

Energy for Electricity

Objective:

Students will describe energy transformations required to produce electric energy for homes.

Materials and Curriculum Correlations ▼

► Introduction

Electric generation requires many energy transformations. In this activity, students will complete the Electric Generation Student Sheet, which is like a puzzle showing the steps in the generation process. Students will learn how electricity is generated and delivered to their homes.

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 pieces of the “Electric Generation Puzzle” and give students a few minutes to put the pieces in order. (boiler, turbine, generator, power line, transformer, consumer)
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 a pinwheel, demonstrating how steam can turn the turbine to create mechanical energy. The transformer’s job is to change the voltage, either up or down. Step-up transformers are needed to replace voltage lost as electricity is converted to thermal energy by electric resistance in the power lines. Many household electronic devices have step-down transformers, which are a miniature version of those on electric poles. These small transformers also commonly contain components to convert the alternating current (AC) from an outlet into direct current (DC).
5. Have students name some further energy transformations that occur once electricity is used in their homes.
6. Ask students how other energy sources would produce electricity differently. When using nuclear power, wind power, hydropower or solar power, which pieces would change or be removed? Distribute the energy source cards and have students work the original puzzle with the new energy sources.
7. Have students discuss the environmental effects of using renewable versus nonrenewable fuels.
8. List advantages and disadvantages of each method of producing electricity. Each energy source has benefits and drawbacks that must be considered and balanced.
9. Help students identify some of the economic and social impacts involved in changing our fuel mix.

Description of Electric Generation Process

1. Boilers at a power plant convert 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 electric generation.
2. Turbines are 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 electric generation process.
3. Generators, turned by a turbine, rotate a coil of wire in a magnetic field converting mechanical kinetic energy to electric kinetic energy. Thermal energy from friction within the mechanism is produced as well but does not contribute to the electric generation process.
4. Power lines transmit electric energy at several thousand Volts. Resistance heating in wires converts electric energy back to thermal energy, resulting in a voltage drop and a loss of usable energy. High voltage lines from a power plant are called transmission lines. The transmission lines run to a substation which contains transformers and switches.
5. Transformers and substations 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. Consumers convert electric energy into many forms to run lighting and home appliances.

To Know and Do More

1. Investigate how transformers work. The websites below are useful guides to show how transformers step voltage up and down and how household transformers also convert alternating current (AC) to direct current (DC).
2. Check out explainthatstuff.com/transformers.html and science.howstuffworks.com for detailed information on how power grids work.
3. If you have access to a voltmeter, have students design and build transformers. Test the voltage in and out of transformers and compare to the number of turns of wire on each core. Have students see if they discover a pattern.

