Electrical Safety World Video
Teacher's Guide

The *Electrical Safety World* video explains electric science concepts and how to use electricity safely in daily life. The content addresses many state and national curriculum standards for grades 3-7, including physical science (electricity in circuits) and health and safety.

The video includes five 3-minute episodes, each on a different safety topic. This presentation guide includes learning objectives, key concepts, discussion questions, and follow-up activities to reinforce the core messages of each episode.

You may wish to introduce these basic energy concepts to your class before showing the video:

Energy is the ability to change or move matter. Without energy there would be no motion, no light, and no heat, and life would not exist. The sources of energy we rely on are very important in our everyday lives. Appliances like refrigerators, ovens, heaters, water heaters, clothes dryers, TVs, computers, and air conditioners all need energy to work. Explore these concepts through the following classroom activity:

1. Make an energy use chart in your classroom. Make three columns on the white board: one each for "What I Did," "Appliance/Equipment I Used," and "Energy Source" (such as electricity, propane, natural gas, charcoal, and so on).
2. Have students call out activities they have participated in during the last week, and the appliances and energy sources that facilitated these activities. Which energy sources are most common?

For most classrooms, electricity will be the most commonly used form of energy. It is important to understand the following principles about electricity so we can use it safely:

- Electricity is always trying to get to the ground.
- Electricity travels on power lines and electrical wires in a closed loop called a circuit. It will stay in its circuit unless something or someone gives it a path to the ground.
- Conductors are materials that allow electricity to flow through them easily, and insulators are materials that do not allow electricity to flow through them easily.
- Water is an excellent conductor of electricity. Because the human body is mostly water, your body is also a good conductor of electricity.
- Electricity will always take the easiest path to the ground. If you become part of that path, your body will conduct electricity and you will be injured, or even killed.
- Volts or voltage are the measurement of the pressure under which electricity flows**.** Contacting a low-voltage circuit can cause serious injury or death. Contacting a high-voltage circuit (such as a power line) often blasts a person clear, but the shock or fall can be fatal.

Episode 1: ELECTRICITY BASICS

Objective: To make students aware of where electricity comes from, its properties, how it gets to our homes and schools, and the dangers associated with it.

Key Concepts:
Introduce the relevant vocabulary words in boldface below before showing the video.

Electricity is generated at **power plants** where various natural resources can be used to turn **turbines**. The turbines turn electromagnets that are surrounded by heavy coils of copper wire. The moving magnets cause the **electrons** in the copper wire to move from atom to atom, generating electricity. (**Atoms** are tiny particles that make up everything around us, and electrons are even tinier particles that orbit the center of an atom. When electrons move from atom to atom through wires, electricity is created.)

Electricity travels over power lines and wires in a closed loop called a **circuit**. Electricity will leave a circuit if something or someone provides it with a path to the ground.

Safety hazards occur anywhere a person could come into contact with electrical lines or equipment. This includes power lines, transformer boxes, substations, and electrical appliances. As long as a person is touching the ground (or something in contact with the ground), electricity has the potential to travel through him or her, causing shock, burns, or even death.

Discussion:
1. Ask students to recap the different ways electricity can be generated. *(Harnessing the power of falling water [hydroelectricity], sunlight [solar energy], heat from the earth [geothermal energy], wind [wind power], uranium [nuclear energy], or fossil fuels [energy from coal, oil, or natural gas].)*

2. Ask students to describe the path electricity travels to get to the lights in their homes or classroom and back to the distribution grid. *(Electricity flows from the power plant through overhead or underground power lines, through a transformer, where the voltage is reduced. From the transformer, electricity travels through service wires to a building's electrical panel. This panel has circuit breakers or fuses that turn off the electricity if there is an electrical problem. From the panel it flows through the building's wiring to a switch or outlet, and then through a power cord to the appliance where it does its job. To complete the return part of the circuit, electricity flows back through a different wire in the power cord to the building's wiring, and back through the service wires to the transformer and the power lines.)*

Going Further:
Students may be under the impression that they can move faster than electricity in order to avoid electrical shock. Explain that electricity travels extremely fast (186,000 miles per second). If they traveled that fast, they could travel around the world eight times in the time it takes to turn on a light switch.

Take students outside the school building and locate lines, transformers, and the entrance of electrical lines into buildings. What other equipment can they see? *(Probably the electric meter.)* What is it used for? *(To measure how much electricity is used in the building.)*

Ask students to make a map of power lines or other electrical equipment near the school (or in their neighborhood at home) that people should stay away from.

Episode 2: CONDUCTORS & INSULATORS

Objective: To teach students the dangers of contacting an electrical circuit, and to teach them to recognize materials that conduct and insulate from electricity.

Key Concepts:
Introduce the relevant vocabulary words in boldface below before showing the video.

