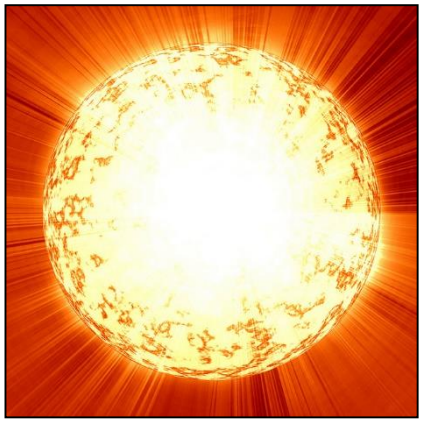
Reflect



The Sun's energy travels to Earth in light waves.

Energy can transfer from place to place and transform from one type to another. Light energy can travel through space from one place to another. You observe this energy movement when you grow plants in sunlight or when you lie in the grass and get warm on a sunny day. This is evidence that light and heat energy from the Sun is transferred to our planet through space. Energy can also move information in the form of light. We use fiber optic cables buried in the ground to transfer data signals to homes and businesses. Light energy travels in waves and does not disturb the air around it. Since the air is not disturbed when light travels through it, light does not create sound waves.

Not only can energy be transferred from place to place, it can also change forms. Lighting a match changes kinetic energy to heat and light energy. The bumps on the matchbox provide a rough surface for the match to run across. As the match is dragged across the rough box surface, some of its kinetic energy is changed to heat energy from the friction between the two objects. The heat created from the friction ignites the substance on the match, causing a chemical reaction. As the match wood burns, its chemical energy is changed to light and heat energy. If you listen closely, you can hear the sound that is created because some of the kinetic energy is changed to sound energy. You can also hear the sound created in the ignition of the match.

Every fiber in the fiber optic cable carries pulses of light.

The rough bumps on the box are a source of friction for the matchstick.

What Do You Think?

What is happening to the all of the matter in the sky during a thunderstorm? Lightning is a naturally occurring jolt of electricity that flows between the clouds and ground. This flow of energy in the form of electricity creates light that we can see from miles away. Some of the electrical energy in a lightning bolt is changed to heat energy, which can scorch the ground where it strikes. When lightning bolts crackle through the sky, they push air out of the way. When the air collapses back together, we hear thunder. The thunder you hear during a storm is caused by the lightning that is transferring energy to all of the air around it.

Lightning bolts light up the sky during a thunderstorm.

Look Out!

A beautiful firework show lights up the night sky.

A chemical reaction releasing heat is demonstrated in the laboratory.

The light, sound, and heat that comes from energy transfer and transformations can be beautiful. These energy transfers can also be very dangerous. When energy is transferred to some materials, a chemical reaction is created. Large amounts of heat and light can be released during these reactions. The extremely large bursts of color and bright light from a fireworks show is an example of a chemical reaction. Chemists create the different colors of light in a fireworks show by mixing different elements together. Lighting the fuse of a firework transfers heat energy to the firework and starts this reaction. In addition to light and heat, sound is also created when this energy is being released. Have you ever had to cover your ears at a firework show because the explosions were so loud?

What Do You Think?

What is a circuit?

Each building in a city gets its electricity from the city's power grid.

Take a look at the plug on the end of an electrical cord. Notice that it has at least two metal prongs. One prong is part of a wire that brings energy into the electrical device. The other prong is connected to a wire that carries energy out of the device. For electricity to be useful, it must always travel in a complete, unbroken circle. That circle is called an electrical circuit. A circuit has several basic parts. It has a source of electrical power and something that uses the electrical power. It also has at least two wires to connect the source to the device. Most circuits also include a switch. The switch controls whether the circuit is open (off) or closed (on). Broken wires or bad connections can also cause an open circuit.

The city power grid is a very large electrical circuit. The power source is usually an electrical power plant. Electrical energy does not flow in an open circuit and if a catastrophe happens, the city power grid may become an open circuit. How might the city's circuit be opened? What would happen to the city and its residents if this happened?

Tornadoes can devastate large pieces of land and cities.

