SUPER CIRCUITS (G3-6)

In this workshop, students will experiment with the components of simple circuits: power, loads, and switches. They will explore how different connections between batteries and loads affect how the load behaves. Educators will guide students in constructing their own circuits with a battery-powered motor, which they will use to power a fan to take home. See pp. 3-4 for standards this workshop supports.

SCIENCE CONCEPTS

Many of the items we interact with use electricity, which runs in circuits.

- A **circuit** is a closed path that electricity runs through. Unless the circuit is closed (think of a complete loop), it will not power anything. Most of the circuit is made of wire.
- Circuits must have a **power supply**, such as a battery.
- Circuits also contain a **load**, or something to use up the electricity, such as a motor or light.
- Most circuits also contain a **switch**, or a way to close (turn on) and open (turn off) the circuit.

Engineering often depends on careful attention to detail and problem-solving, and the **Engineering Design Process** requires testing, revising, and improving.

- It's important to pay attention to your work and make sure the connections you make stay connected.
- Engineers often have to test and strengthen their first attempts before they find a final version of their project.
- Fixing projects is just as important in engineering as building something the first time.

BEFORE YOU VISIT

Why do we use wire in electronics?	Wire is made out of metal because metal is a good **conductor** of electricity, meaning electricity flows easily through metal. This makes wire a good path for electricity.
Why do we coat wire?	We coat wire in plastic or other **insulating** material so that electricity does not leak out of the circuit into other materials or objects. Electricity does not travel easily through insulators, so it stays inside the wire this way.
Why do electronics include switches?	We usually want a way to turn devices off, as a way to conserve the energy of our battery or other power supply. Or, for objects like lights or televisions, we simply don't want them on all the time.
What are some objects you use regularly that might have circuits inside them?	Most electronics contain circuits. Lamps, computers, and electronic toys are all examples. Students will probably think of many more. Anything you plug into a wall socket or insert a battery into has some kind of circuit inside.

AFTER YOU VISIT

Questions

- Think about the first part of the activity, when you explored with lights. What would happen if you added a second battery into your fan's circuit? (Answer: the fan would spin faster.)
- Think about common objects in your house. What do you think is happening when you turn them on and off? (Answer: somewhere inside, the switch is interrupting the flow of electricity, similar to how our switch opens the circuit for our fans.)

Activities

- Have students compare their fan blades. Usually, some students will fold the blades one direction, some the other way, and some students will not fold their blades at all. How does this affect how the fan blows air? What if they fold the fan blades a different way? How does that change how the fan blows?

CAREERS THAT USE ENGINEERING

Electrical engineer: These engineers learn extensively how electronic systems work. They are often the people who design new kinds of electrical systems, and might work for companies that make complicated electronics for new cars, or even for NASA, figuring out how to power spacecraft that fly far from Earth.

Electrician: Electricians must understand the systems of wires and circuits that go into a house or other building. They might plan or install the wiring for a new building, or fix problems with an existing system. Rather than years of schooling, electricians often learn on the job in apprenticeships or special training programs. Electricians get to work hands-on with tools and wiring, and see the results of their work when they finish.

Broadcast engineer: Someone has to manage the complex systems that we use to transmit television, radio, and other forms of communication and entertainment. Broadcast engineers must understand not only electronics, but also the kinds of wiring that visual and audio signals travel over. They may work in one location, or they may get to travel widely, depending on where their job needs someone with their hands-on expertise.

Learn about **more careers** that use engineering!

MINNESOTA ACADEMIC STANDARDS FOR SCIENCE K-12

3.1.1.1.1 Provide evidence to support claims, other than saying "Everyone knows that," or "I just know," and question such reasons when given by others.

3.1.1.2.1 Generate questions that can be answered when scientific knowledge is combined with knowledge gained from one's own observations or investigations.

3.1.1.2.3 Maintain a record of observations, procedures and explanations, being careful to distinguish between actual observations and ideas about what was observed.

3.1.1.2.4 Construct reasonable explanations based on evidence collected from observations or experiments.

3.1.3.2.2 Recognize that the practice of science and/or engineering involves many different kinds of work and engages men and women of all ages and backgrounds.

4.1.2.2.1 Identify and investigate a design solution and describe how it was used to solve an everyday problem.

4.2.3.1.3 Compare materials that are conductors and insulators of heat and/or electricity.

4.2.3.2.2 Construct a simple electrical circuit using wires, batteries, and light bulbs.

5.2.2.1.2 Identify the force that starts something moving or changes its speed or direction of motion.

5.2.2.1.3 Demonstrate that a greater force on an object can produce a greater change in motion.

STANDARDS, Continued

6.1.2.2.1 Apply and document an engineering design process that includes identifying criteria and constraints, making representations, testing and evaluation, and refining the design as needed to construct a product or system to solve a problem.

6.1.3.1.1 Describe a system in terms of its subsystems and parts, as well as its inputs, processes and outputs.

6.2.3.2.2 Trace the changes of energy forms, including thermal, electrical, chemical, mechanical or others as energy is used in devices.