Insulators are materials that do not allow electricity to flow through them easily. Special rubber, plastic, and glass are used as insulators. Utility workers wear insulating materials to protect them from electrical shock, because contacting a power line is dangerous. Safety note: Explain to students that even though some power lines – such as those that run from power poles to buildings – may appear insulated, the coating around them is designed to protect the lines from weather, not to protect people from shock.

Insulating materials keep electricity inside appliance cords. Rubber or plastic **insulation** around the cords keeps the electricity in the wires and prevents you from getting a shock. Cords with worn or frayed insulation, or cords that have been taped, are dangerous, and touching one can give you a major shock, as there is no protection from the electricity in the circuit.

Conductors are materials that allow electricity to flow through them easily. Water and metal are good conductors. That's why metal wires are used for power lines or appliance power cords. Your body is also a good conductor. So if you touch a wire or electrical appliance that is **energized** (containing live electricity), the electricity can travel through your body to the ground and hurt or kill you.

If you overload an electrical outlet by plugging in too many things, you draw more electricity through the wiring in the walls than the circuit can handle. The insulation around these wires could melt, causing a shock and fire hazard.

Discussion:
1. Ask students to explain why it is important to know the difference between conductors and insulators. Then have them give examples of each. *(If you know about some common objects that are conductors, you might be more likely to keep these objects out of electricity's path; that is, you would know not to stick a metal fork into an outlet or toaster or touch a power line with a metal ladder. Conductors: water, metal, the human body. Insulators: rubber gloves, plastic glasses, glass.)*

2. Why are we almost always at risk of electrical shock? *(Because we are good conductors and because we are almost always touching the ground or something in contact with it.)*

3. What precautions do you think utility line workers take to avoid electrical shock? *(They use specially tested insulating gloves, tools, and equipment, and are specially trained.)*

Going Further:
Inspect the appliance cords in your classroom to make sure the insulation is intact. Also check outlets to make sure they are not overloaded. If you find an overloaded outlet, transfer some of the plugs to another outlet.

Ask students to check the appliance cords and plugs in their homes with an adult. (Remind them to turn them off and unplug them first.) If the insulation is cracked or frayed, they should decide with their family whether they should replace the cord or throw the item away.

Episode 3: OUTDOOR ELECTRICAL SAFETY

Objective: To teach students to never contact overhead or underground power lines, and to stay away from substations and surrounding fences.

Key Concepts:
Introduce the relevant vocabulary words in boldface below before showing the video.

The electricity in power lines is at such high **voltage** that it can use almost anything, even a kite string, as a path to the ground! If you are holding that string, electricity will travel through you and you will be shocked. So always fly kites far away from power lines. Also keep metallic balloons indoors so they cannot fly into power lines and create a shock hazard.

Likewise, always climb trees far away from power lines. If you touch a power line – even if it looks insulated – while climbing a tree or standing on a ladder or a roof, you could be seriously hurt or even killed.

Always stay at least 10 feet away from all overhead power lines. This means keeping your body, and any tools or equipment that you are holding, at least 10 feet away from lines of any kind.

Pad-mounted transformers (devices used to increase or decrease electricity's voltage) are found in many neighborhoods and should never be played on. Remind students to report any open/unlocked ones to an adult as soon as possible. Electricity in a **substation** is very high voltage. Never climb a substation fence or go inside a substation.

Ask an adult to call **811** a few days before doing any digging projects. This number connects to the one-call service, which will arrange for local utilities to come and mark any nearby underground electric lines so you can dig safely.

Discussion:
1. Ask students if their family members ever use ladders or long tools like pool cleaners when working outside. What precautions should they take to stay safe? *(Use nonconductive fiberglass ladders and tools; keep all tools and equipment at least 10 feet away from any power line.)*

2. Ask students why a bird can sit on a wire and not get shocked. *(Most birds on power lines don't get shocked because they don't give electricity a path to the ground. The lines they sit on are insulated from the ground by glass or ceramic discs that do not allow the line to touch the pole, which would be a route to the ground. But if a bird with a large wingspan touches a power line and a power pole at the same time, it provides a path to the ground and could be shocked. Birds can also be shocked if their wings contact two power lines at the same time, creating a circuit.)*

3. Ask students what they should always do before they climb a tree. *(Inspect for power lines.)* Why? *(You should always stay at least 10 feet away from overhead power lines.)*

Going Further:
Divide the class into groups. Give the groups five minutes to make a list of common outdoor electrical hazards. Share the lists. The group with the most hazards wins!

Ask students: If metal conducts electricity, why doesn't electricity travel down metal utility poles? *(Because specially designed insulators hold the electrical wires away from the poles. That's why it's so important to never shoot at or throw things at insulators. If they break, electrical wires can touch the utility pole and electricity can travel down it to the ground.)*

Episode 4: INDOOR ELECTRICAL SAFETY

Objective: To help students recognize hazardous situations involving electricity indoors, such as mixing water or metal with electricity, damaging power cords, or overloading outlets.

