WINDMILL GENERATOR

A. OVERVIEW

Subject	Green Science
Age	6-10
Duration	60 minutes
Content	Green energy generation is the conversion of energy found in our environment into electricity in a way that does not add to pollution. Understanding conversion of wind to electricity via a wind-turbine.
Goals	Students will understand : 1. Energy is easily converted from one form to another. 2. Earth's surface winds are a source of electrical energy. 3. Renewable energy from sources such as wind can help reduce air pollution and global warming.
Objectives	After completing this section, the students will explain the conversion of wind to electric energy. They will discuss alternative methods of energy generation and their rationale.
Materials	Windmill generator kit and lesson plan Clean plastic drink bottle Small cross-head screwdriver
Introduction	Background reading – Energy conversion Class discussion – Electricity generation and alternatives
Practical	Students will assemble windmill generators.
Extensions	Investigation and discussion points

B. BACKGROUND READING

Set the background reading as a homework assignment the day before the planned windmill lesson. This lesson will cover 'energy conversion' and provide a springboard for discussion on alternative energy generation.

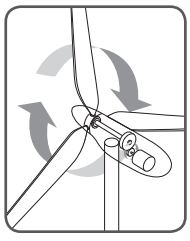
Review

Start the lesson by reviewing the reading.
Points to ensure are understood:
- Energy can be converted from one form to another.
- Each step 'wastes' energy e.g. friction causes heat

Reading material

Energy can change from one form to another e.g. wind energy can become electrical energy and electrical energy can become kinetic (movement) energy. These conversions (changes) occur in a series of steps.
The conversion of one form of energy to another is never perfectly efficient. Some energy will be wasted each step. For example, electrical energy converted to light energy in a cell-phone; some energy is wasted as heat.

Mechanical (wind) to Mechanical (rotation): Wind energy is simply the energy of moving air. Wind energy is a form of kinetic energy (movement energy). In a wind turbine, the airfoil is fixed to a rotating shaft at one end, which turns as lift is generated on the blades of the turbine.

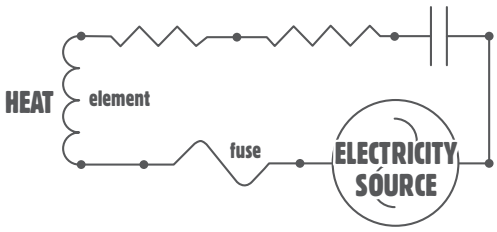


Mechanical (rotation) to Electrical: Inside the wind turbine's housing is an electrical generator. The spinning shaft turns a set of magnets mounted on a rotor. These magnets cause an electrical current to flow in a set of tightly wound coils of wire, located close to the moving magnets. This is electricity moving in the wires.

Electrical to Mechanical (rotation): This is the reverse of what happens inside a wind turbine. An electric current is passed through coils of wire wrapped around an iron core, causing it to become an electromagnet. Several of these magnets inside the motor act on other magnets attached to a rotating shaft, which spin rapidly when a current is flowing through the coils.

Electrical to Heat: Almost all materials that are used to conduct electricity (copper wire, for instance) are not perfect conductors, and resist the flow of electricity to some degree. How much resistance there is depends on what the conductor is made of, how long the conductor is, and how large the current is. When electricity is conducted through a material with great resistance this produces heat. This is seen as 'waste energy' unless in a heating device.

This is a simplified circuit diagram of a heater.
The electricity travels from the electricity source through the fuse that controls the flow of the electricity.
The electricity travels though the element. The element is made of resistant material. Electricity is 'wasted' in the form of heat trying to get through the element.



C. CLASS DISCUSSION

Electricity generation near you

• Advantages/disadvantages of each one

Energy generation	Advantages	Disadvantages
Nuclear power	No air pollution Efficient	Fear of radiation and accidents Nuclear waste Unattractive cooling towers
Coal fire power	Cheap	Air pollution Transport of coal from mines to power stations
Gas power	Cheap	Natural gas supplies dwindling
Hydroelectricity	Cheap No air pollution	Unsightly dams Change of natural environment
Geothermal	Cheap	Change of natural environment Diversion from geyser

Energy around us – Where is it? What does it do?

• Wind – Blows objects/windmills
• Waves – Tsunami destruction/sand moved on beaches
• Sun – Light/heat

Can we capture this energy?

• Solar power
• Wind power
• Wave power

D. PRACTICAL

Each group of students requires 1 kit and 1 instruction sheet. Select the relevant information from the instructions if necessary.
Go through the safety warnings advised in the instructions with the class before assembly.
Check each group's finished model and supervise the class' test runs.

E. EXTENSIONS

• Which part of the Windmill Generator turns movement energy into electricity?
• The generator causes electricity to flow through the LED. What other device causes electricity to flow around a circuit?
• What makes the wind blow?
• What effect does wind speed have on the amount of electricity produced by the generator?
• How would you modify the Windmill Generator to increase the amount of electricity it produces?
• List some good places to build a wind turbine (hint: wind turbines work best in windy places).
• What are the advantages of re-using materials, such as the plastic bottle used in the Windmill Generator?

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