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| **Lesson Title : Energy Storage Devices** | **Unit #:**  **1** | **Lesson #:**  **2** | **Activity #:**  **3** |
| **Activity Title: Batteries** |

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| **Estimated Lesson Duration:** | **5 Days** |
| **Estimated Activity Duration:** | **2 Days** |

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| **Setting:** | **Foundations of Engineering Class, 11-12 Grade** |

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| **Activity Objectives:**   1. Students will be able to describe how batteries work 2. Students will be able to build a basic battery using potatoes and other vegetables |

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| **Activity Guiding Questions:**   1. What makes a battery work? 2. How can you make a battery have more voltage? |

| **Next Generation Science Standards (NGSS)** | |
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| **Science and Engineering Practices (Check all that apply)** | **Crosscutting Concepts (Check all that apply)** |
| ☒ Asking questions (for science) and defining problems (for engineering) | ☐ Patterns |
| ☒ Developing and using models | ☒ Cause and effect |
| ☒ Planning and carrying out investigations | ☐ Scale, proportion, and quantity |
| ☐ Analyzing and interpreting data | ☒ Systems and system models |
| ☐ Using mathematics and computational thinking | ☒ Energy and matter: Flows, cycles, and conservation |
| ☒ Constructing explanations (for science) and designing solutions (for engineering) | ☐ Structure and function. |
| ☒ Engaging in argument from evidence | ☐ Stability and change. |
| ☒ Obtaining, evaluating, and communicating information |  |

| **Ohio’s Learning Standards for Science (OLS)** |
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| **Expectations for Learning - Cognitive Demands (Check all that apply)** |
| ☐ Designing Technological/Engineering Solutions Using Science concepts **(T)** |
| ☒ Demonstrating Science Knowledge **(D)** |
| ☐ Interpreting and Communicating Science Concepts **(C)** |
| ☐ Recalling Accurate Science **(R)** |

| **Ohio’s Learning Standards for Math (OLS) and/or**  **Common Core State Standards -- Mathematics (CCSS)** | |
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| **Standards for Mathematical Practice (Check all that apply)** | |
| ☐ Make sense of problems and persevere in solving them | ☐ Useappropriate tools strategically |
| ☐ Reason abstractly and quantitatively | ☐ Attendto precision |
| ☐ Construct viable arguments and critique the reasoning of others | ☐ Look for and make use of structure |
| ☐ Model with mathematics | ☐ Look for and express regularity in repeated reasoning |

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| **Unit Academic Standards (NGSS, OLS and/or CCSS):** NGSS: [HS-ETS1-1 Engineering Design](http://www.nextgenscience.org/pe/hs-ets1-1-engineering-design) Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. NGSS: [HS-ETS1-2 Engineering Design](http://www.nextgenscience.org/pe/hs-ets1-2-engineering-design) Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. NGSS: [HS-ETS1-3 Engineering Design](http://www.nextgenscience.org/pe/hs-ets1-3-engineering-design) Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. |

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| **Materials**: Video to watch about how a battery works:  <https://www.youtube.com/watch?v=u4FpbaMW5sk&index=2&list=PLkyBCj4JhHt8DFH9QysGWm4h_DOxT93fb> |

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| **Teacher Advance Preparation:** For this activity, the teacher needs to understand how a battery generates electricity. |

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| **Activity Procedures:**   1. Research batteries on the internet 2. Groups fill out a worksheet and present their findings individually to the teacher 3. Build a battery using potatoes that lights an LED light 4. Test other vegetables as batteries, fill out the table provided |

**Formative Assessments:**

WS on information about batteries:

<https://docs.google.com/a/readingschools.org/viewer?a=v&pid=sites&srcid=cmVhZGluZ3NjaG9vbHMub3JnfG1yZGF5MjAxNnxneDo2ODZkODk3N2I4ZTlkZDUx>

Table about batteries and how they worked, along with other materials.

<https://docs.google.com/a/readingschools.org/viewer?a=v&pid=sites&srcid=cmVhZGluZ3NjaG9vbHMub3JnfG1yZGF5MjAxNnxneDo2NTk4ZTdkZGM4MmYzZjRh>

**Summative Assessments:** These are optional; there may be summative assessments at the end of a set of Activities or only at the end of the entire Unit.

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| **Differentiation:** Describe how you modified parts of the Lesson to support the needs of different learners. Refer to Activity Template for details.  *Having them in groups helps with the different types of learning skills and abilities in the class. Since they got to go at their own pace and do different activities, they were allowed to create their own syllabuses.* |

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| **Reflection:** Reflect upon the successes and shortcomings of the lesson.  *This lesson did not go perfectly. Measuring volts using a voltmeter went perfectly. Students used a copper wire and a zinc wire as probes to push into fruits and vegetables to see if they could generate voltage. Some items worked better than others. And, of course, we did a large potato battery in a series of wires that did produce quite a bit of voltage. The problem was the amps. I do not have a lot of experience teaching this and was not aware of all the details about amps and how they were measured. We, as a class, learned about them and that was a cool experience.*  *For next year I will make sure that the students know more about amps going into this activity. Other than that, it was a great experience. Check out my video to see how large our potato battery got.* |