Lesson 6: Transform of Energy

Big Idea: What ways can energy be changed from one form to another?

Objective: Students will demonstrate their understanding of how different forms of energy can be transformed into other forms, by writing about their investigations with two types of wind mills and a water wheel.

NYS Standards:

Science – **4.1a** The Sun is a major source of energy for Earth. Other sources of energy include nuclear and geothermal energy.

4.1b Fossil fuels contain stored solar energy and are considered nonrenewable resources. They are a major source of energy in the United States. Solar energy, wind, moving water, and biomass are some examples of renewable energy resources.

4.1d Different forms of energy include, heat, light, electrical, mechanical, sound, nuclear, and chemical. Energy is transformed in many ways.

4.5a Energy cannot be created or destroyed, but only changed from one form into another.

4.5b Energy can change from one form to another, although in the process some energy is always converted to heat. Some systems transform energy with less loss of heat than others.

Social Studies – Standard 3 Geography: Students will use a variety of intellectual skills to demonstrate their understanding of the geography of the interdependent world in which we live local, national, and global – including the distribution of people, places, and environments over the Earth's surface.

Materials:

Pinwheel Turbine

- Pinwheel plastic sheet
- Bamboo Skewer
- Multi-meter
- Generator from Lesson 4
- Box or floor fan (ideally)*
- Alligator Clips

*smaller fans may need modified directions

Water Wheel

- Generator from Lesson 4
- 2 milk jug caps
- 8 plastic spoons
- Hot glue
- LEGO rods
- Sink
- 1 ½ inch foam noodle
- Hot glue gun

Preparation Work:

- Have enough fans for one per group –**or**– if you choose to have half of the groups start with the water wheel and half of the groups start with the wind turbine, you only will need half as many fans.

Lesson/Activity:

A. Bell Work – Have students write down Big Idea before the lesson begins. It is located on the first slide of the Power Point/SMART presentation

B. Anticipatory Set

a. Video/introduction to wind turbines. Throughout movie have students complete the first three questions on **Worksheet 6.2**. **(5/5 min)**

1) What type of energy is wind? *Kinetic*
2) Wind energy is transformed to what other form of energy? *The wind energy was transferred to mechanical energy by the wind turbine. The wind turbine spun a generator and transformed the energy into electrical energy.*
3) Is wind energy considered renewable or non-renewable? Why? *Renewable because it is always present and not exhaustible.*

b. Teacher needs to present introduction to lesson, along the lines of: *Generating electricity by hand cranking (like we did the other day) is not practical, so we need other ways to spin/turn/crank the generator. Fortunately there are many ways we can do this. Today we will examine how wind and water can be used to generate electricity, and how energy is transferred to the generator.*

C. Body

1) Have students get out their homework, **Worksheet 6.1**. Using the students homework and/or the pictures on the first slide of the Power Point/SMART presentation have the students share where they see energy changing forms. **(5/10 min)**
   a. Some examples of acceptable answers would include: Solar → solar panels, wind → wind turbines, water → water wheel, gravitational PE → rotational energy (like Savonious Helix Rotor demonstration in Lesson 2), mechanical energy → spin generator, chemical energy → powers human to spin generator, biomass → burned in power plant, gasoline → spins alternator
   b. The pictures on the first slide could be: wind → mechanical → electrical, chemical → kinetic (human swinging) → kinetic (ball hit), potential → chemical → kinetic
2) Have students break into their groups and each group will assemble a wind turbine. **(5/15 min)**
   a. Assembly instructions are provided in **Appendix A** *and are on* **Slide 4** *of the power point.*

   b. *Each generator needs a LED and a multi-meter connected in parallel. The multi-meter should be set to measure AC Voltage.*

