TOPICAL OUTLINE PLANS FOR THE WEEK

COURSE | AP Physics
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TEACHER | Zachary Blackwood
UNIT | Energy Transfer Model
HOUR | 7th
SCHOOL | Lewis Cass Jr. Sr. High School
DATE | 1/12/15-1/16/15

BROAD WEEKLY GOAL

Students will be able to:
- Describe energy as an ability to cause change
- Calculate the Kinetic Energy of an object
- Calculate the Gravitational Potential Energy of an object

Standards met:

P.2.1 Describe qualitatively and quantitatively the concepts of momentum, work, kinetic energy, potential energy, and power.
P.2.2 Quantitatively predict changes in momentum using the impulse-momentum theorem and in kinetic energy using the work-energy theorem, as developed from Newton’s laws of motion.
P.2.3 Analyze evidence that illustrates the laws of conservation of energy and conservation of momentum. Apply these laws to analyze elastic and completely inelastic collisions.
P.2.4 Describe and quantify energy in its different mechanical forms (such as kinetic, gravitational potential, elastic potential) and recognize that these forms of energy can be transformed one into another and into non-mechanical forms of energy (such as thermal, chemical, nuclear, and electromagnetic).

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
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<tbody>
<tr>
<td>Topic of Lesson</td>
<td>Springs-Race Introduction</td>
<td>Spring-Race</td>
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<td>Flavors of Energy</td>
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<tr>
<td>Lesson Objectives</td>
<td>Students will be able to discover a relationship between the distance a spring is stretched, and the speed a cart ends up traveling</td>
<td>Students will discover how the speed of the cart is not linearly related to the stretch of a spring</td>
<td>Students will be able to use the Force-distance graph a spring to predict its ability</td>
<td>Students will be able to describe the basics of the different types of energy</td>
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<tr>
<td>Problem of the Day</td>
<td>What could we measure about this spring?</td>
<td>What is different about a stretched spring?</td>
<td>What parts of a graph typically have interesting physical meanings?</td>
<td>What is energy?</td>
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<td><strong>Time/ Layout</strong></td>
<td>5 minutes – discuss POD</td>
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<td>30 minutes – setup: stretch a spring attached to a cart a certain distance, and let the cart go. Then use a different type of spring. Discuss with the students what variables would be involved, and which would be most important. Describe the challenge: stretch each spring so that the carts end up going the same speed. Ask students for proposals for how to make this happen (same stretch, same force, etc.)</td>
<td>42 minutes – have students continue analyzing the Spring Race, and use the F vs D graphs to attempt to adjust the springs so that the speed of the carts after release is the same. Suggest that the students might look at the slope of the lines, the positions, or the areas.</td>
<td>15 minutes – have students finish collecting their data and making their analysis of the spring-cart systems</td>
<td>42 minutes – describe energy content in terms of, roughly, “ability to do damage”, and work through each type of energy with the students in these terms, giving the common variables used to label them.</td>
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<td>12 minutes – have students begin to try different strategies for the ‘spring race’</td>
<td>42 minutes – have students continue analyzing the Spring Race, and use the F vs D graphs to attempt to adjust the springs so that the speed of the carts after release is the same. Suggest that the students might look at the slope of the lines, the positions, or the areas.</td>
<td>27 minutes – have students present their conclusions about the relationship between the angle, distance and height. Ask why the heights were so similar with different angles, and if this signals a relationship between spring energy and gravitational energy. Have students discuss whether this relationship (conservation of net energy) applies to all systems and all flavors of energy.</td>
<td>See <a href="http://j.mp/energy-flavors">http://j.mp/energy-flavors</a> for example dialogue</td>
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<td>See <a href="http://j.mp/energy-transfer-model">http://j.mp/energy-transfer-model</a> for example dialogue</td>
<td>5 minutes – discuss POD</td>
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### Assignment

**State Standards**

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7/10/14  
11:37 AM
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#### BROAD WEEKLY GOAL

Students will be able to:
- Describe interactions between systems in terms of energy transfer
- Use conservation of energy to explain observations and make predictions

#### Standards met:

P.2.1 Describe qualitatively and quantitatively the concepts of momentum, work, kinetic energy, potential energy, and power.

P.2.2 Quantitatively predict changes in momentum using the impulse-momentum theorem and in kinetic energy using the work-energy theorem, as developed from Newton's laws of motion.

P.2.3 Analyze evidence that illustrates the laws of conservation of energy and conservation of momentum. Apply these laws to analyze elastic and completely inelastic collisions.

P.2.4 Describe and quantify energy in its different mechanical forms (such as kinetic, gravitational potential, elastic potential) and recognize that these forms of energy can be transformed one into another and into non-mechanical forms of energy (such as thermal, chemical, nuclear, and electromagnetic).

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<td>Topic of Lesson</td>
<td>Spring and Height</td>
<td>PhET – Energy Transfer</td>
<td>PhET - Skateboard</td>
<td>Energy Pie Charts</td>
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<td>Lesson Objectives</td>
<td>Students will be able to discover a relationship between the “stretch-energy” and the height a cart travels</td>
<td>Students will be able to describe interactions between systems in terms of energy transfer</td>
<td>Students will be able to qualitatively and quantitatively whether energy is conserved</td>
<td>Students will be able to use pie charts to analyze the energy of objects</td>
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<td>Problem of the Day</td>
<td>What would you expect the relationship to be between angle of the ramp and distance the cart travels? Angle and height?</td>
<td>What flavors of energy are there?</td>
<td>What is the relationship between the flavors of energy?</td>
<td>What types of energy are there?</td>
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<td>15 minutes – have students finish collecting their data and making their analysis of the spring-cart system</td>
<td>42 minutes – have students do a virtual experiment using <a href="http://j.mp/phet-forms">http://j.mp/phet-forms</a> and exploring the transfer of energy between different systems. Have them describe how the energy flows, what type of energy is involved in each situation, and what sources of waste there are in each case.</td>
<td>42 minutes – have students do a virtual experiment using <a href="http://j.mp/sk8park">http://j.mp/sk8park</a> and exploring the transfer of energy in real time in and out of the skater/board system. Have them describe the rules which govern the relationship between where the skateboarder is/what he’s doing and each flavor of energy. Have them then look at snapshots of the pie chart, and describe where the skateboarder is, and what he’s doing.</td>
<td>42 minutes – work through how to use Energy Pie charts to analyze conservation of energy situations. Demonstrate using the pie charts with a falling ball from a small height, and then from a large height, and have students practice analyzing different situations using them.</td>
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<td><strong>Assignment</strong></td>
<td>Lab Worksheet</td>
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<td><strong>State Standards</strong></td>
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Assessment Plan: Students will work in small groups on a worksheet with practice problems. They will review their answers by sharing with a large group, with one intentional mistake. The other groups will have to ask questions to lead them to their mistake. After this review, the students will be given a quiz going over these concepts, mainly conceptual, with some quantitative problems as well.

Resources:
- Springs
- Cart and Track System (http://www.pasco.com/prodCatalog/ME/ME-9429_12-m-classic-dynamics-system/) - $439 (or equivalent system)

Community:
- After the unit, the AP students will work in small groups to come up with ways to present their ideas to the Integrated Chemistry & Physics class for their unit on Energy.