MOTOR POWER (G3-6)

In this workshop, students will experiment with the components of simple circuits: power, loads, and switches. They will explore how motors use magnets and electricity to move and work. Educators will guide students in constructing their own circuits with a battery-powered motor, which they will use to power a crazy wigglebot 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.

Motors are one example of an object that requires electricity to run.

- Motors rely on **electromagnets**, or objects (in this case, a coil of wire) that are not naturally magnetic, but develop a magnetic field when electricity runs through them.
- A simple magnet can push on the electromagnet, causing it to spin, and it now works as a **rotor**.
- Simple motors need wire, a source of electricity, and a magnet to move the wire. They also require some kind of metal wire or post to provide a path for the electricity to move from one component to another.

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 motors inside them?	Fans, many toys, and most things with moving parts include motors. Remember that a motor turns electrical energy into kinetic energy (the energy of motion). An **engine** is different, and turns chemical energy (gasoline) into thermal energy (heat).

AFTER YOU VISIT

Questions

- Think about the first part of the activity, when you explored with motors. What did the different kinds of motors have in common? How were they different?
- 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 wigglebots.)

Activities

- Have students compare their wigglebots. Some will move in straighter lines, while others will jitter in a circle. Can students find any pattern to how their wigglebots move?
- Students can always improve upon their wigglebots with additional craft supplies. What happens if they attach bigger or smaller erasers or objects to their motor prong? Does it change how their wigglebot moves?

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. 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.

4.2.3.2.3 Demonstrate how an electric current can produce a magnetic force.

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

STANDARDS, Continued

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

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.

6.2.2.2.1 Recognize that when the forces acting on an object are balanced, the object remains at rest or continues to move at a constant speed in a straight line, and that unbalanced forces cause a change in the speed or direction of the motion of an object.

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