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| **Lesson Title : The Big Idea: Energy Driven Devices** | **Unit #:**  **1** | **Lesson #:**  **1** | **Activity #:**  **1** |
| **Activity Title: Are You Tied Up With Cords** |

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| **Estimated Lesson Duration:** | **3 Days** |
| **Estimated Activity Duration:** | **1 Day** |

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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 types of energy 2. Students will be able to describe different uses for energy 3. Students will be able to cite examples of how energy is generated 4. Students will be able to identify energy storage devices 5. Students will be able to identify capacitors and batteries as storage devices |

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| **Activity Guiding Questions:**   1. What types of energy are there? 2. What do you use energy for? 3. What are different ways of generating energy? 4. What different types of Energy Storage Devices are used? 5. What characteristics are there for each energy storage devices? 6. What is the difference between a battery and a capacitor? 7. How do capacitors store energy? 8. How do we make capacitors charge quickly and discharge slowly? |

| **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:  <https://docs.google.com/a/readingschools.org/viewer?a=v&pid=sites&srcid=cmVhZGluZ3NjaG9vbHMub3JnfG1yZGF5MjAxNnxneDo1ODU2YjVhMDQ3YjZkYmNi> |

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| **Teacher Advance Preparation:** For this activity the teacher will need an understanding of energy, electricity, capacitors and batteries. |

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| **Activity Procedures:**   1. Play the video and ask what do these items have in common? 2. Look at the “machines” around you and ask if these things have anything in common with things in the video. 3. Students generate ideas about these items 4. Students generate questions about the items and they are written on a board 5. From this list narrow it down to one essential question 6. Students generate challenges that society would need from the questions they posed. |

**Formative Assessments:**

Big Idea worksheet for students to use: <https://docs.google.com/a/readingschools.org/viewer?a=v&pid=sites&srcid=cmVhZGluZ3NjaG9vbHMub3JnfG1yZGF5MjAxNnxneDo3Njg4OTU5NDI1YTUyODNk>

**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.

*The only assessment is filling out the worksheet listed above. It was extremely useful.*

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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.  *Students worked in groups for this activity. Pairing students of different abilities allows each student to speak their mind and get their point across. Their learning styles and abilities can enhance the group’s progress towards the goal of the big idea.*  *I also made a point of making sure everyone got to answer. I have the three second rule which makes students wait three seconds before raising their hand to answer. This gives every student time to ponder the answer. Then it gives me a chance to call on different students. Sometimes, I call on students whose hand is not even raised.* |

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| **Reflection:** Reflect upon the successes and shortcomings of the lesson.  *This lesson went great. I was actually worried that they would get through the essential questions too quickly. This is a very inquisitive class and they showed it right away. I would not change a thing that happened. The handout was very useful.*  *Students were first asked what they saw from the video and most of them wrote things like: electrical, movement, growing, flowers, cars and so on.*  *After a discussion they quickly came to the conclusion that all these things use some form of energy to move and work. This is where I thought we were going too fast and we would be done early.*  *Therefore, the Big Idea was Energy. Now what are some essential questions about energy? They came up with some incredible ideas. Here is a list:*   * *Can we create a new type of energy?* * *Can we improve how energy is stored?* * *Where does energy come from?* * *Why does energy never run out?* * *How do you engineer something that holds energy?* * *How does energy transfer from one thing to another?*   *After this we discussed challenges that we could make into a lesson. Here is what they came up with:*   * *Use non-conventional objects to make a power source.* * *Test electric vs battery.* * *Test current every day.* * *Create energy storage device with low cost, strength, holds power for long time.*   *From this would come the challenge, but I waited until later to disclose it.*  *This lesson and activity went perfectly. I highly recommend this unit.* |