Energy

Strand	Force, Motion and Energy	
Topic	Investigating energy	
Primary SOL	6.2	The student will investigate and understand basic sources of energy, their origins, transformations, and uses. Key concepts include a) potential and kinetic energy; e) energy transformations.
Related SOL	6.1	The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which i) models and simulations are designed and used to illustrate and explain phenomena and systems.

Background Information

Suggested sequence for Enhanced Scope and Sequence lessons related to SOL 6.2:

1. Energy
2. Energy Transformations
3. Energy Sources
4. Electricity Generation

Energy causes things to happen all around us. The sun gives out light and heat energy. At night, street lamps use electrical energy to make light. Cars driving by are powered by gasoline, which contains stored energy. We eat food, which has energy in it and which our bodies use to play or study. Energy makes everything happen.

Energy can be divided into two different types, depending on whether the energy is stored or moving:

- *Potential energy* is energy that is stored.
- *Kinetic energy* is energy that is moving.

Energy cannot be created or destroyed; it can only be changed, or *transformed,* into other forms. Some examples of the transformation of energy from one form to another are the following:

- The sun shines on a plant, which transforms the solar energy into food through the process called photosynthesis. Fortunately for us, plants often produce more food than they need, which they store in stems, roots, seeds, or fruit. We can obtain this energy directly by eating the plant itself or its products.
- Humans eat a plant, transforming the potential chemical energy stored in it into kinetic mechanical energy or into another form of potential chemical energy stored as fat.
- Potential chemical energy in flashlight batteries is transformed into electrical energy and then light energy when the flashlight is turned on.
- A car engine transforms the potential chemical energy in gasoline into heat, which creates kinetic mechanical energy to power the car.
- A toaster transforms electrical energy into thermal energy.
- A television transforms electrical energy into light and sound energy.

- A power plant transforms some form of potential or kinetic energy into electrical energy (i.e., electricity). Most power plants burn a fuel to make thermal energy. In some power plants, thermal energy is used to boil water to make steam. The steam is fed under high pressure to a turbine, which spins. The turbine's spinning shaft is connected to a turbogenerator that changes the mechanical spinning energy into electricity.

The most commonly used *sources of energy* are the following:

- **Sun.** *Solar energy* comes to Earth from the sun in two forms—heat and light. Solar radiation can be used directly to make electricity in a solar cell, or it can be changed into steam for making electricity, heating homes, or heating water.
- **Wind.** Wind, like the sun, is a source of energy that has been used by mankind throughout history. Wind is still used to turn blades on windmills, and the resulting movement can be used to pump water or produce electricity.
- **Water motion—hydro.** Moving water, such as water flowing in a stream or river or falling over a waterfall or dam can be used to generate electricity, called *hydro power.* The water turns wheels that run turbines that, in turn, run generators that make electricity.
- **Water motion—tidal.** Water in motion because of the ebb and flow of the ocean tides can also run turbines that generate electricity.
- **Earth's heat.** *Geothermal energy* is the natural heat of the Earth, originating in the interior of the Earth and flowing outward to the surface. This heat can be used in its unchanged form to heat homes, among other things, or it can be harnessed in the form of steam to turn turbines and generate electricity.
- **Fossil fuels.** Fossil fuels, like petroleum (oil), natural gas, and coal, are the results of solar energy being transformed in the distant past into potential chemical energy. These fuels are found under the ground or ocean, and it is usually necessary to drill deeply into the Earth to extract them. These fuels are used to make heat and/or electricity, as well as other products like gasoline.
- **Wood.** Wood is another example of solar energy being transformed into potential chemical energy. Unlike fossil fuels, however, it is a renewable resource, as more trees can always be grown to make more wood. When wood is burned, it gives off heat, which can be used for various purposes.
- **Atomic fuel.** *Nuclear energy* is made in power plants by splitting the nuclei of heavy atoms such as uranium. This splitting of nuclei, or *nuclear fission,* releases a very large amount of heat energy. This heat can be used to boil water and make steam, which then turns turbines to make electricity.

People and other living organisms are dependent upon many renewable and nonrenewable sources of energy, but use of these resources must be considered in terms of their cost/benefit tradeoffs. All living organisms also depend on having clean air and water—i.e., a healthy environment. Many sources of energy are managed and supplied by the private sector (private individuals and corporations), often at considerable cost to the environment. Local, state, and federal governments have significant roles in managing and protecting the environment. The need for sources of energy and the need for protecting the environment are often at odds, and the government must set priorities. Ultimately, however, resource conservation and environmental protection begin with the individual.

