

**CODE/MOE/UOIT Makerspaces Project**

**Lesson Plan: Grade 6 Science - Electricity and Electrical Devices:**

**Experiments with making a series circuit, parallel circuit, fruit/vegetable clock, and paper circuits**

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| **Big Ideas:**  Electrical energy can be transformed into other forms of energy. Other forms of energy can be transformed into electrical energy.  **Lesson Objectives:**  Students will explore devices that convert electricity to other forms of energy. The building of circuits should further strengthen students’ understanding of how electrical systems work.  **Science and Technology Specific Curriculum Expectations:**   * 1. **- Use appropriate science and technology vocabulary, including current, battery, circuit, transform, static, electrostatic, and energy, in oral and written communication**   **3.3 - Identify materials that are good conductors of electricity (e.g., copper, gold, silver, aluminum, water [when it has a high mineral content]) and good insulators (e.g., glass, plastic, rubber, ceramics)**   * 1. **- Describe how various forms of energy can be transformed into electrical energy**   **2.2 - Design and build series and parallel circuits, draw labelled diagrams identifying the components used in each, and describe the role of each component in the circuit**   * 1. **- Use scientific inquiry/experimentation skills to investigate the characteristics of static and current electricity**   2. **- Design, build, and test a device that produces electricity (e.g., a battery built from a lemon or potato; a wind turbine)**   3. **- Use technological problem-solving skills to design, build, and test a device that transforms electrical energy into another form of energy in order to perform a function**   4. **- Explain the functions of the components of a simple electrical circuit**   5. **- Describe series circuits and parallel circuits** | |
| **Learning Goals:**  “We are exploring devices that convert electricity to other forms of energy. Students will strengthen their understanding of how electrical systems work by building simple series and parallel circuits. Students will come to understand how we use electricity in our lives.” | **Success Criteria:**  “We will be successful when the device or circuit displays the transformation of electrical energy into another form of energy. Students will also be able to describe the process, using proper science and technology vocabulary related to electricity. Students will create a card that lights up using a simple or parallel circuit design.” |
| **Lesson Overview:**  **Students will experiment with batteries, wires, bulbs, switches, conductive tape, and various fruits and vegetables to assemble series and parallel circuits and to test for conductivity.** | |
| **Materials and Technology:**   * several 3, 6, and 9 volt batteries * Dry Cell Batteries * miniature light bulbs and wires * strips of copper and zinc * sand paper * insulated wire, alligator clip wires * switches, buzzers * Fruits and Vegetables such as Potatoes, Lemons, Oranges, and Apples * compass * Conductive tape, mini 2 prong light bulbs * card stock (different colours)   Resources: Hands On Science and Technology, Grade 6  The Big Book of Maker Space Projects, by Colleen Graves and Aaron Graves  Makerspaces.com | |
| **Student Accommodations/Modifications:** | **Lesson will be differentiated by:**   * **Content, specifically:** * **Process, specifically:** * **Product, specifically:** * **Environment, specifically:** |
| **MINDS ON: Getting Started** | |
| During this phase, the teacher may:  • activate students’ prior knowledge;  • engage students by posing thought-provoking questions;  • gather diagnostic and/or formative assessment data through observation and questioning;  • discuss and clarify the task(s). | During this phase, students may:  • participate in discussions;  • propose strategies;  • question the teacher and their classmates;  • make connections to and reflect on prior learning. |
| Describe how you will introduce the learning activity to your students. What key questions will you ask? How will you gather diagnostic or formative data about the students’ current levels of understanding? How will students be grouped? How will materials be distributed?  **Building background**  **Find out what students already know about electricity. Use a KWL chart or other cooperative learning strategy such as “Place Mat,” Think-Pair-Share,” or “Graffiti.” Talk about objects that use electricity in the room.**  **How does electricity travel to power devices?**  **How is electricity used to power a robot?**  **Draw a circle on the board and another shape that is not is not connected.**  **Ask: Which of these shapes would allow electricity to flow through and power a light bulb or device? In order for electricity to flow and power a device, there must be an unbroken, or closed pathway.** | |
| **ACTION: Working on it** | |
| During this phase, the teacher may:  • ask probing questions;  • clarify misconceptions, as needed, by redirecting students through questioning;  • answer students’ questions (but avoid providing a solution to the problem);  • observe and assess;  • encourage students to represent their thinking concretely and/or pictorially;  • encourage students to clarify ideas and to pose questions to other students. | During this phase, students may:  • represent their thinking (using numbers, pictures, words, manipulatives, actions, etc.);  • participate actively in whole group, small group, or independent settings;  • explain their thinking to the teacher and their classmates;  • explore and develop strategies and concepts. |
