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| **Lesson Title : What’s Lost, Not Energy!** | **Unit #:**  **1** | **Lesson #:**  **1** | **Activity #:**  **1** |
| **Activity Title: What is a Rube Goldberg?** |

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

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| **Setting:** |  |

Classroom, or if available computer lab.

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| **Activity Objectives:** |

Define energy.

Describe how energy is not destroyed, only transformed.

Describe current issues associated with energy in modern times.

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| **Activity Guiding Questions:** |

What is energy?

What happens to energy when it is “used”?

For what purpose is energy used?

Where do we get our energy from?

What issues are we challenged with regarding energy today?

| **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):** |

• Conservation of 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) |

<https://www.youtube.com/watch?v=qybUFnY7Y8w>

<http://www.infinitecat.com/games/tom-n-jerry.html>

<http://makezine.com/2011/03/17/top-10-rube-goldberg-machines/>

Pre-assessment

Brainstorming Handout

Rube Goldberg Challenge Packet/Handout

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| **Teacher Advance Preparation:** |

Assure that web links will work with your school’s devices and network limitations. Many schools have blocks on certain types of sites. The design of a Rube Goldberg through the Infinitecat website may require some instructional guidance for the students. Students should have access to the internet, preferably on computers or some devised with larger screens.

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| **Activity Procedures:** |

Day 1

* Give pre-assessment on understanding of energy concepts and collect completed assessment.
* Give “This Too Shall Pass” handout and work through based on instructions. Collect when finished.
  + Show the video of OK GO! “This too shall pass” on the following link. <https://www.youtube.com/watch?v=qybUFnY7Y8w>
* Have the students go to the websites <http://www.infinitecat.com/games/tom-n-jerry.html> and/or <http://makezine.com/2011/03/17/top-10-rube-goldberg-machines/>.
* Students will address the following questions from the handout which is to be turned in at the end of class.
  + “What do you know about energy?”
  + “What questions do you have about energy?”
  + “What ideas do you have for a project or challenge that we could do for class that is related to energy?”
* This will provide student generated input on the Big Idea and essential questions.
* Allow students the remaining time to investigate these websites to generate ideas regarding a challenge project.

Day 2

* Discuss with students their input regarding ideas for a project or challenge regarding energy.
* Introduce the Rube Goldberg challenge using the Rube Goldberg Packet.
* Have the student break up into groups of 4. Each student shall take on a role and record their responsibility on their packet.
* Allow the student’s time to begin fleshing out some ideas regarding their Rube Goldberg Device. Roam the room to help answer questions.

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

Formative assessments will be performed based on conversations stemming from the leading questions starting the activity and student responses. Instructor will need to make sure subsequent lessons adequately focus on areas where current student understanding needs assistance.

**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 summative assessment will be the pre-assessment.

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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 are given a choice to either watch videos of other Rube Goldberg Devices or to participate in a virtual Rube Goldberg challenge.

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

I felt the unit had the proper effect of guiding the students to the challenge of designing a Rube Goldberg device. Several students quickly saw through this and knew what the challenge would be. Many of the suggestions were specific to design qualities that the Rube Goldberg device could have, such as popping a balloon. Several, actually stating turning on a light which directly matched the challenge. I believe quite a few students didn’t really understand what they were ultimately getting to when it came to asking them to identify a challenge and they left it blank.

I also felt that I didn’t spend adequate time evaluating their guiding questions at the time of the lesson, although in retrospect, they did have many of the same questions which I had predicted they would have. I had issues with the website <https://www.youtube.com/watch?v=qybUFnY7Y8w> which showed the OK Go Video, the website was blocked to the students so I had to show this video to the entire class rather than them exploring the video themselves. I also had to show them the videos from <http://makezine.com/2011/03/17/top-10-rube-goldberg-machines/> for the same reason. Partially this was a result of running low on time. To adjust, I selected only two videos to show in class. The intent on the selected videos was to provide them with ideas. The website for <http://www.infinitecat.com/games/tom-n-jerry.html> worked well and the students were able to begin designing a device, several had indicated they had visited the website through previous classes. Most students were unable to complete the game in class although about 2-3 were able to “catch” Jerry Mouse. I also found that the kids were able to access the site through the direct link, but were blocked when they tried to enter through the home websites menu, most likely due to the fact that they had to press “Game” on the main menu which mostly likely blocked them.

The preassessment results surprised me and provided important insight. First of all, the results were higher than expected. Many understood the relationship of energy and its conservation. Although I found that when the concept were presented in a scenario, such as the pendulum in the preassessment, their performance dropped off. Also, it was very evident that they did not have a high level of understanding regarding the use of the calculations for potential and kinetic energy. Very few were able to complete the calculations even when given the formula. As a result, I put a priority on instruction to address this.