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Life Is Like a Rollercoaster (Physics)

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UNDERSTANDING BY DESIGN

Unit Cover Page

Unit Title: Life Is Like a Rollercoaster (Physics)

Grade Level: 6th Grade

Subject/Topic Area(s): Physics-Force, Work, Motion and Energy

Designed By: Michelle Hockley

Time Frame: 4 weeks

School District: Northside Independent School District

School: William P. Hobby Middle School

School Address and Phone: 11843 Vance Jackson
San Antonio, TX 78230
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Brief Summary of Unit (Including curricular context and unit goals):

The main goal of this unit is for students to formulate a basic understanding of the mechanical physics concepts of force, work, motion and energy. Simple machines were examined in elementary school science so a review of these concepts is included in the unit. Then force, work, motion and energy are introduced with emphasis on lab work during which students will take the information and apply it.

The final assessment of the unit is a performance task in which students will independently design and create a rollercoaster with the requirements that it must be fun, safe and educational. The educational component will include Newton's Laws of Motion, graphing of speed and motion, and potential vs. kinetic energy.

Unit: Force, Work, Motion and Energy

Grade: 6th Grade Science

Stage 1 – Desired Results

Established Goals (e.g., standards)

- TEKS 6.8E investigate how inclined planes and pulleys can be used to change the amount of force to move an object
- TEKS 7.7A contrast situations where work is done with different amounts of force to situations where no work is done such as moving a box with a ramp and without a ramp, or standing still
- TEKS 6.8B identify and describe the changes in position, direction, and speed of an object when acted upon by unbalanced forces.
- TEKS 6.8D measure and graph changes in motion
- TEKS 6.8A compare and contrast potential and kinetic energy

Transfer

Students will independently use their learning to…

Design a safe and fun rollercoaster that demonstrates the mechanical physics concepts of force, work, motion and energy.

Meaning

Understandings

Students will understand that….

- If unbalanced forces are exerted on a body, it will change the direction of motion.
- If the forces are balanced on an object, the object will be at rest and not moving.
- Simple machines change the amount of force needed to move an object.
- Every form of energy is either potential or kinetic energy.

Essential Questions

- To Work or Not to Work?
- Is the Force strong with you?
- Why would you want simple machines in your life?
- Are you balanced?
- Which is more important in life-potential or kinetic energy?

Acquisition

Knowledge

Students will know…

- Vocabulary: force, balanced forces, unbalanced forces, gravity, buoyancy, motion, inclined plane, input force, Joule, load, machine, net force, Newton, output force, speed, pulley, work.
- Speed is equal to distance divided by time.
- Work is equal to force times distance.
- Newton's Laws of Motion

Skills

Students will be able to…

- Calculate average speed using distance and time measurements
- Calculate work using force and distance measurements
- Measure and graph changes in motion
- Distinguish between potential and kinetic energy

<table>
<tr><th colspan="3">Stage 2 – Evidence</th></tr>
<tr><td>CODE (M or T)</td><td>Evaluative Criteria (for rubric)</td><td></td></tr>
<tr><td>T

M/T
M/T</td><td>• Fun and appealing design
• Accurate model or drawing
• Accurate graph of the motion of the rollercoaster
• Correct labeling of types of energy and demonstration of Newton’s Laws of Motion</td><td>Performance Task(s)
Students will demonstrate meaning-making and transfer by…
• Designing and creating with a physical model, computer model or a drawing of a rollercoaster for Fiesta Texas. Include at least two simple machines in the design. There must be at least one loop and one steep drop in the design. The rollercoaster must change directions at some point and go from forward moving to backwards moving.
• Creating a graph of the motion of the rollercoaster.
• Creating an advertisement brochure that explains and illustrates why your rollercoaster is not only safe and fun, but also how it is educational because it follows the concepts of Newton’s Laws of Motion. The educational section of the brochure must also describe the locations on the rollercoaster where potential energy or kinetic energy is present.

