Traveling Science Shows

THE FRANKLIN INSTITUTE

Post-Show

ENERGY

After the Show

We recently presented an Energy show at your school, and thought you and your students might like to continue investigating this topic. The following activities are designed to review and extend the ideas covered in the show.

Please remember to use appropriate safety measures for all activities. An adult instructor should always supervise students during experiments.

Visit us online at www.fi.edu/TSS or contact us at tss@fi.edu.

THING-A-MA-JIG

FOR GRADES 1-8

American cartoonist Rube Goldberg was famous for designing machines that performed very simple, everyday tasks through a complicated series of events. You can find numerous examples of his inventions in books and online. Not only are his inventions entertaining, they also illustrate the principles of energy transfer, transformation, and conservation that we discussed during the show. In this activity, students will engineer a machine to complete a task in the style of Rube Goldberg.

EQUIPMENT

Tape
Scissors
Balls
Blocks
Paper
Assorted everyday objects such as: coffee cans, string, spools, ramps, bags, balloons, etc.

PROCEDURE

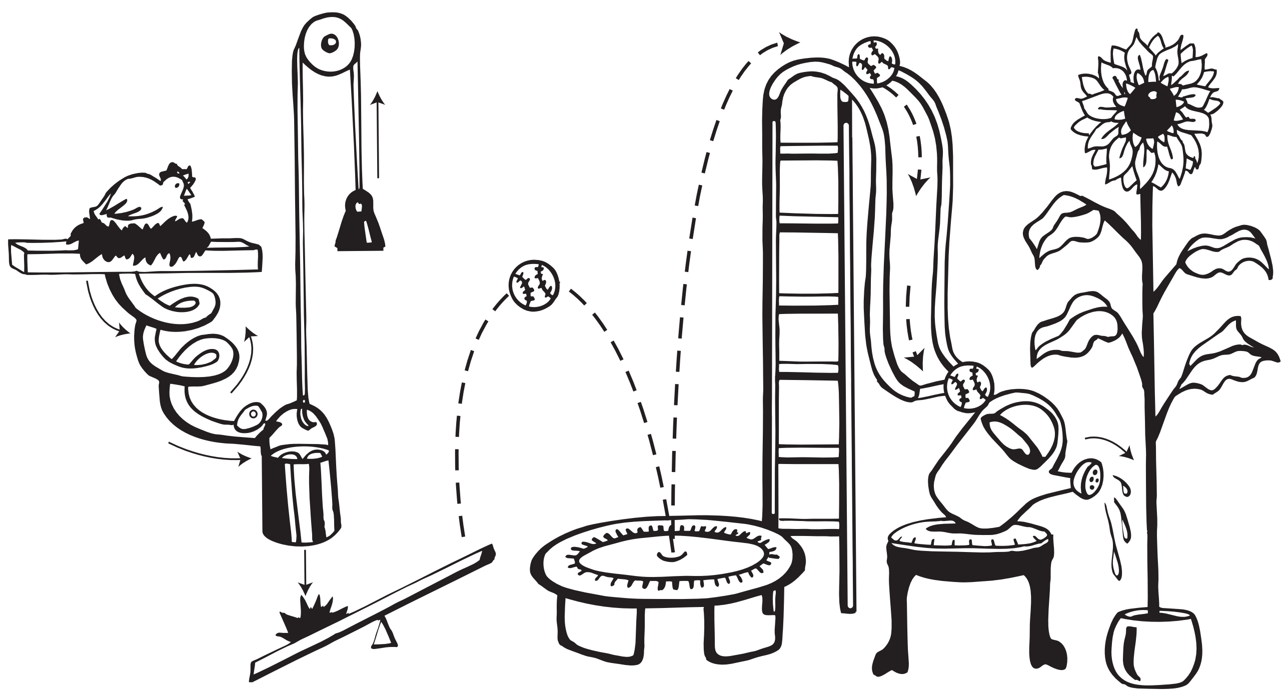
1. Research Rube Goldberg machines and discuss how they work. How many different kinds of energy can you find represented in one machine? Where do the energy transfers or transformations occur?

2. Pick a simple task. For instance, make a pencil mark on a piece of paper at least 6 feet away, or make a ping-pong ball land in a cup 10 feet away.

3. Build a machine that uses a chain reaction to accomplish the task. Experiment and have fun!

WHY?

