities: textbook worksheets/workbooks</th>
</tr>
</thead>
</table>
| 1½ weeks (5½ hours) | Material | • Properties of material:  
- Natural and man-made materials  
- Metals  
- Non-metals (including glass, porcelain, pottery and polymers: plastic, rubber, fabrics)  
- Description of material  
- Uses of material: suitability of different materials for different purposes. | • Compare materials used in daily life.  
• Explore properties that can be seen, felt, heard and tasted: describe materials using words like hard, soft, flexible, sticky, brittle, wet, dry, liquid, stiff, shiny, dull, strong.  
• Distinguish between objects (things) based on the materials from which they are made.  
• (Two or more objects can be made from the same material).  
• Evaluate suitable materials used to make various familiar products. | Example of materials to be used: wood, plastic, salt, mealie-meal, steel, glass, syrup, paint, water and even air |
Activity 1: Comparing energy use

• This activity is done to show the suitability of different materials for different purposes.
• Put up an A4 poster of the traditional incandescent bulb and the compact fluorescent light (energy-saving).
• Ask the learners to describe the lights - what is inside that produces the light.
• The table below shows differences you need to focus on.

<table>
<thead>
<tr>
<th>Traditional incandescent bulb</th>
<th>The compact fluorescent light (energy-saving)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Has a tungsten wire inside</td>
<td>• Has mercury gas</td>
</tr>
<tr>
<td>• Conducts electricity</td>
<td>• Does not heat up as much</td>
</tr>
<tr>
<td>• Has to heat up to 2000°C before heat is converted to light</td>
<td>• Saves energy</td>
</tr>
<tr>
<td>• Wastes energy</td>
<td></td>
</tr>
</tbody>
</table>

After the discussion give learners the worksheet as class or homework.

1. Study the pictures of the lights and answer the following questions.

<table>
<thead>
<tr>
<th>Traditional incandescent bulb</th>
<th>The compact fluorescent light (energy-saving)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Has a tungsten wire inside</td>
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<td>• Saves energy</td>
</tr>
<tr>
<td>• Wastes energy</td>
<td></td>
</tr>
</tbody>
</table>

1.1 Why do you think mercury gas was used instead of the wire in the energy-saving light? [Too much heat is required before the wire produces light; wastes energy - we need light not heat; mercury gas does not require as much heat to produce light].

1.2 Why do you think plastic was not used to replace the wire inside the traditional bulb? [Plastic will burn out - it will not be able to stand the heat of the electric current].

1.3 Which light must we use to save electricity at home? [Energy-saving light].
Activity 1: Comparing energy use

2. Study pictures A and B then answer the following questions.

2.1 Which light is used in picture A? [Energy-saving].

2.2 Which light is used in picture B? [Old light bulb].

2.3 Why is glass used to cover both lights? [Glass is transparent - you can see through it - allows light to pass through].

2.4 Which lights do you think last longer? Give a reason for your answer. [Energy-saving - the old light bulb burns out quickly, that is why the bin is full in picture B].

2.5 What shows you that the old light bulb gives off a lot of heat? [Thermometer/temperature reading is higher].

2.6 How does using the right kind of material to make lights help us? [It helps us save money - the electricity account is lower in picture A because the energy-saving light uses gas which does not require a lot of heat].
# Energy-saving

## Grade 5

The activity/activities which follow have reference to the extracts of content from the Department of Education’s (2011) CAPS policy document - Natural Science and Technology (Intermediate Phase Grades 4, 5 and 6).

<table>
<thead>
<tr>
<th>TIME</th>
<th>Topic</th>
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<th>Possible activities: investigation, practical work and demonstration</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1½ weeks (5½ hours)</td>
<td>Energy</td>
<td>• Concept of energy:</td>
<td>- Explain the concept of energy: Something that is needed to be able to do work or the capacity to do work</td>
<td>Pictures, posters and real examples</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- List advantages and disadvantages of renewable and non-renewables sources of energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Investigate the effect of depriving a flame of oxygen</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Renewable and non-renewable sources of energy:</td>
<td></td>
<td>Pictures, posters and real examples</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- the concept of renewable and non-renewable sources of energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- examples of renewable and non-renewable sources of energy e.g. fossil fuel, running water, wind, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Different forms of energy:</td>
<td></td>
<td>Pictures, posters and real examples</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- potential energy: stored energy and can be used</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- not necessary to know different types</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- kinetic energy: all moving objects possess kinetic energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- examples of potential and kinetic energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Investigate examples of potential and kinetic energy:</td>
<td></td>
<td>Pictures, posters and real examples</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- potential energy: magnets, electric cells, a stretched string, elastic band, an object that can do work by falling (because of the gravitational force of the earth), food, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- kinetic energy: and moving objects, moving water, moving air, wind, moving part of a machine, etc.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Activity 1: Renewable and non-renewable resources.

