CONSERVATION STATION

WEEK OF RESOURCEFULNESS | CLASSROOM ACTIVITIES

ENERY-WATER NEXUS STEM INVESTIGATIONS

Combustion Energy Conversion

KEY LEARNING OBJECTIVES

Students will be able to:

- **Observe** the conversion of chemical energy to heat energy to mechanical energy.
- **Create** a model that shows the energy losses occurring as energy is converted from one form to another.
- **Evaluate** different types of energy and **determine** ways in which energy can be harnessed.
- **Discuss** and **formulate** a list of ideas that would improve upon the efficiency of energy harnessing system.

OVERVIEW

This activity demonstrates the conversion of energy into usable forms. The teacher will start the combustion demonstration by placing a pinwheel on a ring stand above a flask of water and lighting a sterno beneath. While waiting for the water to boil, the teacher will explain that the system represents components of a fossil fuel plant. The teacher will draw an energy flow diagram of the system identifying how the potential chemical energy in the sterno is converted to heat energy in the water, which is converted to mechanical energy in the pinwheel. Students will understand that energy losses occur as energy is converted from one form to another. When the water boils and the pinwheel begins to spin, the teacher will lead a class discussion on how the system could be improved to create electrical energy.

CONNECTION TO THE ENERGY-WATER NEXUS

- Energy is stored in many different forms and can be transferred to alternate types of energy.
- Scientist and engineers working in the field of renewable energy must overcome the challenges of conversion, transmission and storage before it can replace more traditional power sources such as oil and gas.

NATIONAL STANDARDS

Next Generation Science Standards

- MS-PS3-5 Energy
  Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

Itron | Discovery EDUCATION

- MS-PS1-4 Matter and its Interactions
  Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
- MS-ETS1-4 Engineering Design
  Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

BACKGROUND

Electricity is vital to modern life. It powers our lights and appliances at home. It powers many industry processes. It is used to power trains and to charge electric vehicles. For many decades almost all the electricity consumed in the world has been generated from three different forms of power plants—fossil, hydro and nuclear. Fossil fuel power plants burn carbon fuels such as coal, oil or gas to generate steam that drives large turbines that produce electricity. Large hydro power plants generate electricity by storing water in vast reservoirs behind massive dams. Water from the dams flows through turbines to generate electricity, and then goes on to flow through rivers below the dam. Nuclear energy originates from the splitting of uranium atoms—a process called fission. This generates heat to produce steam, which is used by a turbine generator to generate electricity.

KEY VOCABULARY

- Chemical energy
- Heat energy
- Mechanical energy
- Electrical energy
- Energy loss
- Efficiency
- Combustion

MATERIALS

- Match
- Sterno
- Erlenmeyer flask (250ml)
- Water
- Pinwheel
- Ring stand and clamp
- Energy Combustion Diagram Handout

TEACHER PREPARATION

- Set Up of Energy Conversion Demonstration (Place a sterno at the base of a ring stand. Using a clamp, secure a 250 ml flask containing 100 ml of water to the ring stand 2 inches above the sterno. Place a rubber stopper with an opening large enough for a straw to fit through on the flask to direct the steam. Secure a pinwheel on the ring stand 2 inches above the straw using a clamp.)
- Copies of *Energy Combustion Diagram Handout*

PROCEDURE

1. Tell students that they will be observing energy changing into different forms. Explain the system and that it represents components of a fossil fuel power plant. Distribute the *Energy Conversion Diagram* handout.
2. Begin the demonstration by lighting the sterno.
3. While the water is heating, draw an energy flow diagram on the board. Identify and discuss the forms of energy for each part of the demonstration. Students should add these annotations to their *Energy Combustion Diagram* handout.
4. Make sure students understand that energy is never lost. Stress that conversions end with "usable" and "unusable" forms of energy. Have students discuss and annotate the energy conversion portion of their diagrams. Randomly select a few students to share their thoughts.
5. Return to the demonstration as the pinwheel should now be turning. The teacher should explain that this model is like a coal fired power plant, which would have one more step: the steam would rotate a turbine that has magnets and coils of copper wire. The moving magnetic field causes electrons in the copper to wiggle, thereby creating an electric potential (voltage).
6. Have students work in small teams to design a similar energy conversion system that would be more energy efficient by decreasing unusable forms of energy. Students should draw three possible systems on the back of the *Energy Combustion Diagram* handout.

EXTENSION

Have students research alternative energy sources. Describe each alternative source and provide benefits and constraints for each. Discuss whether these alternative sources are available in your state and what environmental impact these energy sources would have.

SOURCES

https://www.energy.gov/

https://www.energy.gov/science-innovation/clean-energy

https://www.eia.gov/energyexplained/?page=renewable_home

ENERGY COMBUSTION DIAGRAM

Energy Forms		Energy Conversions