Other Evidence (e.g., formative)

Quizzes, Exit Tickets and Informal Checks for Understanding</td></tr>
<tr><th colspan="3">Stage 3 – Learning Plan</th></tr>
<tr><td>CODE (A, M, T)</td><td colspan="2">Pre-Assessment
How will you check students’ prior knowledge, skill levels, and potential misconceptions?
• Students will take a survey to assess prior knowledge about force, work, motion and energy
• Students will be asked the essential questions in a group discussion format</td></tr>
<tr><td>

A

A</td><td>Learning Activities

Day 1
• To Work or Not to Work? (Hook) (essential question)
-Students perform scenarios in the classroom and decide as a class if work is being done or not.
(ex. Carrying books across a room versus picking up books)
• Is the Force strong with you? (essential question)
-Students will discuss in groups what “force” means to them.</td><td>Progress Monitoring (e.g., formative data)

Pre-assessment of prior knowledge</td></tr>
</table>

A/M	**Day 2** • Interview Famous Scientists (Jigsaw) -Students will interview three students portraying Aristotle, Galileo and Newton -Students that interview the scientists will create posters with the physic concepts that the scientists discovered. The posters must include a drawing of the concept as well as a written explanation.	
A/M	**Day 3** • To Work or Not to Work? Explanations & Calculating Work • Work Scenarios- Students go to different stations. At each station is a card describing a scenario. Students must decide in their group if work is being done and the reason for their decision. If work is being done, they must also calculate how much work is being done.	
M	**Day 4** • Continuation of Work Scenario Stations. • Students must calculate showing their work on the white boards some examples of work given to them. • Exit Ticket with three scenarios.	Exit Ticket with three work scenarios and calculating work to check for understanding
M	**Day 5** • Simple Machines Review- (computer lab) -Students will watch a BrainPOP video on simple machines. -Students will go to the following website: http://www.hopkinton.k12.ma.us/hopkins/curriculum_activities/simplemachines/index.htm Information regarding simple machines is on the website. -- Students will use the information to answer questions on the worksheet. -Students will take a quiz on the computer.	Quiz over simple machines
T	**Day 6** • Force Lab- **Objective:** To compare the amount of force needed to move an object with and without the use of inclined planes or pulleys. -Students will record data on direction change, distance and input force. -Students will graph results and make a conclusion.	Lab assessment
M A	**Day 7** • Force and Work Quiz • Balancing Act (hook) -Bring in an animal perched on a branch/item and ask students what are the forces acting upon the animal. Ask students if the forces are balanced or unbalanced.	Quiz over force and work

A/M	**Day 8** • Motion and Speed Notes with powerpoint. -Students will enter Cornell notes into their interactive notebooks.	Summarize notes
M	**Day 9** • Are you balanced? (essential question) • Balanced or Unbalanced Forces? -Students will create a Venn diagram to compare and contrast balanced and unbalanced forces. -Students will draw a resultant vector arrow to indicate the direction and amount of net force for different situations.	Venn diagram
M	**Day 10** • Speed Olympics- (outside) -In a group, students will choose one activity that involves doing something "the fastest" such as running, pushing a ball with their noses or doing a set number of jumping jacks. Students will do the activity while another person in the group takes accurate data on how long it took each person to complete the activity. The results will be posted on the Elmo and then as a class we will decide which activity could be used to calculate speed and which ones could not (must have distance to calculate speed). Students will calculate the speed of these activities and share results with class.	
M	**Day 11** • Matching Motion and Speed -Direct instruction on how to graph motion and speed using examples from the Speed Olympics (model graphing of motion and speed). -As a class, graph more examples from the Speed Olympics. -In pairs, students will match cards that have a graph of speed and motion on half of the cards and the other half have a "story".	Matching cards to check for understanding
T	**Day 12** • Representing Motion Lab (start outside for data) – **Objective:** Demonstrate that changes in motion can be measured and graphically represented. **-**Students will compare results from a "snail walk" and a "power walk".	Lab assessment
M A	**Day 13** • Force and Motion Quiz • Roll Back Toy (hook) -Students will create a toy with a coffee can that represents energy of motion (kinetic) and stored energy (potential) Increase students' awareness of kinetic energy by having them: -Identify objects in motion around them	Quiz over force and motion