Give each learner a worksheet on renewable and non-renewable resources.

Did you know:

Renewable resources are limitless - we can use these resources again e.g. energy from the sun and wind.

Non-renewable resources are not limitless - these resources get used up e.g. coal (fossil fuel) and water. Fossil fuels can take millions of years to form. Fossil fuels like coal are burnt in a power station to turn huge machines to make electricity.

The picture below shows in a very simple way, how coal is used to make electricity.

1. Is coal a renewable or non-renewable resource? [Non-renewable]
2. Where do you think most of the mains electricity in South Africa comes from? [By burning fossil fuels like coal in a power station to turn huge machines to make electricity].
3. Which two non-renewable resources shown in the diagram are used to generate electricity? [Coal and water].
4. Why is water a non-renewable resource although there is so much water around? [There is sufficient water only if it rains in certain catchment areas - if it does not rain there is likely to be a shortage of water].
5. Why is it a disadvantage to use coal as a resource in the process of making (generating) electricity? [Coal is a non-renewable resource - it will run out one day especially if we waste electricity].
## Activity 2: Energy, change and mechanisms - electrical energy

<table>
<thead>
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</table>
| 1 week       | Energy for moving things (work)    | • Electrical energy: a source of electrical energy is needed in either cell/battery or mains electricity.  
- Electricity is used for lighting, heating, driving machines, etc.  
- Different uses of electric energy in homes, schools, shops, factories, hospitals, streetlights, etc.  
- Safety when using electricity: electrical energy can be dangerous. Know the rules for usage of electrical energy.  
Sources of energy used to move things, e.g. fossil fuel, water, the earth’s gravitational pull, springs or elastic bands. | Investigate energy used for moving things. Use given research material, case studies, pictures, etc. (must include fossil fuels, water, earth’s gravitational pull, springs/elastic bands) | Picture, poster, real examples, poster of the real cycle, etc. |
| 1 week       | Energy systems                     | • Systems that store and release energy:  
- Parts of systems that stretch and bend: springs and rubber bands  
- Parts of systems that can fall: water | - Investigate simple systems (prepared by the teacher) that use springs/rubber bands e.g. catapult model vehicle using twisted/stretch rubber band/spring, etc. Observe how they work. Operate the systems (make them work)  
- Investigate simple systems (prepared by the teacher) that use objects that fall (gravity) to make them move e.g. water (water wheel) weight falling, causing the wheel to turn, wind (windmill), etc. Observe how they work. Operate the system (make them work) | Real examples pictures, poster |

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GRADE 5  TERM 2  

STRAND: ENERGY, CHANGE AND MECHANISMS  

<table>
<thead>
<tr>
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</table>
| 1 week       | Energy for moving things (work)    | • Electrical energy: a source of electrical energy is needed in either cell/battery or mains electricity.  
- Electricity is used for lighting, heating, driving machines, etc.  
- Different uses of electric energy in homes, schools, shops, factories, hospitals, streetlights, etc.  
- Safety when using electricity: electrical energy can be dangerous. Know the rules for usage of electrical energy.  
Sources of energy used to move things, e.g. fossil fuel, water, the earth’s gravitational pull, springs or elastic bands. | Investigate energy used for moving things. Use given research material, case studies, pictures, etc. (must include fossil fuels, water, earth’s gravitational pull, springs/elastic bands) | Picture, poster, real examples, poster of the real cycle, etc. |
| 1 week       | Energy systems                     | • Systems that store and release energy:  
- Parts of systems that stretch and bend: springs and rubber bands  
- Parts of systems that can fall: water | - Investigate simple systems (prepared by the teacher) that use springs/rubber bands e.g. catapult model vehicle using twisted/stretch rubber band/spring, etc. Observe how they work. Operate the systems (make them work)  
- Investigate simple systems (prepared by the teacher) that use objects that fall (gravity) to make them move e.g. water (water wheel) weight falling, causing the wheel to turn, wind (windmill), etc. Observe how they work. Operate the system (make them work) | Real examples pictures, poster |
Give each learner a worksheet on the uses of electricity. The learners should use the picture of the Watt and Kilowatt families to answer questions.

