



## TOPIC OF STUDY

Electrical Safety



## KEY TERMS

arc flash  
closed circuit  
electricity  
energy  
power  
electrocution  
open circuit  
insulator  
loads

## LESSON

Electrical Safety

## BIG IDEA(S)

There are specific tools and techniques that are used to safely work with electrical systems.

## OBJECTIVES

Students will be able to:

- Understand the different types of electrical hazards
- Demonstrate basic electrical safety skills
- Connect things that everyone loves to do to energy and demonstrate the large role electricity plays in everyone's life
- Trace the pathway of electricity generation, transmission, and distribution

## TASK LIST SUBCATEGORY

- 305 Recognize and mitigate hazards
- 311 Recognize, identify and safely use hand tools and power tools
- 702 Recognize and use electrical concepts, terminology, relationships, and formulas

## OVERVIEW

The voltage of the electricity and the available electrical current in regular businesses and homes has enough power to cause death by electrocution. Even changing a light bulb without unplugging the lamp can be hazardous because coming in contact with the "hot", "energized" or "live" part of the socket could kill a person.

All electrical systems have the potential to cause harm. Electricity can be either "static" or "dynamic." Dynamic electricity is the uniform motion of electrons through a conductor (this is known as electric current). Conductors are materials that allow the movement of electricity through it. Most metals are conductors. The human body is also a conductor.

Electric current cannot exist without an unbroken path to and from the conductor. Electricity will form a "path" or "loop". When you plug in a device (e.g., a power tool), the electricity takes the easiest path from the plug-in, to the tool, and back to the power source. This action is also known as creating or completing an electrical circuit.

## INSTRUCTIONAL

### TEXT/REFERENCES

[NFPA 70e Standard for Electrical Safety in the Workplace](#)

Solar Electric Handbook, SEI, 2013. Pp. 346-348

### MATERIALS NEEDED

#### MATERIALS

Demo: electrically insulated gloves (rated for different voltages), arc flash rated hard hats, face shields, flame retardant clothing

## IMPLEMENTATION (LESSON PLAN)

### 1. Basic Rules

- a. To get a full understanding of the various hazards that exist in the workplace please reference [NFPA 70e Standard for Electrical Safety in the Workplace](#): NFPA 70E requirements for safe work practices to protect personnel by reducing exposure to major electrical hazards.
- b. Only qualified persons are permitted to work on electrical equipment
- c. If at all possible (even if it inconveniences the client) a person should work on de-energized equipment or wiring. Working while no power is present can save lives! Additionally, always double check your work before energizing.
- d. Seeing an off sign or switch in the off position is NOT good enough! Just because a breaker says a circuit is off or a switch is in the off position does not mean the equipment you want to work on is safe. You must always use a voltage wand (non-contact voltage tester) or multi-meter in order to determine there is no voltage present.
- e. If you are working on a particular circuit, service, or piece of equipment and you have de-energized it but the switch for energizing is not within sight then you must use [lock-out tag out](#). Lock out tag out is the industry standard for safely de-energizing equipment and ensuring it remains de-energized while work is being performed.
- f. When turning off larger electrical equipment understand the hazards and plan out how to mitigate them. For example: if a large knife switch needs to be thrown to open a circuit do not stand in front of the door of the knife switch just in case an arc blows the door off. The door exploding into you could potentially crush you.
- g. If you must work on a live circuit then you must wear rated electrical gloves (the rating of the glove must be higher than the voltage you are working with). Proper use of electrical gloves is very important. First you should put on a thin cotton glove to absorb sweat. Then put on the rated rubber electrical glove. Lastly place a leather glove over the rubber glove to protect from cuts or abrasions in the rubber gloves. Additionally, you should wear eye protection and an electrically rated hard hat. Class E (Electrical) Hard Hats are designed to reduce exposure to high voltage conductors.
- h. When working in an area where an arc flash is possible it is important to wear an [arc flash suit](#).

### 2. Types of Hazards

- a. [Electrical shock](#) - Electrical shock occurs when electrical current enters the body. Electrical current can cause serious physical harm including damage to your heart. Electrical shocks can be fatal or lead to serious injuries.
- b. [Arc Flash](#) - Simply put, an arc flash is a phenomenon where a flashover of electric current leaves its intended path and travels through the air from one conductor to another, or to ground. The results are often violent and when a human is in close proximity to the arc flash, serious injury and even death can occur. [https://www.osha.gov/sites/default/files/2018-12/fy07\\_sh-16615-07\\_arc\\_flash\\_handout.pdf](https://www.osha.gov/sites/default/files/2018-12/fy07_sh-16615-07_arc_flash_handout.pdf)

### 3. Gear

- a. Electrical Gloves
- b. Electrical rated hard hat
- c. Glasses
- d. Arc flash suit
- e. Insulated tools
- f. Fiberglass ladder
- g. Voltage wand
- h. Multi-meter



## IMPLEMENTATION (LESSON PLAN) - CONTINUED

### 4. Safety is everyone's responsibility

Designate a student who is responsible for checking for electrical hazards and have them prepare a plan to mitigate the hazards.

## MEETING INDIVIDUAL NEEDS

### STUDENTS WHO NEED LEARNING SUPPORT

Students can try on various pieces of safety gear. Have students practice working with electrical gloves on so they can get used to the feeling.

### STUDENTS WHO HAVE DEMONSTRATED EARLY MASTERY

Advanced learners can deep dive into electrical safety and how to know when an arc flash hazard is present as well as the steps to mitigate it.



SOLAR

## TOPIC OF STUDY

Electrical Safety



2 HOURS  
(2 SESSIONS)

