A Wild Ride! Week 2: Grades 6-8

Day	Topics	Related Standards
1	Transferring Energy	**Analyze** how humans use technology to store (potential) and/or use (kinetic) energy.
2	Graphing Motion	**Construct an explanation** on how energy can be transferred from one energy store to another.
3	Ramping it Up!	**Plan and carry out an investigation** that can support an **evidence-based explanation** of how objects on Earth are affected by gravitational force.
4	Getting Loopy!	Use non-algebraic **mathematics and computational thinking** to explain Newton's laws of motion.
5	The Triple Crown!	Use non-algebraic **mathematics and computational thinking** to explain Newton's laws of motion.

A Wild Ride! Week 2

Day 1: Transferring Energy

Teacher/Parent Background:

What do scientists and engineers do when they are faced with a challenge? This week students will be introduced to the strategies of scientists and engineers by learning about the steps of the engineering design process in order to begin defining their own, week-long challenge: *How can we design an exciting and safe roller coaster using Newton's Laws?*

In previous grades students learned about using different types of energy, for example: mechanical, light, sound, electrical, and thermal energy. All types of energy can be categorized as one of two basic types of energy; kinetic energy and potential energy.

Potential energy is the energy stored in an object, or energy waiting to happen. Sometimes potential energy is described as gravitational potential energy because objects have the potential to change their position due to the force of gravity. Sometimes potential energy is described as chemical potential energy because the energy is stored within the matter itself. Sometimes potential energy is described as elastic potential energy because it is stretched or compressed within the object. Kinetic energy is the energy of motion. Only matter in motion has kinetic energy.

Example: Some apples are on the tree high above the ground. The apples have the potential to fall to the ground. The energy of the apples in this system is stored because of their position. When the apple is in free fall due to the force of gravity, the apple is in motion and has kinetic energy.

All energy can be identified as either potential or kinetic energy.

Overview:

In this activity, students will demonstrate how potential energy can be converted to kinetic energy and back again by working through the "ask" phase of the Engineering Design Process.

Related Standards:

- Analyze how humans use technology to store (potential) and/or use (kinetic) energy.

Key Terms:

- Potential Energy
- Kinetic Energy
- Energy Transformation
- Total Energy

Materials List:

- Masking Tape or Duct Tape
- Ruler
- String or fishing line
- Block of wood
- Heavy object or weight, to tie to string (preferable if mass object is known)
- Computer
- Pen/Pencil

Activity Description:

Before students jump into building a roller coaster, we want to help them develop the skill of thinking like an engineer. Students spend some time asking themselves what they need to know to solve the following problem: How can you design an exciting and safe roller coaster?

Once students have some questions, they can start the following activity to gain a better understanding of how energy is being converted during a roller coaster ride.

1. Tightly tie a piece of string to the heavy object. This object will act as the pendulum bob.
2. Tape the upper end of the string to the top of a desk or table so that the pendulum bob hangs just above the floor.
3. Test the swing of the pendulum and adjust the length of the string if needed. The pendulum should swing freely and be as close to the floor as possible.
4. Place the block of wood directly in front of the hanging bob so that they touch each other. You want the pendulum bob to strike the block at the bottom of its swing. Mark the placement of the block with a piece of masking tape labeled block-start.
5. Place the wood block at the spot where you labeled block-start. Keep the string straight while raising the pendulum bob 10 cm above the floor (use a ruler to measure the distance from the floor to the pendulum bob)
6. Release the pendulum bob. Mark the displaced position of the block with a piece of tape labeled block stop.
7. Measure the distance between block-start and block-stop. Record the measurement on the data table 1.
8. Leave the piece of tape labeled block-start in place and then move on to repeat the rest of the process two more times. Record your results and calculate the average of the three distances.
9. Repeat the entire process for three trials starting with the pendulum bob height at 20 cm.
10. Repeat the entire process for three trials starting with the pendulum bob height at 30 cm.
11. Repeat the entire process for three trials starting with the pendulum bob height at 40 cm.

Next, students will go to Energy in a Roller Coaster Ride interactive on PBS Learning.

1. Read the Background Reading.
2. Launch the simulation.
3. Draw a diagram that illustrates the transformation of energy, using the interactive activity as an example. Then describe the transformation. For example: When I carry a sled to the top of a snowy hill, the potential energy of the sled increases. As I stand with my sled at the top of the hill,

the kinetic energy is zero and the potential energy is at its maximum. As I slide down the hill, the potential energy of the sled decreases and its kinetic energy increases.

Closure:

Ask students the following questions:

1. Describe the pattern in the data. In other words, how did the changes in the starting height of the pendulum bob affect how far the block moved?
    - *The higher the pendulum was started, the further it moved the block after it hit it.*
2. How does raising the height of the pendulum bob affect its potential energy?
    - *The higher the pendulum bob, the greater the potential energy.*
3. As the pendulum is let go from increasing heights, how is the resulting kinetic energy affected? What is the evidence?
    - *The higher the bob, the faster it swings when released, causing the block to move farther. This shows more kinetic energy.*
    - *The swinging pendulum bob must have more kinetic energy if it starts higher because the block moves further.*

Extension:

Watch & Learn: Transfer of Energy

Watch & Learn: What is Kinetic and Potential Energy?

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Never stop wondering.
Never stop imagining.

Student Handouts

Data Table 1

Distance of Displaced Block of Wood				
Height of Pendulum Bob	Trial 1 (cm)	Trial 2 (cm)	Trial 3 (cm)	Average (cm)
10cm				
20cm				
30cm				
40cm				

Potential to Kinetic Energy Diagram