1. What is the main source of energy the families are using? [Mains electricity].

2. Give examples from the picture to show the following uses of electricity?
   a. Lighting. [Lights in the passage; bedrooms; kitchen].
   b. Heating. [Water; ironing; heater; stove; microwave].
   c. Driving machines. [Fan; washing machine; microwave; fridge motor].

3. Do you think the Watt and Kilowatt families are using electricity wisely (are they wasting or saving energy)? [They are wasting - they have lights on upstairs when there is no one upstairs; the TV is on while they are eating; the TV upstairs is on - no one is watching; the hot water is getting cold in the bath - electricity has been used to heat the water].

4. Why should both families save electricity? [We use mostly coal to generate electricity - if we waste electricity we are wasting coal which is a non-renewable resource].

5. What are some of the ways the families can save electricity? [By switching off lights that are not being used; switch off the television at the switch; use hot water when necessary].

6. In order to use our coal resources wisely and save electricity what do you think should be the golden rule for the use of electricity?

**Switch it off if you are not using it.**
The activity/activities which follow have reference to the extracts of content from the Department of Education’s (2011) CAPS policy document - Natural Science and Technology (Intermediate Phase Grades 4, 5 and 6).

### Energy-saving

**Grade 6**

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</tr>
</thead>
</table>
| 2½ weeks  | Energy transfer in an electrical energy circuit system                | • Concept of a system:  
  - Parts of a system working together  
  - Change in one part of the system (circuit) affects all the other parts of the system  
  - Inputs and outputs  
  • Energy transfer from one system to another cell/battery in a circuit:  
  - Concept of electrical energy transfer  
  - Electrical energy stored in cells  
  - Relationship between the number of cells and amount of energy (more cells = more energy)  
  • Resistance:  
  - Concept of resistance  
  - Relationship between the number of bulbs in a series and the brightness of the bulbs  
  - Concept of current | Investigate the effects of increasing the number of cells in a series on the brightness of the lamps. Record the results. | Cells, bulbs, insulated wires, switches                                                                                           |
| (8¾ hours) |                                                                                     |                                                                                                                                                                                                           |                                                                                                                                       |                                                                                                                         |
| 1 week    | Energy systems                                                            | • Energy transfer from different appliances or machines to its surroundings:  
  - Heat (geyser, stove, kettle)  
  - Sound (drill, vacuum cleaner, hair dryer)  
  - Light (light bulb)  
  - Movement (electrical fan)  
  - Energy loss (wasted energy) |                                                                                                                                               | Picture of tools and appliances e.g. electric drill, electric iron, kettle, food mixer, etc.                                    |
| (3½ hours) |                                                                                     |                                                                                                                                                                                                           |                                                                                                                                       |                                                                                                                         |
### Energy-saving

#### GRADE 6  TERM 4

**STRAND: ENERGY AND CHANGE**

<table>
<thead>
<tr>
<th>TIME</th>
<th>Topic</th>
<th>Content</th>
<th>Possible activities: investigation, practical work and demonstration</th>
<th>Resources for all activities: textbook worksheets/workbooks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 weeks (7 hours)</td>
<td>Nutrition</td>
<td>- <strong>Food groups:</strong> Classification of food types</td>
<td>- Sort and tabulate different foods into three major food groups</td>
<td>Picture of different food types, food packaging</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Food for growth</td>
<td>- Read labels on food packaging to identify the three food groups</td>
<td>Different foods</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Oils and fats: food for energy and protection of organs</td>
<td>- Carry out a starch test with iodine on different foods such as bread, apples, eggs, etc.</td>
<td>Iodine solution</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Vitamins and minerals: food for protecting bones, teeth and the immune system</td>
<td>- Evaluate a given diet to determine if it contains sufficient quantities of all food groups</td>
<td>Pamphlets</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>A balanced diet and diseases:</strong></td>
<td></td>
<td>Charts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- A balanced diet contains sufficient quantities of all three groups, vitamins and minerals.</td>
<td></td>
<td>Poster</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Diseases result from not having a healthy, balanced diet e.g. tooth decay, rickets, constipation, obesity, diabetes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 week (3½ hours)</td>
<td>Health of the planet</td>
<td><strong>A healthy environment is important for the health of the people</strong></td>
<td></td>
<td>Information on the negative and positive effects we have on the environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All humans, plants and animals need a place where they can carry out their life processes successfully</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Humans, plants and animals need food, clean water, air and shelter to complete their life cycle successfully: depends on the environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Humans can have a negative or positive effect on the environment, choose to have a positive impact on the environment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Activity 1: Energy and change - energy transfer

- Give each learner a worksheet on energy and change - energy transfer.
- Use the diagram on the worksheet for a class discussion on energy transfer that takes place when coal is used to generate electricity.
- The learners are to answer the questions on their own after the discussion.