In a Rube Goldberg machine, energy is continually transformed from one type to another. As the energy passes along any machine, some is lost as heat; however, in an effective machine, enough of the initial energy input will be conserved and reach the end to complete the task.



FIZZY, BUBBLY FUN

FOR GRADES 1-4

As you saw in the Energy show, a chemical reaction is an example of an energy transformation. In this experiment, students will determine how heat energy impacts a chemical reaction.

EQUIPMENT

3 clear glass or plastic cups
Hot, cold, and room-temperature water
3 seltzer tablets
Thermometer and stop-watch (optional)

PROCEDURE

1. Fill one cup with hot water, another cup with room-temperature water, and the third with ice water.
2. Before you do anything else, observe the glasses of water and the seltzer tablets. Do you think these items have energy? If so, what types of energy do they have?
3. Place a seltzer tablet in each cup and watch the reaction. What kinds of energy can you observe now?
4. In which temperature water did the reaction take place the fastest? The slowest? How can you tell which reaction happened the fastest and slowest? Older students can graph the time it took to complete the reaction against the temperature of the water.
5. Brainstorm other ways to make the reaction happen faster – for instance, breaking the tablet into smaller pieces, or adding vinegar to the water. Now test out your hypotheses!

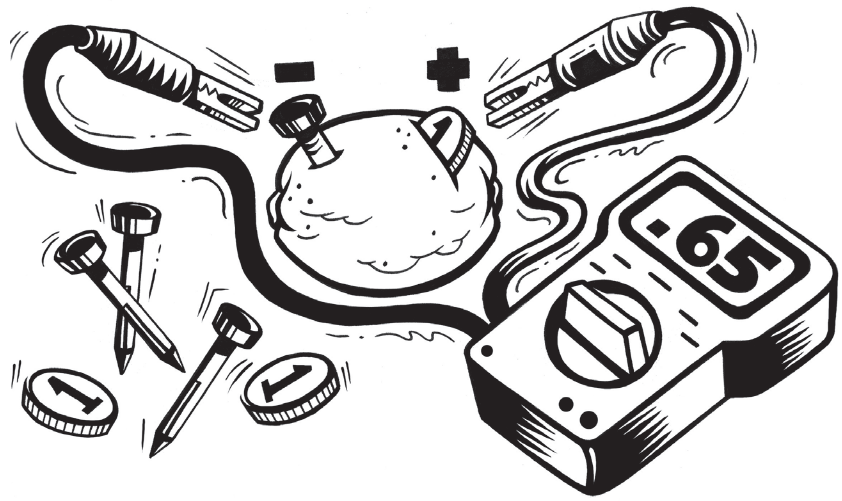
WHY?

In a chemical reaction, energy is transformed from one type to another. Here, the potential energy in the seltzer tablets and the heat energy of the water release potential chemical energy that was stored in the tablets. As temperature increases, a chemical reaction speeds up. This is because heat energy speeds up the molecules, increasing the rate at which they bump into each other and react. Conversely, cooling a chemical reaction will slow it down, which is why we put glow-sticks in the freezer to keep them glowing longer.

MAKE YOUR OWN BATTERY

FOR GRADES 5-8

We saw examples of both chemical energy and electrical energy during the Energy show. Batteries convert stored chemical energy into electrical energy, providing the power to start an electrical current flowing through a circuit. In this activity, students will construct a simple battery. This battery will not be able to run a motor, but it will produce a dim glow from a light-emitting diode (LED). Make sure the experiment area is dry, and use only the electricity sources indicated in the directions.



EQUIPMENT

Lemons (large, fresh, "juicy" lemons works best)
2" galvanized nails (galvanized nails are coated in zinc)
Pennies (must be pre-1982 copper pennies)
Volt-meter (optional)
Copper wires
Light-Emitting Diode (available from stores such as Radio Shack)

PROCEDURE

1. Insert a penny into a slit on one side of the lemon.
2. Push a galvanized nail into the other side of the lemon. The penny and the nail should not touch.
3. If desired, connect the volt meter to the penny and nail to read the voltage of the lemon battery.
4. Use wires to connect multiple lemon batteries. Connect the penny of one lemon battery to the nail of another to form a circuit.
5. Complete an electric circuit by connecting the lemon batteries to an LED.

WHY?

