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| **Lesson Title : What’s Lost, Not Energy!** | **Unit #:****1** | **Lesson #:****1** | **Activity #:****2** |
| **Activity Title: Kinetic and Potential Energy Ramps** |

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| **Estimated Lesson Duration:** | **4 days** |
| **Estimated Activity Duration:** | **2 day** |

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| **Setting:** |  |

Classroom

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| **Activity Objectives:**  |

1. Describe and identify real-life scenarios of Law of Conservation of Energy
2. Identify multiple types of energy.
3. Define potential and kinetic energy.
4. Describe and identify energy transformations.
5. Describe how potential and kinetic energy relate to one another within the context of the Law of Conservation of Energy

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| **Activity Guiding Questions:**  |

What happens to energy as it is used?

What is the relationship of potential to kinetic energy?

How can they demonstrate the Law of Conservation of energy?

| **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 New Learning Standards for Science (ONLS)** |
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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)** |

| **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, ONLS and/or CCSS):** |

**Ohio’s New Learning Standards: Science Standards: Physical Science**

• Conservation of energy

• Quantifying kinetic energy

• Quantifying gravitational potential energy

• Energy is relative

• Transfer and transformation of energy (including work)

**Next Generation Science Standards**

PS3.A: Definitions of Energy

PS3.B: Conservation of Energy and Energy Transfer

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| **Materials**: (Link Handouts, Power Points, Resources, Websites, Supplies) |

Energy Powerpoint.

Energy Conversion Worksheet

Bowling Ball Pendulum kit (demonstration, optional)

Potential and Kinetic Energy Tracks and Large Marbles <https://www.sargentwelch.com/store/catalog/product.jsp?catalog_number=CP33578-00>

Landing pads such as cardboard, which may also be written upon.

KE and PE Tracks – Lab Packet

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| **Teacher Advance Preparation:** |

Need to have ramps which all start at the same height, but have different pathways and slopes leading to the bottom of the track. Sargent Welch has an ideal track for this (see link above), others may be substituted. Requires large marbles to roll down the ramps.

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| **Activity Procedures:** |

Day 1

* In preparation for the ramp activity students will need to have an understanding of the types of energy there are (specifically kinetic and potential energy). Use the powerpoint to discuss with the students these ideas and concepts of: What is Energy? What is the Law of Conservation of Energy? And some types of Energy that are available.
* Give the student “Energy Conversions” worksheet. Student may work together to complete the worksheet. The worksheets will require them to demonstrate how energy transformation will occur in various situations. This will require them to use their knowledge of the various types of energy. Review the student answers in class.
* Perform Bowling ball pendulum demonstration.

Day 2

* Handout the PE-KE Ramp packets.
* Students will follow the guidelines on the lab packets. They will roll marbles down the tracks to first test which tracks the marbles will roll down the quickest. They will see the marbles do not roll down the track and arrive at the bottom at the same time. The students will then test each track to determine the distance the marbles fall. Students will observe that the marbles all land at relatively the same distance from the base of the tracks. This demonstrates to the students that the height of the marble (all start at the same height) determines the marble’s energy, Not the pathway they take down the ramp. This will connect the relationship of potential and kinetic energy relative to one another.

**Formative Assessments:** Link the items in the Activities that will be used as formative assessments.

The formative assessment will be performed as the results of the “Energy Conversion” worksheets are reviewed. During the PE-KE Ramp activity walks throughs will be performed observing discussions and viewing student results.

**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.

Summative assessment will be based on student’s answers from the KE-PE lab packet questions.

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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. |

Results from the energy transformations may have multiple answers that are correct, the primary point of the exercise will be to give the student the opportunity to assess various situations and see that energy transformations are occurring. It will be less important that everyone have the same steps.

When comparing observations to mathematical formulas for kinetic and potential energy additional personal assistance may be required to evaluate the formulas qualitatively as students as students tend to find this challenging when no numbers are provided.

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| **Reflection:** Reflect upon the successes and shortcomings of the lesson. |

The discussion of the notes and the hand out went fine. However, as discussed previously, the students have some difficulty regarding the idea of conservation of energy when using contexts not previously used. The worksheets were designed for them to pull any of a number of energy forms and show which energy forms pertained to the scenarios. I think overall they understood this, but I believe they were stuck on the idea that there had to be one specific correct answer. Many also did not take advantage of their notes which showed them many forms of energy they could use in the worksheet. As a result, we spent time in class discussing the possible answers and also I emphasized that I was not looking for a specific group of answers, but rather for them to understand that energy gets converted and the combinations are not limited.

The PE-KE tracks went fairly well. Most understood what was occurring through the process of rolling the marbles down the track, understanding that the overall energy does not change but is converted from potential to kinetic. This inquiry approach required me to explain some of the questions, as they are not used to the layout of the leading questions. The primary difficultly I had with this lab is that, although the tracks are designed to have the marble leave the bottom of each track at the same speed, the results were not perfect, so I continuously had to assure each group that the fine in assessing the results in general. I felt that they understood that it made sense that they should hit at the same distance from the track since they started at the same height.