3) Each group places their turbine 10-20cm in front of a fan that is OFF, and then turns the fan on and observes the LED and multi-meter at all fan speeds. Students fill out **Worksheet 6.2** while they adjust the experimental variables. **(10/25 min)**
   a. *Students will investigate the impact of varying the wind speed for their particular turbine. They vary the wind speed and record both a qualitative analysis of the effect on the LED and also quantitative data on the voltage produced. From this data they can conclude that the higher the wind speed the more power generated.*
4) Have groups assemble a water wheel. **(5/30 min)**
   a. *Assembly instructions are provided in* **Appendix B** *and are on* **Slide 5** *of the power point.*
   b. *Depending on the number of available sinks it may not be possible to have all of your students working with their water wheels at the same time. Three accommodations for this are proposed:*

      Variation 1: *One possible alternative is to have a pre-assembled water wheel which each group of students tests their generator on. This would work if some of your groups finish before others, such that they will not all be needing the water wheel at the same time*

      Variation 2: *Half of the class could be working on water wheels while the other half works on wind turbines. This could also apply if you do not have enough fans. Half way through the period they could switch.*

      Variation3: *Instead of sinks students could use available plastic storage bins. (30 gallon storage bin) They will not have access to running water, but a soda bottle full of water is more than sufficient to act as a faucet.*
5) (**TIME CONSTRAINT VERSION**) Each group tests their water wheel in their sink/storage bin. They answer question 5 in the **Worksheet 6.2. (5/35 min)**

5) (**SECOND DAY EXTENSION VERSION**) Each group places their water wheel in a sink/storage bin. Using **Worksheet 6.3** the students test the voltage produced when the water is dropped from a bottle onto the water wheel from three different heights.
   a. *This experiment can be quite wet, so it is advised that students set their waterwheels down in the bottom of the sink/storage container.*
   b. *Due to the water being present, place the multi-meter outside of the storage container or on the counter (if using a sink) away from the splashing water.*
   c. *Three different heights are needed to complete* **Worksheet 6.3**.
   d. *Suggested time allotment is as follows:*
      1. *Homework collected/reviewed* **(5/5 min)**
      2. *Project Explanation and Instructions* **(5/10 min)**
      3. *Data retrieval and analysis of results* **(20/30 min)**
      4. *Clean up* **(5/35 min)**
      5. *Class discussion and Understanding Assessed* **(5/40 min)**

D. Conclusion:

Put up **Slide 6** from the power point and have a selected **(5/40 min)**

Further Development

Click here for a PHET simulation of a skate boarder who demonstrates transfer between kinetic and potential energy.

Click here for a YouTube video which describes how wind turbines function.

Click here for project ideas, power points, curriculum and lessons, and workshop/events all dedicated to wind energy. This website is produced by Kid Wind.

