



Solar Boats

Lesson 1: What is Energy?

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DESCRIPTION: Students will gain an understanding of the fundamentals of energy through observing a variety of energy transformations and develop a foundational vocabulary for identifying and discussing energy concepts. Students will make observations about how energy is converted between stored and kinetic forms through interacting with these changes in a station-based format. Students have the opportunity to share their findings and engage in scientific talk based on their interactions.

GRADE LEVEL(S): 4, 5, 6

SUBJECT AREA(S): Science, energy, potential energy, kinetic energy, energy sources, nuclear energy, fossil fuel energy, renewable energy, circuits, energy transfer, fuels

ACTIVITY LENGTH: 1 hour

LEARNING GOAL(S):

Students will obtain the foundational knowledge of energy sources and forms of energy. In addition, students will learn that energy can transfer from one form to another. Students will build the understanding that there are different types of energy and many can not be directly observed.

NEXT GENERATION SCIENCE STANDARDS:

- 4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
- 4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

STUDENT BACKGROUND:

Students may have very little background in this subject matter. This lesson builds a foundation for future activities.

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Materials List (30-person class)

- (3-5) Rulers
- (1) Complete circuit (battery, light bulb, wires)
- (3-5) Wind-up toys
- (1-5) Rubber band-propelled vehicles

- Several magnets and a variety of magnetic and non-magnetic items (strings, cups, lids, skewers, paperclips, washers)
- (1-3) Empty water bottles
- (1) Large ball and (1) Small ball

Vocabulary

- **Energy:** the ability to do work.
- **Energy** comes in two basic forms: potential and kinetic.
- **Potential Energy** is any type of stored energy; it isn't shown through movement.
 - 1) **Chemical:** energy stored in chemical bonds.
 - 2) **Nuclear:** energy stored in nuclear bonds.
 - 3) **Gravitational:** energy of an object due to the force of gravity acting upon it.
 - 4) **Electrical Potential:** energy of matter due to its electric charge.
- **Kinetic Energy:** energy of movements or the motion of objects.
 - 1) **Sound:** vibration of atoms due to sound waves.
 - 2) **Light:** electromagnetic energy of the movement of light waves.
 - 3) **Thermal:** individual atoms vibrating that create heat or an increase in temperature.
- **America's Primary Energy Sources:** nuclear, fossil, and renewable energy.
- **Nuclear Energy:** use of sustained nuclear fission to create heat and electricity.
- **Fossil Energy:** energy from fuels such as coal, petroleum, and natural gas.
- **Renewable Energy:** solar, wind, water, geothermal and biomass.

Lesson Details

Prep (30-person class)

Set up six (6) stations for students to experience energy and energy transfer (~5 people per station, rotating every ~5 minutes)

- **Station 1: Sound Energy** – Rulers and a desk or table. When the ruler strikes the table surface, this represents a transformation from one type of kinetic energy into another: motion into sound.
- **Station 2: Chemical/Electrical Potential Energy in Battery** – A complete circuit with light bulb. When the circuit is completed, this represents a transformation from potential energy into kinetic energy: chemical and electrical potential energy into electrical kinetic energy and finally into light energy.
- **Station 3: Mechanical Energy** – Wind-up toys. When the toys are wound up and released, this represents a transformation from potential to kinetic energy: elastic energy into motion and sound.
- **Station 4: Elastic Energy** – Rubber band-propelled vehicles. When the vehicles are released, this represents a transformation from potential to kinetic energy: elastic energy into motion and sound.
- **Station 5: Magnetic Energy** – Several magnets with strings, cups, lids, skewers, paperclips and washers. Students' primary goal here is to extract the idea that some objects are

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magnetic while others are not. When a magnet encounters a magnetic material, an energy transformation can be witnessed when the paperclips and washers move (if they are magnetic) - kinetic energy. The exact energy transfer/transformation is pretty complicated – the important piece here is that some processes are invisible.

- **Station 6: Thermal Energy** – Empty water bottles; place the lid upside down with a water seal. Rub hands for 15 seconds and place hands on bottle. Air will heat up and lift the lid. When the lid is raised, this represents a transformation from one type of kinetic energy into another: heat into the motion of the lid.

Activity 1 – Intro and Stations

- Focus Question: **What is Energy?** Have students write their thoughts in their science journals.
- Have students rotate through all six stations, taking notes on sheet provided.
- Once rotations are completed, have students share out their observations and define the different energy sources. Note vocabulary above.

Activity 2 – Culminating Activity: Bouncing Balls

Culminating Activity from “Science Kids” Experiments <http://www.sciencekids.co.nz> (Navigate to “Experiments” and then “Bouncing Balls”)

This activity, titled “Bouncing Balls” or “Energy Transfer through Balls”, is designed to illustrate the phenomenon of kinetic energy transfer between two balls, and can be used to discuss the concept of the law of conservation of energy. This activity from the Science Kids website, uses balls of two different sizes and masses (e.g. tennis ball and basketball) placed on top of each other. When dropped simultaneously, the kinetic energy from the large ball will transfer to the small ball upon contact with the ground, and the small ball should bounce impressively into the air. This activity is designed to lead directly into Solar Boats Lesson 2: What is Energy Transfer?

Additional Cross-Curricular Activities

Economics/Math:

- Calculate the costs of different types of energy.
- What factors are included in the price of energy?
- Are environmental impacts included in the price of energy?
- How does the price of energy influence the consumption of energy?

Social Studies:

- How are decisions on energy made?
- What factors influence how much energy a person uses?

References

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“Energy Transfer through Balls.” Science Experiments for Kids. Science Kids.

<http://www.sciencekids.co.nz/experiments/bouncingballs.html>

“Energy Sources.” U.S. Department of Energy. [http://www.energy.gov/science-](http://www.energy.gov/science-innovation/energy-sources)

[innovation/energy-sources](http://www.energy.gov/science-innovation/energy-sources)

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