ACTIVITY 6

HOW TO PRODUCE ENERGY TO SUPPLY A CHALET ALL YEAR LONG?

EXPERIMENT OBJECTIVES AND CONTENT

In this activity, students learn to use different forms of energy

KNOWLEDGE GAINED FROM PROGRESSION OF LEARNING

MATERIAL WORLD

B. Energy:

1. Forms of energy
   (a) Describe different forms of energy (mechanical, electrical, chemical, heat, solar, sound, nuclear)
   (b) Identify sources of energy in the environment (e.g, moving water, chemical reaction in a battery, sunlight)
2. Transformation of energy
   (a) Describe situations in which humans consume energy (e.g, heating, transportation, food, recreation)
   (d) Describe transformations of energy from one form to another

EARTH AND SPACE

B. Energy:

1. Sources of energy
   (b) Identify sources of natural energy (solar, moving water, wind)
   (c) Identify sources of fossil-fuel-based energy
3. Transformation of energy
   (a) Describe a renewable source of energy
   (b) Explain that light, moving water and wind are sources of renewable energy
   (c) Describe the methods developed by humans to transform sources of renewable energy into electricity (hydroelectric dam, wind turbine, solar panel)
   (d) Explain non-renewable energy
   (e) Explain that fossil fuels are non-renewable sources of energy

SUGGESTED MATERIALS

Scientific equipment:

- Electric motor (minimum 10 V)
- Connecting wires with clips
- 1.5 V bulbs or LEDs
- Sockets for bulbs
- Thermometer

Household materials:

- Tub to collect water
- Bucket
- Plastic bottle
- Fan to simulate wind
- Water wheel
- Container with cover

School supplies:

- Glue gun

Perishable non-scientific materials:

- Glue sticks for glue gun
- Wooden skewers
- Sticky putty
- Cardboard to make fan rotor, or rotor from a small fan
- Black cardboard
- Plastic wrap
- Aluminum foil

EXAMPLE OF CONTEXT RELATED TO EVERYDAY LIFE

Felix's grandparents just bought a chalet in the woods. The chalet is in a sunny, windy spot near a river. It has a wood stove, but it's not enough to heat the entire chalet. Felix's grandparents asked him to help them find ways to use alternative sources of energy for the chalet. And with winter coming, there's no time to lose. What sorts of things could Felix suggest?

SUGGESTED PREPARATORY ACTIVITIES

Lead a discussion with the class on the energy needs of a chalet (heating, cooking, food storage, lighting, etc.). Also raise the issue of different forms of energy during this discussion.

INITIAL IDEAS AND HYPOTHESES

Here are a few examples of hypotheses the students might formulate based on their initial ideas:

Example 1
I think Felix could use wind energy by building a wind turbine. I believe this because I have seen wind turbines in the Gaspé and they work well.

Example 2
I think Felix could use the moving water in the river. I believe this because I once saw a chalet with a special wheel in the river to make electricity.

Example 3
I predict that Felix could use solar energy to heat the chalet. I believe this because my pool is heated with solar energy and it works well.

RECORD ALL YOUR IDEAS AND OBSERVATIONS IN YOUR EXPERIMENT WORKBOOK.

PLANNING AND CARRYING OUT

Here are a few examples of experiments the students can carry out to verify their hypotheses:

Example A
Students build a fan rotor using thick cardboard (or use the rotor from a small fan) and install it on the electric motor. It is important that the rotor be securely attached to the motor shaft. They build an electrical circuit to connect the motor/rotor assembly to the light bulb (remind students that electricity is a form of energy). A fan is used to simulate the wind. Students place the motor/rotor in the simulated wind.

Example B
Students make a waterwheel using a plastic bottle, or use a waterwheel from a toy, and install it on the electric motor shaft. They also build an electrical circuit to connect the motor to the light bulb (remind students that electricity is a form of energy). Students pour water from a bucket over the waterwheel. Be sure to have a tub on hand to collect the water.

Example C
Students place water in a container, measure the water temperature and close the container. They then make a solar oven by building a cone of black cardboard and covering the inside of it with aluminum foil. The container is then placed inside the cone, which is closed with plastic wrap. The whole assembly is placed outside so that the inside of the cone receives the maximum amount of sunlight. After a few hours, students remove the container from the cone and measure the water temperature again to compare it with the initial reading.

EXPERIMENTAL FACTORS

To ensure scientific rigor, the students should evaluate the experimental factors that might influence the experimental results.

- Fan orientation
- Size of the electric motor
- Amount of water
- Quality and duration of sunlight

DISCUSSION: SUGGESTED INTEGRATION ACTIVITIES

To go over concepts learned during the activity, review concepts related to renewable and non-renewable energy using an association game with different forms of energy (natural gas, wind, mechanical, etc.), their categories, and their uses. The goal of the game is to show how different sources of energy can complement each other to meet all needs (the idea of using the appropriate form of energy for the situation).