| Describe the task(s) in which your students will be engaged. What misconceptions or difficulties do you think they might experience? How will they demonstrate their understanding of the concept? How will you gather your assessment data (e.g., checklist, anecdotal records)? What extension activities will you provide?  **Constructing Electric Circuits**  **Divide the class into working groups. Provide each with a dry-cell battery, 2 alligator clip wires, light bulb and socket or buzzer. Challenge students to find a way to light up, or sound the buzzer using the material provided. Build a simple electric circuit.**  **How did you make the bulb light up or the buzzer ring?**  **What did you learn about wiring a light bulb to a dry-cell battery?**  **What do + and - mean?**  **What would happen if a switch were added to the circuit? Give switch to groups.**  **Have groups test their predictions for open and closed circuits.**  **After groups have successfully made their electrical device work, have them make a labeled sketch of the circuit they built, using the following electricity terminology.**  **Electric Circuits Vocabulary**  **open circuit, closed circuit, conductor, insulator, power source, load, switch, flow of electrons, positive terminal, negative terminal, direct current, battery, series circuit, parallel circuit.**  **Focus a discussion on the flowing stream of electrons in current electricity.**  **Where do electrons come from?**  **How do electrons move in a circuit?**  **Why do you think it is called current electricity?**  **How is current electricity different from static electricity?**  **Watch Brainpop Videos:** [**www.brainpop.com**](http://www.brainpop.com)   * **Batteries** * **Electric Circuits** * **Current Electricity**   **Watch Bill Nye Electricity** [**https://www.youtube.com/watch?v=NFsvDnj5aIg**](https://www.youtube.com/watch?v=NFsvDnj5aIg)  **Series and Parallel Circuits with Multiple Batteries and Bulbs**  **Students will have the simple electric circuit they constructed earlier in front of them**  **At each question have the students experiment/test their circuit.**  **What happens when a second or third light bulb is added?**   * **The bulbs are dimmer because the additional bulb slows the flow of electricity in the circuit, causing the lights to dim**   **What would happen if the circuit is disconnected or if there is a broken bulb in the circuit?**   * **The circuit will be open and none of the bulbs will work.**   **How can you alter the circuit for all of the bulbs to remain lit.**   * **Tell students that the configuration of the circuit must change so bulbs are on separate closed pathways with the energy source. Allow time for the groups to experiment with building a circuit that lights 2-4 light bulbs. Challenge the students to create a circuit when a single component is disconnected with the circuit.** * **This type of circuit is called a parallel circuit, where the bulbs are connected on separate pathways. Each bulb will be equally bright, but will drain the battery at an accelerated rate.** * **Have the students compare and contrast the working models of parallel circuits created by each group.** * **Have students make a labeled sketch of their parallel circuit and record their observations about building this type of circuit.**   **What happens to light bulbs when you add several dry-cell batteries connected in a series or parallel circuit?**   * **Note: Several batteries will make a stronger current and could blow a light bulb. The bulb needs to be of higher voltage than the voltage of the total number of batteries.**   **Why is electricity able to flow through a wire?**   * **It is a good conductor**   **What kinds of materials make good conductors of electricity and what materials are insulators? Students can experiment the conductivity of different materials with their models.**  **Electricity From Fruit and Vegetables**  **Using a battery, chemical energy is converted to electrical energy.**  **Wet and Dry Cells**  **Dry Cell Battery - When a battery is connected by wires to some kind of device, like a light bulb or buzzer, the acidic paste in the battery begins to act on the metal. The carbon rod in the middle of the battery, becomes positively charged and the zinc becomes negatively charged. The electrons run out of the battery at the negative end of the battery.**  **Fruits and Vegetables have different kinds of acids or electrolytes in them.**  **Oranges, Lemons - Citric acid**  **Berries, pineapple, tomatoes - Ascorbic Acid**  **Apples, Berries, Tomatoes - Malic Acid**  **Potatoes - Phosphoric Acid**  **When the zinc and copper electrodes are placed in the fruit/vegetable the acid (electrolytes) begins to act on the metal (chemical reaction). The copper becomes positively charged and the zinc becomes negatively charged. The electrons move out of the zinc into some kind of load, like a bulb, buzzer or digital clock.**  **An Electricity Detector**   1. **Make an electricity detector**   **Wrap 1m of thin wire around a compass 5 or 6 times. Leave the ends of the wire loose.**  **2. Push a strip of copper and zinc into a lemon. Place them parallel to each other and make sure they do not touch each other.**  **3. Clip one end of the wire from the compass to the copper strip and the other end to the zinc strip. Watch what happens to the compass needle. Test the same experiment using an apple, potato, orange, or banana.