Study the diagram on how electricity is generated (made) and answer the questions.

1. Describe the input energy and output energy at points 1, 2, 3, 4 and 5.

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Coal - burnt</td>
<td>Heat/steam</td>
</tr>
<tr>
<td>2. Steam/heat</td>
<td>Movement - turns the turbine</td>
</tr>
<tr>
<td>3. Movement - turns the turbine</td>
<td>Movement - turbine turns the generator</td>
</tr>
<tr>
<td>4. Movement - generator turns</td>
<td>Electrical energy</td>
</tr>
<tr>
<td>5. Electrical energy</td>
<td>Light/heat energy</td>
</tr>
</tbody>
</table>

2. Give examples of the following energy transfers in the picture:

<table>
<thead>
<tr>
<th>Energy</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Heat</td>
<td>Burning coal to water</td>
</tr>
<tr>
<td>2. Movement</td>
<td>Steam/heat - movement of turbine</td>
</tr>
<tr>
<td>3. Light</td>
<td>Electrical energy to light in the light bulb</td>
</tr>
</tbody>
</table>
Activity 2: Energy and change – energy transfer and energy-saving

- Give each learner a worksheet on energy and change - energy-saving.
- The learners should use pictures of the Watt and Kilowatt families to answer the questions.

Study the picture of the two families (the Watt and Kilowatt families). Note that the design of both houses is the same. All the fan lights are 14W each.

1. Which source of energy is the Watt and Kilowatt families using? [Mains electricity].
2. Select one of the appliances downstairs and draw a flow diagram to show the input and output energy.

```
Electrical energy → power station → home → stove → heat energy
(input)                                 (output)
```

3. Give examples of energy transfer from the pictures for the following:

<table>
<thead>
<tr>
<th>Energy transfer</th>
<th>Appliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Electrical energy to get heat</td>
<td>Iron/stove/microwave/geyser/heater/light bulbs/kettle</td>
</tr>
<tr>
<td>2. Electrical energy to get sound</td>
<td>Television/radio</td>
</tr>
<tr>
<td>3. Electrical energy to get light</td>
<td>Light bulbs/television/computer screen</td>
</tr>
<tr>
<td>4. Electrical energy to get movement</td>
<td>Fan/washing machine (inside)</td>
</tr>
</tbody>
</table>

4. While there is some energy loss (wasted energy) like through heating of the fridge motor, what are some ways in which the family is wasting energy? [They have lights on upstairs when there is no one upstairs; the TV is on while they are eating; the TV upstairs is on - no one is watching it; the hot water is getting cold in the bath - electricity has been used to heat the water].
5. In the picture find the following appliances used by the Watt family. [Remote television/s, stove, geyser and refrigerator (fridge)].

5.1 Which appliance do you think uses the most amount of energy in the house? Explain why you chose that appliance. [Geyser - it is on for 24 hours - water loses heat/hot water is used - the geyser has to work to heat the water].

5.2 Which appliance uses the second most amount of energy in the house? Explain why you have chosen that appliance. [Fridge - also on for 24 hours - every time the fridge door is opened warm air enters - when the door is closed the motor has to work harder to cool the warm air and cool the inside to the correct temperature].

5.3 Which appliance uses the third most amount of energy in the house? Explain why you have chosen that appliance. [Remote controlled appliances - if they are switched off with the remote control, the light is still on - that means electrical energy is still being used - the appliance is not off].

6. Based on what you have learnt about lighting technology (CFLs and incandescent lights), what advice would you give the Kilowatt family? [Use only CFLs].

7. Using what you have learnt about electricity write down one energy-saving behaviour you will put into practice in your home or school from today. Write down the behaviour on a piece of paper/cardboard and keep it in a place where it will remind you every day. [e.g. I will switch off lights that I am not using].