A battery consists of two electrodes, each of which houses a chemical reaction. In this battery, the zinc nail and copper penny form the electrodes. In one electrode, a chemical gives up electrons. The electrons then flow through a circuit towards the other electrode, where a different chemical accepts the electrons. The lemon juice is an electrolyte, which also helps the electrons flow. Electrons flowing through a circuit creates current, the source of electrical energy.

MORE INFORMATION…

We've provided the following information to help refresh your memory about the topics we covered during the show, and to deepen your understanding about important energy topics.

Energy: The ability to do work. In science, work is a force acting over a distance, usually resulting in motion. When you throw a basketball, you are doing work because the force you apply to the ball acts over a distance and causes it to move.

Heat or Thermal Energy: The energy in the movement of atoms and molecules. A warm substance, such as steam, has faster-moving particles than a cold substance, such as ice. Adding heat can raise the temperature of something, and removing heat will lower its temperature.

Light Energy: The energy of electromagnetic radiation. Some light energy, such as that from a candle or light bulb, allows us to see. Light energy also comes in many other forms that, although they are not visible to us, are important and energetic nonetheless. Ultra-violet light, for example, is invisible to our eyes but can burn our skin.

Sound Energy: The movement of vibrations, also known as sound waves, through any medium (solid, liquid or gas). When a sound wave reaches our ears, our brain interprets the vibrations as sound.

Electrical Energy: Energy related to electrical charges and their movement. Sub-atomic particles such as the electron and the proton have a property known as electrical charge that determines how they interact. These interactions can produce electrical current (what we commonly call "electricity") as well as magnetic forces.

Potential Energy: Energy stored in any system or object. Potential energy can occur, for example, when an object is elevated from the ground. This is called gravitational potential energy, since the energy is the result of gravitational forces between the object and the Earth. Other forms of potential energy include elastic and chemical.

Kinetic Energy: The energy related to a body's motion. For instance, both a speeding car and a crawling worm exhibit kinetic energy. Kinetic energy is often defined as how much work it would take to get an object moving at its current speed from a resting state (i.e. sitting still).

Chemical Energy: Energy related to chemical reactions and the making and breaking of the chemical bonds that hold atoms together. Some chemical reactions release energy while others absorb energy. Energy can be stored in chemical bonds and in chemical compounds. Food, for example, contains chemically stored energy (measured in calories) that is released during the digestive process for use in growth, cellular functions, and other processes.

Laws of Thermodynamics: A set of universally applicable rules that govern energy transformations. The First Law of Thermodynamics states that energy is neither created nor destroyed. Energy can, however, change forms.

Conservation: The word conservation has many meanings. Conservation of energy, as stated in the First Law of Thermodynamics, means that the amount of energy in any given system remains the same; even when energy is transformed from one form to another, the total amount of energy is conserved. In everyday usage, however, the term energy conservation refers to efforts to avoid wasting consumer energies (such as electricity).

Energy Transformation: Though energy is neither created nor destroyed, it can be transformed from one type to another. For example, the Sun releases nuclear energy, partially as light energy. When this light reaches earth, it can be absorbed by plants and transformed into chemical energy through the process of photosynthesis. If this plant finds its way onto your dinner table, your body transforms the chemical energy into the mechanical energy needed to do the hokey pokey as well as heat energy to keep your body warm.

Waves: Many different types of energy can travel as waves. A wave is a disturbance traveling through a medium, like a wave cheer at a stadium. The up-and-down motion of the wave travels, but the people do not. Some waves, like electromagnetic waves, can travel independent of a medium and can travel through outer space.

MORE RESOURCES…

The Franklin Institute: On your next field trip, check out Electricity, an interactive exhibit all about electrical energy. Then visit Amazing Machine to see some examples of energy transformation in historical and everyday machines. Go to http://www.fi.edu/teacherresources/ for exhibit guides.

Energy and Energy Resources: At http://www.fi.edu/msp/force/basics4.html, you'll find a collection of websites and activities about energy.

Sound and Light: Visit http://www.fi.edu/msp/sound/index.html for online teaching and learning resources on sound and light energy.

Magnetism and Electricity: For lesson plans, games, videos, and more about electromagnetic energy, visit http://www.fi.edu/msp/magnetism/index.html.

Solar Energy: Check out http://www.fi.edu/msp/solar/index.html for information and activities related to solar energy.