

Objective

The student will describe energy transformations required to produce electrical energy for homes.

Curriculum Focus

Science, Technology

Materials

Electrical Generation Puzzle, cut apart, class set

Pinwheel (optional)

Hand generator (optional)

Transformer from a household item such as a cellular phone charger (optional)

Key Terms

Boiler

Generator

Transformer

Turbine

Activity 4: Energy for Electricity

INTRODUCTION

Electrical generation requires many energy transformations. In this activity, students will complete a puzzle showing the steps in the generation process and see how electricity is delivered to homes. Though it is a simple puzzle, students generally have no idea how electricity is produced until they have completed this activity.

PROCEDURE

1. Ask students if they believe that energy is important to their lives. How would their lives be different without electricity?
2. Ask students where electricity comes from and how it is made. Tell them that the process of generating and delivering electricity requires many energy transformations.
3. Pass out the *Electrical Generation Puzzle* and give students a couple of minutes to complete it.
4. Go through each step of the puzzle, asking students to give the type and form of energy going in and coming out of each step. Point out that burning the fuel in the boiler is a chemical change that breaks the bonds of the hydrocarbons in the fuel to release thermal energy (and waste products such as carbon dioxide and sulfur dioxide). Compare the turbine to the pinwheel, demonstrating how steam can turn the turbine to create mechanical energy. Use the hand generator to show how the mechanical energy of the turbine is converted to electrical energy. If you have done *Activity 3*, you can compare a generator to a motor.
5. Explain that the purpose of the transformers is to increase or decrease the voltage. Step-up transformers are needed to replace voltage lost as electricity is converted to thermal energy by electrical resistance in the power lines. Many household electronic devices have step-down transformers, which are a miniature version of those on electrical poles. These small transformers commonly also convert the alternating current from an outlet into direct current.
6. Have students name some further energy transformations that occur once electricity is used in their homes.
7. Ask students how the process of generating electricity with

alternative energy sources would vary from the fossil-fuel-generated electrical plant shown in the puzzle. Which pieces would be different or removed if you were using nuclear power? Wind power? Hydropower? Solar power? Alternative energy source cards are in the Extensions folder on the accompanying CD.

8. Have students discuss the environmental effects of using fossil fuels versus alternative fuels.
9. List advantages and disadvantages of each method of producing electricity.

DESCRIPTION OF ELECTRICAL GENERATION PROCESS

1. Boiler—converts chemical potential energy from fuel (fossil fuels, biomass, hydrogen) to thermal kinetic energy, changing water to steam. Light and chemical energy (new chemicals in the gases produced) are also formed, but the energy does not contribute to the process of electrical generation.
2. Turbine—turned by steam, converting thermal kinetic energy to mechanical kinetic energy. Thermal energy from friction within the mechanism is produced as well, but does not contribute to the electrical generation process.
3. Generator—turned by turbine, rotating coil of wire in a magnetic field converts mechanical kinetic energy to electrical kinetic energy. Thermal energy from friction within the mechanism is produced as well, but does not contribute to the electrical generation process.
4. Power lines—transmit electrical energy at several thousand volts, resistance heating in wires converts electrical energy back to thermal energy, resulting in voltage drop and a loss of usable energy.
5. Transformer—Substations and transformers may be step-up or step-down. Step-up transformers along the power lines increase voltage periodically; step-down transformers on poles or in yards reduce the voltage to a safe level for home use.
6. Consumer—converts electrical energy into many forms to run lighting and home appliances.

TO KNOW AND DO MORE

Investigate how transformers work. The website below is a useful guide to how transformers step up and down voltage, and how household transformers also convert AC to DC current.

Check out www.explainthatstuff.com/transformers.html.

ELECTRICAL GENERATION PUZZLE