	-Discriminate between fast and slow moving objects -Compare how various objects move (walk, roll, jump, etc.) -Analyze if still objects are really moving (e.g., a plant)	
M	**Day 14** • Which is more important in life- potential or kinetic energy? (essential question) • Potential vs. Kinetic Energy Notes w powerpoint. -Students will enter Cornell notes into their interactive notebooks.	Summarize Notes
T	**Day 15** • Bounce the Ball Lab- **Objectives:** -Illustrate the relationship between potential and kinetic energy. -In this activity, students will investigate the relationship between height and the amount of stored energy. Students should understand that potential energy transforms to kinetic energy.	
T	**Day 16** • Comparing Potential and Kinetic Energy -In pairs, Students will sort cards that represent kinetic energy into one column and the cards that represent potential energy into another column. -Independently, Students will create a Venn diagram comparing potential and kinetic energy.	Venn diagram
T	**Day 17** • Buffer Day **Day 18** • Introduce and Assign Performance Task -Students will begin to create their rollercoaster design **Day 19** • Continue Performance Task **Day 20** • Complete Performance Task	Transfers learning to a realistic situation with learner independence

Life Is Like A Rollercoaster

- You are a mechanical engineer that designs roller coasters. Fiesta Texas is looking for a new and exciting rollercoaster to add to their theme park in San Antonio. You would like to design that new rollercoaster, but there is a lot of competition among engineers designing roller coasters. You will have to convince the executives at Fiesta Texas that you have the most safe, fun and educational design for a rollercoaster.

- Give your rollercoaster an awesome name!

- Your design can be shown as a physical model, computer model, or a drawing.

- Your rollercoaster must include at least one loop and one steep drop.

- You must include at least two simple machines in the design of your rollercoaster.

- You must create a marketing proposal brochure that explains to Fiesta Texas why your rollercoaster design is safe, fun, and educational. In the educational section you must include the following:

    1. An analysis of how your rollercoaster follows Newton's laws of motion.
    2. An explanation of the simple machines that you used to create your rollercoaster. Also, label on your model or drawing where the simple machines are located.
    3. A graph of the changes in speed and motion of the rollercoaster.
    4. Label on your model or drawing where potential energy occurs and where kinetic energy occurs.

Due Date:

Name_____ Date Submitted_____

Rollercoaster Design Rubric

	0-2 points	**6-7 points**	**8-9 points**	**10 points**
Design	Vague, non-detailed line drawing	Limited details in drawing	Solid roller coaster design, includes possible theme, some energies, etc.	Detailed roller coaster design, theme and name present, energies labeled, Newton's Laws indicated
Coaster Model	Model of coaster is incomplete	Model is completed but construction appears shaky	Model is completed on time	Model is completed on time and exhibits strong construction
Or Drawing	Not Accurate	Barely resembles the coaster	Somewhat resembles the coaster	Clearly resembles coaster
Attractive Model/Drawing	Unacceptable	Neat	Done in color, very neat, labels are handwritten	Done in color, labels are typed
Types of Energy Labeled	Not labeled	One type of energy labeled	Two types of energy are labeled	Three or more types of energy are labeled
Newton's Laws Labeled	Not labeled	One of Newton's Laws is labeled	Two of Newton's Laws are labeled	All three Laws are labeled
Would Attract Visitors	Not Attract	Minimal attraction	Moderate attraction	Strong attraction
Requirements	No loop or steep drop	Either loop or steep drop missing	At least one loop and one steep drop included	At least one loop and one steep drop included plus extra ones
Calculations	3 or more mistakes in computation	2 or more mistakes in computation	1 or more mistakes in computation	No mistakes in computation
Graph	Not present	Present with several inaccuracies	Present with a few inaccuracies	No inaccuracies

Earned Points = ____/90