Materials

- Pencils
- Chart paper

Vocabulary

energy sources, energy transformation, forms of energy, kinetic energy, mechanical energy, potential energy

Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

Introduction

1. Informally assess students' energy awareness. Promote inquiry with questions such as the following:
   - What is the Earth's energy source?
   - How is the sun's energy converted into the chemical energy of food?
   - Why is energy necessary?
   - What would life be like without energy?
2. Review the two types of energy, potential and kinetic, by having students put a pencil at the side of their desk and push it off the edge to demonstrate kinetic energy while falling. Then, have them pick up the pencil and put it back on the desk. Tell them that they used their own energy to lift and move the pencil back to the desk. Moving it anywhere higher than the floor adds potential energy to it. The higher it is, the farther it could fall, and so the higher the pencil is raised, the more potential energy it has.
3. Reinforce this demonstration by discussing a rubber band: If you use energy to stretch out a rubber band and hold it in that position, the stretched rubber band has potential energy. If you let it go, it moves and has kinetic energy.
4. Create a working model of energy transformation. For example, illustrate the transformation of wind energy into mechanical energy, using a simple pinwheel, or illustrate how heat can be transformed into mechanical energy, using the heat from a candle. Have students brainstorm other common examples.
5. Provide students with a list of basic terminology related to energy sources and energy transformations (see Background Information above), and guide them in creating a class definition of each term.

Procedure

1. Have small groups of students brainstorm ways they depend on energy every day. Have them create a preliminary list of energy uses.
2. Have the groups share and discuss their lists of everyday energy needs. For each need, ask the class to answer the following questions:
   - What form of energy is needed? (e.g., electrical)
   - How does that form of energy become available to us?
   - Where does it come from?
   - How it is created/transformed for our use?

3. Have students record all the ways they interact with energy in their lives over a 24-hour period. Whenever possible, students should identify the form of energy (e.g., electricity) and its source (e.g., coal-fired power plant, nuclear power plant).

Observations and Conclusions

1. Have students share their records of interaction with energy. Have them use their observations to chart the forms of energy most frequently used and the sources of this energy. Create a class chart of this data.
2. Discuss our dependence on energy, particularly electricity. Ask, "What happens when we temporarily lose power for a period of time? What would we do if we ran out of power? How would this affect our lives?"

Assessment

- **Questions**
  - How is potential energy different from kinetic energy?
  - How do energy sources impact our lives?
- **Journal/Writing Prompts**
  - Compare and contrast potential and kinetic energy, using a common or everyday item as an example.
  - Write a short personal narrative describing a day when you wake up and discover there is no electricity.
- **Other**
  - Have students create a spreadsheet for the data collection in this lesson.
  - Have students make a "Wanted" poster for Energy, featuring new knowledge from this lesson about such things as forms, transformation, and sources.

Extensions and Connections (for all students)

- Have students research ways that potential and kinetic energy play a role in the field of engineering (e.g., how Newton's laws are used for the design of seat belts and child restraint devices).
- Direct students to build a small-scale wind turbine and determine how a full scale version could help the school save on electricity consumption.

Strategies for Differentiation

- After the Introduction, have students play a modified game of "Simon Says," using the items mentioned in the Introduction. For example, the teacher says, "Simon says, show me potential energy." In response, the students stretch rubber bands and hold them.
- Have students identify the regions of kinetic and potential energy in a picture or model of a roller coaster, labeling the regions with colored sticky notes. Yellow represents kinetic energy, and pink represents potential.
- Have students create a pinwheel "windmill" using a pencil, straw, construction paper, and a paper fastener. Have students blow their windmills to demonstrate wind energy. Discuss how wind is a source of energy that you cannot see but that is frequently all around us. Discuss places on Earth where the wind hardly ever stops blowing.
- Have students write about a time when the community lost electricity, discussing the resources they could not use without power and the alternative resources they used during

the power outage. Have them discuss how the community is affected by a power outage and who should get their power restored first, and why.

- Have small groups of students explore Web sites to find out how the local, state, and federal governments regulate the environment and the conservation of energy resources.