Key Concepts:
Do not put a metal fork in a plugged-in toaster. Unplug the toaster first to avoid a shock hazard.

Do not leave electrical appliances on or use them near water, because water conducts electricity.

Do not run appliance cords under rugs. They could get damaged by being stepped on.

Do not overload outlets. Too many electrical appliances on one outlet can heat up the wiring in the walls, melt the insulation on the wires, and cause a fire.

Discussion:
1. GFCI wall outlets, which are pictured in the kitchen and bathroom in this episode, monitor the flow of electricity to an appliance. GFCI stands for ground fault circuit interrupter. If there is more electricity going out of an outlet than is coming back to the outlet, it means that some electricity is traveling to the ground instead of back through the circuit. If the GFCI detects this, it interrupts power automatically to prevent shock.

2. Ask students to recap the unsafe things in the home that the actors found. *(radio by sink, metal fork in toaster, blow dryer by water on the sink, power cord under rug, overloaded outlet)*

3. Ask students why you should unplug a toaster before trying to get something out of it. *(A plugged-in toaster could conduct electricity to you, especially if you use a metal fork, which is highly conductive.)*

4. Ask students to explain the correct way to unplug an appliance, as shown by the actors in the video. *(First make sure it is turned off and cooled down. Then, firmly grasp the plug at the outlet and pull. Do not pull on the cord; only pull on the plug.)*

Going Further:
Ask students to locate GFCIs in your classroom or school. What conclusions can they draw about where GFCIs are placed? *(GFCIs are used outdoors and in kitchens and bathrooms because the greatest risk of electrical shock occurs near water.)*

Divide the class into groups. Give the groups five minutes to make a list of common electrical safety mistakes they could find in their homes or in the classroom. Share the lists. The group with the most mistakes wins!

Now that students know a little about electrical safety, ask them to be on the lookout for examples of people doing unsafe things around electricity in movies or on television. Did the person get an electric shock? Encourage students to write up their examples and/or do an oral presentation. Have them include what the character did wrong, and what could happen if a real person were to do the same thing.

Episode 5: FALLEN POWER LINES

Objective: To teach students what to do if a power line falls on their car or on the road.

Key Concepts:
If a car you are in hits a power pole or has a power line fall on it, do not get out. You are safe in the car, because electricity from the power line will use the metal of the car as a conductor for its path to the ground, not you. For this reason, it's safest not to touch any of the metal in the car, like the radio.

Stay in the car until utility workers come to tell you it's okay to get out of the car. (Not all rescue workers are trained to deal with energized power lines, so only utility workers can tell you when it's safe.) Anyone who touches the car and the ground at the same time could be hurt or killed, so if passersby approach the car, warn them to stay far away.

In case of fire, you will need to get out of the car. To do so, jump out as far from the car as you can, and don't touch any part of the car or ground at the same time. Land with your feet together, and shuffle 20 yards away from the car, keeping both feet on the ground at all times.

If you see a fallen power line but you are not trapped in a car, stay far away from the line. Always assume that a downed power line is live, and that the ground around it could be charged with electricity. Stay at least 20 yards away from any downed power lines. Even if the line is not sparking or humming, it could be carrying electricity. Don't touch the line or anything it is touching, like a tree or fence. Call 911 to report any fallen lines.

Discussion:
1. Why is it safe to stay inside a car with a power line on it? *(Your body is not creating a path to the ground for electricity, so as long as you stay in the car you will not be shocked.)*

2. Why do you need to shuffle away from the car when you jump out? *(When a power line falls, electricity fans out in the ground. The voltage in the ground is strongest near the power line, and weaker farther away from the power line. If you walk with your feet apart, your legs can act as a bridge between two areas of different voltage, and can form a circuit for electricity to travel through. If you shuffle with your feet together, your legs cannot form a circuit, so electricity from the ground will not travel through you.)*

3. If you are standing on the ground, should you help someone else get out of the car? *(No. If you touch the body of the car to help someone from the car, you provide a direct path to the ground for electricity.)*

Going Further:
Ask students to practice the emergency exit procedure for leaving a car with a power line on it in case of fire. First have them practice jumping off their chairs with feet together as far out as they can. Then have them practice the 20-yard shuffle outside in small groups. They will need a string or yardstick with which to measure a yard, and then they can map out how far 20 yards is. Ask them to predict how many shuffle steps it will take them to go that distance, and then have them do it to see if they were right.

Ask students to create a wallet card warning drivers about the dangers of fallen power lines. Be sure they include how to stay safe and when/how to safely exit the vehicle. Have them give this to a parent to keep in their wallet.