

Lesson Plan

Project:

Electrical Circuits and Inventions with MaKey MaKey

Curriculum Links:

Grade 6 Physical Science: Electricity

Grade 6 Science: Processes of Science

(See <https://www.bced.gov.bc.ca/irp/gc.php?lang=en> for more details)

Objectives:

After this presentation, students will be able to:

- Use proper terminology to describe the parts of a circuit
- Understand the concept of electron flow in circuits
- Describe the difference between conductors and insulators, and provide examples of each
- Construct a simple electrical circuit
- Create an invention (e.g. game controller) using electrical circuits

Activities:

Circuit Simulation

In this activity, students will simulate an electrical circuit by modelling the flow of electrons in a circuit with a battery, a switch, and a resistor.

Materials:

- Painter's tape or masking tape
- Smarties or other small, nut-free candy
- Small step stool

Procedure:

1. Use tape to create a large enough shape for all students to walk along its perimeter. This will represent the wire in an electric circuit.
2. The students represent electrons by evenly spacing themselves around the perimeter of the taped shape, and then moving around the perimeter in only one direction.
3. The presenter represents stands in a stationary position on the taped shape's perimeter, and represents a battery. As an electron passes by the battery, it receives energy from the battery in the form of a small nut-free candy (e.g. Smarties).
4. When the students have moved past the battery a few times, ask for a volunteer. This volunteer will represent a switch by standing in a stationary position just outside the taped shape's perimeter. The switch alternates between sticking out their hand to block electrons from moving past it (i.e. the switch being in the OFF position) and retracting the hand back to resume electron flow (i.e. the switch being in the ON position), and may swap between these two modes as they wish.
5. When the students have moved past the battery a few times with the switch in place, place a small step stool on the taped shape's perimeter. The step stool represents a resistor that impedes the movement of electrons, as the electrons have to step on and off while going around the circuit.
6. When the students have moved past the battery a few times with the switch and the resistor in place, allow the battery to distribute additional candies to each electron that passes by it. This represents an increase in the amount of voltage (energy per electron).
7. Eventually, there will be no more candies to distribute. When this happens, instruct all of the electrons to stop moving. This represents the battery being completely discharged, leaving the electrons with no energy source to keep them moving.
8. End the activity. Ensure that the tape is removed at the end of the session.

Lemon Battery

In this demonstration, lemons serve as the battery that lights up an LED through the use of an electrochemical reaction.

Materials:

- Copper strips
- Zinc strips
- Copper wire leads and alligator clips
- LEDs (rated < 2 Volts)
- Knife
- Lemons

Procedure:

1. Roll the lemons firmly along a hard surface to release the lemon juice.
2. Use the knife to poke two slits into the lemon.
3. Insert the copper and zinc strips vertically into the slits made in the lemon. These strips will serve as the electrodes. Ensure that part of the strips are still sticking out of the lemon.
4. Connect one wire lead to each metal strip.
5. Connect the free ends of each metal strip to the LED; the LED should light up.
6. If the LED does not light up, try switching the orientation of the LED such that the electron flow through the LED is in the opposite direction.
7. If the LED still does not light up, connect another lemon in series to the first by connecting the copper electrode of one lemon to the zinc electrode of the next.
8. The LED lights up because a electrochemical reaction between the zinc and the citric acid (a component of lemon juice) releases electrons. Electrons flow from the zinc strip to the copper strip, thus generating an electric current.

Graphite Resistor Lightbulb

In this activity, students will construct a simple electrical circuit with the following components: a battery, an LED, and a variable resistor (graphite).

Materials:

- Pencils (softer leads, such as 6B, work best)
- Paper (slightly heavier weight paper is better for this)
- LEDs
- 9 volt batteries
- Wire leads and alligator clips

Procedure:

1. Draw a rectangle on a piece of paper using a pencil, and then fill in the rectangle with pencil. Press down hard to ensure sufficient application of graphite onto the paper.
2. Using the wire leads, connect one end of a 9V battery to an LED.
3. Using the wire leads, connect free ends of the LED and the battery to the graphite rectangle.
4. The LED lights up because graphite is barely good enough of a conductor to let enough electrons travel through it and generate an electric current for powering the LED.
5. If the LED does not light up, try switching the orientation of the LED such that the electron flow through the LED is in the opposite direction.
6. The intensity of the light increases as the length of the resistor (as measured by the distance between the wire leads) decreases. This makes our resistor a variable resistor,

since it is possible to vary the amount of graphite that the electrons must travel through in order to complete the circuit.

MaKey MaKey Inventions

In this activity, students will see a demonstration of a MaKey MaKey invention, and then will build an invention of their own using household items.

Materials:

- MaKey MaKey kit
- Variety of household materials (e.g. metal, plastic, rubber, Play-Doh, fruit)
- Pencils
- Paper
- Laptop

Procedure:

1. Before the start of the lesson, set up the bananaphone by connecting the bananas to the appropriate slots of the MaKey MaKey using jumper cables and alligator clips. Connect an alligator clip to the ground, and create a grounding wire using this connection.
2. Provide a variety of household objects to connect to the MaKey MaKey. Choose some conductors, and some insulators.
3. The insulators will not be able to be used to send inputs through to the MaKey MaKey, as they do not allow electrons (and therefore also electric current) to easily travel through them.
4. When a person and an object are touching the two leads, and the person touches the object touch, the circuit is completed and the MaKey MaKey sends a signal to the computer to generate a keystroke, mouse click, or other programmable action
5. Use enough separate circuits to create an invention (e.g. joypad for ↑↓←→)