**  **What kind of transformation of energy occurs when the lemon makes electricity? (chemical - electrical)**  **Will other fruits and vegetables work?**  **What do you think will happen if you connected many fruit and vegetable batteries in sequence?**  **Will a lemon, apple, potato, orange, or banana power a simple digital clock?**  **Materials needed, 2 potatoes, 2 pieces of heavy copper wire, 2 galvanized nails, 3 alligator clip wires, a simple low voltage digital clock**  **Remove the batteries from the digital clock.**  **Keep the battery cover removed so you can access the terminals with your wires**  **Label the two potatoes 1 and 2.**  **Press one nail about an inch into each potato near the end.**  **Once the nail is secured, press a piece of copper wire into the opposite end of the potatoes as far from the nail as possible. Each potato should have one nail and one copper wire sticking out of the opposite ends. Make sure the nail and wire aren’t touching inside the potato.**  **Use the alligator clips to connect the potatoes and clock.**   * **Connect the copper wire in the first potato to the positive(+) terminal in the clock.** * **Connect the nail on the second potato to the negative (-) terminal in the clock** * **Use the third alligator clip to connect the nail in the first potato to the nail in the first potato to the copper wire in the second one.**   **How long do you think the potato clock will run?**  **Does it keep accurate time? Watch your clock for 2 or more weeks.**  **Set up an apple, banana, potato, orange, and lemon clock. See how long the clocks will tell accurate time.**  **Card Circuits**  **Display a card from the store that sings a song, buzzes or lights up. Inside the card is a simple closed series or parallel circuit. Students will make a circuit card using conductive tape, mini LED light bulbs, and 3V disc battery.**  **Materials for each student: 8X11 Card Stock, conductive tape, 1or more LED light bulbs, 1- 3 V disc battery.**  **Watch - Make awesome birthday cards at home using paper circuits. Or other video on youtube about making paper circuits**  [**https://www.youtube.com/watch?v=c\_ApyKqqctM**](https://www.youtube.com/watch?v=c_ApyKqqctM)  **Resources**  **Makerspaces.com**  **Directions:**   1. **Fold Card stock** 2. **Make a design (in pencil) on the front of the card that incorporates a light** 3. **Make a hole where your light(s) will be.** 4. **Challenge the students to make a series or parallel circuit using copper tape, mini LED light bulbs and a 3 V disc battery. They need to think about the positive and negative sides of the batteries and the long (+) and short (-) prongs of the LED lights.** 5. **Draw the configuration of the tape, battery, and lights on the board for students that need to follow the support or have copies of templates for the students to use available. Some are available in, “ The Big Book of Maker Space Projects by Colleen and Aaron Graves” or “Makerspaces.com”**   **For Consideration**  **Test your battery first to make sure it is working. Make sure the tape is not damaged and secured on the paper. If using a binder clip, make sure it is exerting enough pressure to keep the battery and the copper tape in contact. Make sure the copper tape is connecting with the LED prongs.** | |
| **CONSOLIDATION: Reflecting and Connecting** | |
| During this phase, the teacher may:  • bring students back together to share and analyse strategies;  • encourage students to explain a variety of learning strategies;  • ask students to defend their procedures and justify their answers;  • clarify misunderstandings;  • relate strategies and solutions to similar types of problems in order to help students generalize concepts;  • summarize the discussion and emphasize key points or concepts. | During this phase, students may:  • share their findings;  • use a variety of concrete, pictorial, and numerical representations to demonstrate their understandings;  • justify and explain their thinking;  • reflect on their learning. |
| How will you select the individual students or groups of students who are to share their work with the class (i.e., to demonstrate a variety of strategies, to show different types of representations, to illustrate a key concept)? What key questions will you ask during the debriefing?  **At different stages, the teacher could conduct a gallery walk of the different circuits where students could explain the construction of their circuit.**  **Teacher would encourage the students to share ideas and collaborate at each stage**  **Students can video tape the stages of the construction of the circuits.**  **Students will produce two diagrams of a series and parallel circuit using correct electricity terminology.**  **Students can record observations in a chart format of the Fruit/Vegetable clock they created. How well does your clock keep time? Is it losing or gaining time? How long does the clock last? Does a fresh fruit keep the same time as an older or decomposing piece of fruit?**  **Card Circuit**  **For Consideration**  **Test your battery first to make sure it is working. Make sure the tape is not damaged and secured on the paper. If using a binder clip, make sure it is exerting enough pressure to keep the battery and the copper tape in contact. Make sure the copper tape is connecting with the LED prongs.**  **Students will be successful when they produce a card that lights up when the battery is in contact with the copper tape.** | |