**Lesson: Energy Storage**

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| **Big Idea/Big Question:*** **Energy can be stored or manifests itself in different ways and can be transferred between systems.**

**Secondary ideas (prior knowledge):*** **Energy dissipation is not reversible.**
 | **Key Vocabulary:** **Energy, Storage Modes, Dissipation** |
| **Lesson Objective(s):** VA SOL PH.8 The student will investigate and understand that energy can be transferred and transformed to provide usable work. Key concepts include a) transformation of energy among forms including mechanical, thermal, electrical, gravitational, chemical, and nuclear; and b) efficiency of systems.VA SOL PH. 4 The student will investigate and understand how applications of physics affect the world. Key concepts include: a) examples from the real worldVA SOL PH.5 The student will investigate and understand the interrelationships among mass, distance, force, and time through mathematical and experimental processes. Key concepts include: a) **linear motion**; d) **Newton’s laws of motion.**SWBAT:* Create a quantitative graphical representation of the energy stored in a system, and allocate it in different storage modes.
* Distinguish between an energy transfer or dissipation.
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| **Part I - Engage (10 minutes):** The teacher will demonstrate one of the scenarios used for qualitative pie charts and refer students back to the definition of energy as “the ability to change itself or its surroundings. The students will be asked to complete the analogy “Energy is like\_\_\_\_\_\_\_\_because \_\_\_\_\_\_\_\_”.Students will have a think-pair-share as the teacher goes around the room, so as to select a couple of statements as examples for the group discussion. Unless presented by students, the teacher will propose the analogy of **energy and money**. **Explore, Pie Graphs – (30 minutes):**The teacher will introduce the following activity to transition to lesson from qualitative graphs into quantitative graphs. Students will be assigned to small groups, each group will start with a predetermined amount of play money. Each student in the group is responsible for a single denomination ($5, $10, $20) and together they will document which portion (fraction/percentage) of the total amount is in each denomination using a pie chart. For each group, one student will be assigned the role of inspector (proofread graphs) and one will be the spokesperson (to communicate with the bank).In two rounds, the groups will transfer some of their money internally so that the total amount remains constant but the portion in each denomination changes. This may require some students to visit “the bank” and trade $10s into $5s, for example, so that each person only holds his or her denomination. After each round, the group will update their pie chart on a new graph.**Explain – (5 minutes): The group will pause to examine the analogy in further detail, as each denomination could represent a storage mode. At this point, the teacher will introduce the concept of “dissipated” energy (as purchase with no-returns policy) if students have yet to mention it.** **Explore, Bar Graphs – (10 mins)** In the last round, the groups will be able to make non-refundable purchases for small items (i.e. stickers or erasers) so that the total amount remains constant but the portion in each denomination changes. Each group will update their pie chart on a new graph and must gray out the amount used for the purchases to represent the amount of money now missing from the total.**Explain Part II (10 minutes) - The group will pause to examine the analogy in further detail, and discuss examples of instances where energy is dissipated.** **Evaluate: Part II (25 minutes)****At this point, students have created a model for gravitational potential energy.****The model will be deployed using a set of scenarios where students must calculate the potential gravitational energy to assign the remaining as elastic or kinetic, and represent the energy transfer in a before/after set of pie charts. The amount of dissipated energy, if applicable, will be given as a percentage of the total energy to scaffold the concept.** *Accommodations:* * *Scientific calculators will be available for all students.*
* *Repeated, clarified instructions will be provided upon request.*
* *Students may use protractors, if needed.*

*Differentiation using manipulatives*(5-10 minutes)If a student or group of students still has difficulty creating the graphs, they will be provided pre-made slices of different sizes to attach to their chart. This may, however, require them to adjust the amounts to match the slice. *Differentiation using technology*(5-10 minutes)If a student or group of students have difficulty with the concept of pie charts or bar graph, they will be provided access to a processor or tablet to create their graphs using [www.createagraph.gov](http://www.createagraph.gov)  | **Formative Assessment:**Teacher will circulate the room during think-pair-share and select groups that are on track with the introduction.During the money transfers, the teacher will circulate the room to ensure  |
| **Support:*** Students will be provided both verbal and written instructions.
* English language learners will be provided a translation of instructions (Spanish), if requested.
* Teacher will model steps of the activity, as needed.
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| **Summarize the lesson:** The goal of the lesson is for students to construct graphical representations of an energy inventory. This requires a progression of understanding the concept of energy storage modes and dissipated energy. Background knowledge necessary for student to successfully complete the lesson includes use of percentages and fractions.  | **Formal Assessment:**-To be determined with Mr. Schaller- |
| **Differentiation:**Discussions within small groups will be used to gauge which groups require more prompting or information to complete the assigned tasks. Groups may be selected such that a) at least one student in the group has a strong math background and can serve as the inspector; or b) students are grouped by ability so that the teacher can provide an alternate version of the activity (see differentiation notes) if needed.To assist students that have trouble with multi-step procedures (identified as part of their accommodations), the group will be provided with blank charts to collection information given and keep track of their calculations.  |
| **Follow-up:**To continue the energy-money analogy, energy transfers among groups will be used to represent “working on a system” and practice constructing bar graphs before deployment of the model. |