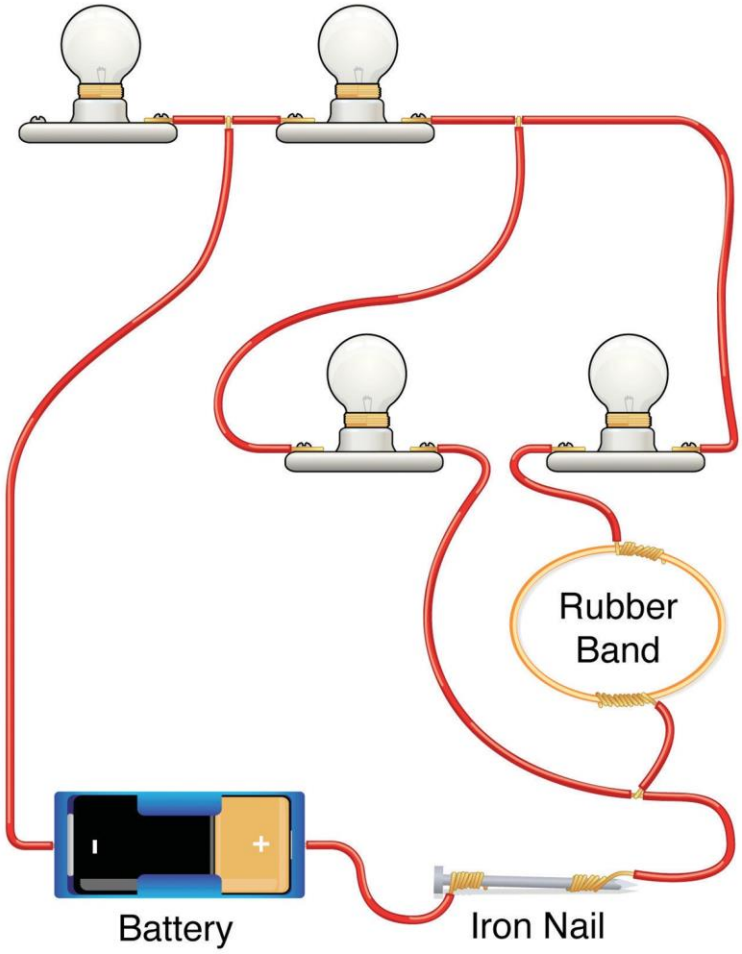
When a natural disaster destroys parts of the electrical power grid, fixing it is not always easy. Engineers and designers must come together to fix the problems within the constraints of their available resources. They must also work quickly because the people living in the city need electricity in their homes.

Before each repair can be made, the servicemen must make sure that they are following the safety codes for electricity. Also, sometimes buildings and roads must be repaired before electricity can be reconnected. As engineers work to restore the functions in the city, they must take into account how they can solve problems and meet all of the demands of safety, productivity, and resources.

Try Now

What do you know?

The diagram shows one or more complete circuits. It also shows one or more incomplete circuits. The diagram also includes four light bulbs. Circle the bulbs that will light up when electric current flows from the battery. [Hint: Do you think rubber transfers electrical energy well?]



What Do You Think?

Can you engineer a solution?

In the table below, you see problems that need engineers to fix while operating within the limits of the resources available to them. Also, as they design ways to fix problems around the globe, they must still meet criteria that are given to them. Take an engineering challenge and look at the table below. Take a minute to think about each problem and devise a plan to correct that problem. For each problem situation, work with a friend to develop the constraints and criteria you must address to find a solution.

Problem **This problem is occurring in your city.**	**Constraints** **These are the only available materials you have to fix the problem.**	**Criteria** **These are the desired features of your proposed solution to the problem.**	**Solution** **This is your plan for designing a solution for your city.**
1. A tornado destroys everything in its path down the middle of your city. The roads, houses, buildings, and parks on each side of the destruction are now isolated.			
2. An earthquake has shifted the ground in your region of the country. The fiber optic cables in the ground have been broken.			

Connecting With Your Child

Using Static Electricity

To help your child understand a fascinating application of static electricity, try this activity at home. What is the quickest way to separate salt and pepper? Let static electricity do the work! Everything you need can be found in your kitchen.

Materials
- Salt
- Pepper
- Plastic spoon
- Wool cloth or clothing

Procedure
- Measure about a teaspoon of salt and a teaspoon of pepper. Then mix them together with a spoon.
- Can you think of a way to separate them using only the spoon?
- Rub the plastic spoon on a piece of wool cloth. As you rub the spoon, you are giving the plastic spoon a negative charge. Something that is negatively charged will attract the positive particles in other objects.
- Hold the spoon about an inch above the pile of salt and pepper. Both salt and pepper will be attracted to the spoon, but pepper is lighter. Try holding the spoon close to the mixture pile. The pepper should jump up and cling to the spoon!

Questions to discuss with your child
- What happened when you rubbed the spoon with the wool cloth?
- What type of energy were you using when you rubbed the spoon with the wool cloth? Did this energy change form? To what?
- Why were the pepper flakes attracted to the plastic spoon?