SUGGESTED ACTIVITIES FOR APPLYING KNOWLEDGE

You could ask students to identifies to sources of energy that they use daily and to present their findings, including alternative sources to other students with a science fair.

SCIENTIFIC CONCEPTUAL CONTENT

Energy
Energy is what allows work to be done. "Work" can mean various things, for example inducing motion.

Sources of energy
Energy sources are the raw materials or natural phenomena that are used to produce energy.

Renewable energy
Energy is referred to as renewable when its source can be replaced on a human time scale. Sunlight, wind and water are all sources of renewable energy.

Solar energy
Solar energy is energy from the sun's rays. A solar panel is needed to convert it into electricity.

Wind energy
Wind energy is energy that comes from the force of the wind. A wind turbine can be used to convert it into electricity. The wind turns the turbine blades, which are connected to an alternator, which produces electricity.

Hydraulic energy
Hydraulic energy is the energy contained in moving water.

Hydroelectricity
Hydroelectricity is electrical energy produced by transforming hydraulic energy from a waterfall into electricity by way of an alternator, among other things. In Canada, this is the most common source of electricity.

Non-renewable energy
Sources of energy that do not renew fast enough to be considered inexhaustible on a human timescale are called non-renewable energy. Natural gas, oil, and coal are non-renewable energy sources.

Natural gas
Natural gas is the result of the transformation over millions of years of organic matter. It is made up of 95% methane, less than 4% ethane and nitrogen, and 1% carbon dioxide and propane. It is lighter than air and must be given an artificial odour so that leaks can be detected, because it is odourless in its natural state.

Petroleum
Petroleum is a mineral oil resulting from the transformation at high pressure (for example in the depths of the oceans) of organic matter, often plant matter, over millions of years. Petroleum (often simply called "oil") is a fossil fuel.

Coal
Coal is a sedimentary rock that has formed from decaying plant matter. It represents the largest source of fossil fuel in the world.

Biogas and biomethane
Biogas is a gas produced by the fermentation of plant, and animal, based organic matter (wastewater treatment sludge, agricultural and household waste, etc.). It contains about 50% methane, along with other ingredients such as carbon dioxide (CO_2) and water. Biogas can be treated to remove the CO_2 and other ingredients to produce biomethane, a renewable natural gas. Produced locally, it can be injected into the natural gas distribution network and thereby used to heat buildings or run natural-gas-powered vehicles.

CULTURAL REFERENCES

History
Solar energy was used long before the invention of solar panels that transform sunlight into electricity. For example, the ancient Greeks used mirrors to concentrate the sun's rays to light the Olympic flame.

Québec history
From the early 1950s to the start of the new millennium, 185,000 hydropower pioneers worked to build one of the largest hydroelectric systems in the world in Québec's taiga around James Bay: the La Grande complex.

Solar energy
The most powerful solar power plant in the world is in Ontario. It contains 1.3 million solar panels that produce enough electricity to supply 12,800 homes.

Heritage
Québec still has several operational water mills. They are used primarily to mill flower. For example, the Moulin Michel, in Gentilly, was designated a historical monument in 1985 by the *ministère des Affaires culturelles*, and it is now possible to tour the facility.

Wind energy
One of North America's largest wind farms is located in the Gaspé. With 133 wind turbines, Le Nordais in Cap-Chat supplies electricity to about 10,000 Québec homes. It is also home to Éole, the highest vertical axis wind turbine in the world, at 110 metres. It is no longer operational.

Hydroelectric dams
About 210 kilometres from Baie-Comeau, on Québec's North Shore, is the Daniel-Johnson Dam. It is the largest multiple arch buttress dam in the world. In the same region are the Jean-Lesage (Manic-2) and Manic-5 generating stations, which can be visited with a guide.

Natural gas
Natural gas has been distributed in Québec since 1957. It comes primarily from Alberta and is distributed to thousands of restaurants, schools, small businesses, buildings, corporations, and public places. It is used mainly for air and water heating, but it is also used in some manufacturing processes.

Petroleum
Québec imports all of the crude oil it uses and refines it into various petroleum products (gasoline, diesel fuel, fuel oil, etc.). Oil is also used by the transportation and industrial sectors.

Biomethane
Québec's first facility to inject biomethane into the natural gas distribution network will be located in Saint-Hyacinthe and is about to be built. Once in production, the city's use of this biomethane will reduce 25,000 tonnes of greenhouse gasses annually.

FOR MORE CULTURAL REFERENCES,
VISIT THE ÉCLAIRS DE SCIENCES WEBSITE:
www.eclairsdesciences.qc.ca

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