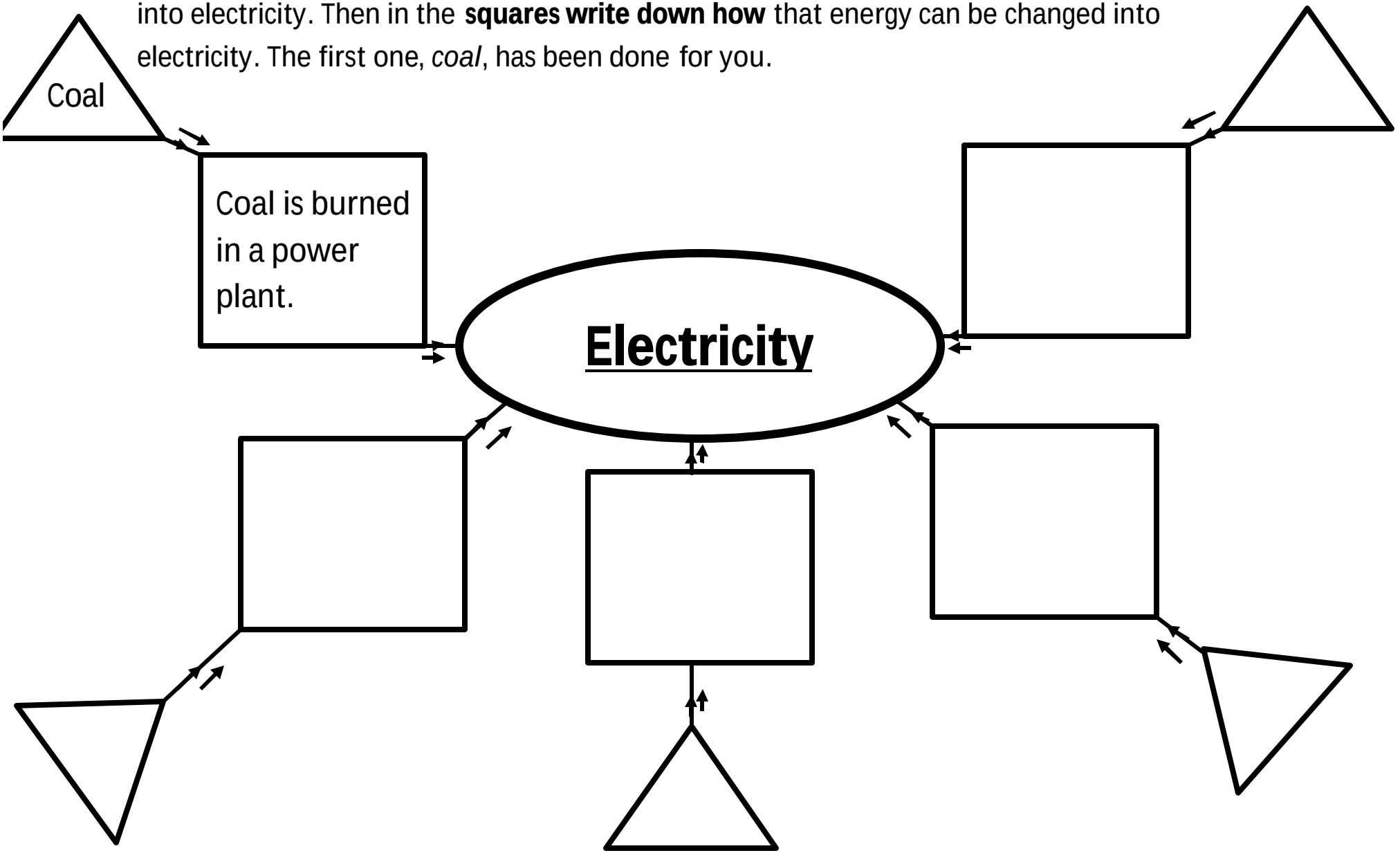
Click here for instructions on how to build a demonstration anemometer.

Click here for a unit plan from Texas which incorporates seven different activities teaching students about windmills.

Transformation of Energy
Worksheet 6.1

Name: _____
Date: _____
Period: _____

Directions: In each of the **triangles write down a different energy source** that can be changed into electricity. Then in the **squares write down how** that energy can be changed into electricity. The first one, *coal*, has been done for you.



Name: _____ Date: _____
Period: _____

Transformation of Energy
Worksheet 6.2

Big Idea:

While you watch the movie, answer the following questions.

1) What type of energy is wind?

2) Wind energy is transferred to what other form of energy?

3) Is wind energy considered renewable or non-renewable? Why?

Answer questions 1-4 for your wind turbine

1) Once you have your wind turbine built and the generator attached, place the entire apparatus in front of your Learning Team's fan. Start the fan on LOW. Was the turbine able to spin fast enough to light the LED? What was the voltage generated?

2) Now turn your fan to MEDIUM. Is the LED able to light on MEDIUM? If your turbine was able to light the LED on LOW, describe the change in the appearance of the LED. What was the voltage generated?

3) Now turn your fan to HIGH. Describe any change in the appearance of the LED. What was the voltage generated?

4) Did the LED ever remain lit without blinking? If so, at what fan speed did the LED remain constant? Using your knowledge from the previous lessons, why or why not did this happen?

5) In the space provided below draw a picture of your water wheel assembly, and describe what you did and what happened when the water hit the water wheel.

Name: _____ Date: _____
Period: _____

Transformation of Energy
Worksheet 6.3

Directions:

Place your water wheel in the bottom of the sink. Fill your bottle with water and find out how heavy it is. Then hold the bottle

Trial #	1	2	3
Height of Bottle			
Weight of Water			
Voltage Produced			