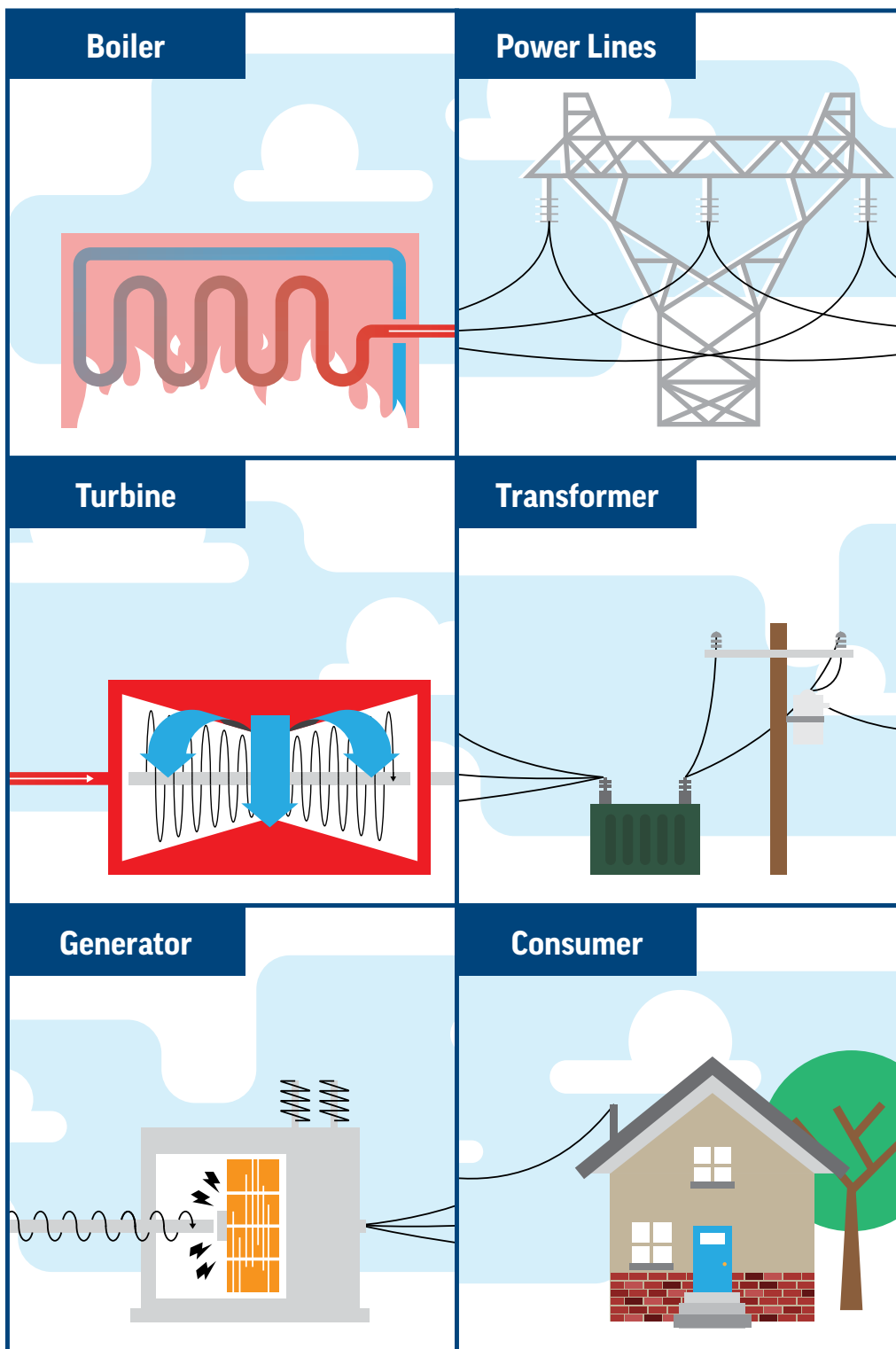
Materials Needed:

- Copies of “Electric Generation student sheet,” cut apart
- Copies of “Energy Source Cards Electric,” cut apart
- Pinwheel (optional)
- Hand generator (optional)
- Transformer from a household item, such as a cell phone charger (optional)

Curriculum Correlations

K-ESS2 - 2	MS-PS1 - 2	MS-PS3.B	HS-PS3.A
4-PS3 - 2	MS-PS2 - 3	HS-PS1 - 4	HS-PS3.B
4-PS3 - 4	MS-PS2 - 5	HS-PS3 - 1	HS-PS3.D
5-ESS3 - 1	MS-PS3.A	HS-PS3 - 2	

Electric Generation



Energy Source Cards Electric

Geothermal

Created with heat from inside the earth



Biomass

Organic material with stored energy



Hydroelectric Dam

Produces electricity from falling water



Wind Generator

Produces electricity from wind



Photovoltaic Panel

Produces electricity from sunlight



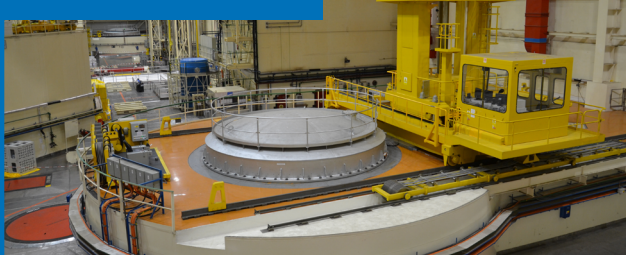
Power Tower

Produces heat from reflecting sunlight



Nuclear Reactor

Produces heat from uranium



Hydrogen Fuel Cell

Produces electricity from hydrogen and oxygen in a chemical reaction

