



Youth & Education Programs

Design the Ride (GA Lesson Plan #1)

Suggested Grade Levels: Grades 6-12

Standards:

MS-PS3-1 Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.

MS-PS3-2 Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.

MS-PS3-4 Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

MS-PS3-5 Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

DCI.PS2.A.TT The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

CTE.EA.KPAS.5.2 Solve predictable and unpredictable work-related problems using various types of reasoning (inductive, deductive) as appropriate.

CTE.EA.KPAS.5.3 Use systems thinking to analyze how various components interact with each other to produce outcomes in a complex work environment.

Scenario Overview / Introduction:

Learning Goal:

Students will distinguish the different types of energy (mechanical, chemical etc.) and be able to plain transfer one type of energy to another, while also measuring the kinetic energy of a moving object.

Essential Question:

What types of energy are involved with amusement rides that go extremely fast and whip around sharp angles?

Learning Objectives:

1. Students will be constructing a Rube Goldberg device to demonstrate potential energy to kinetic energy conversions.



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Vocabulary

- **Chemical Energy:** Energy given or needed that changes the arrangement of atoms or molecules
- **Energy Transfer:** Conversion of one type of energy to another such as from mechanical energy to heat energy or from chemical energy to sound energy.
- **Friction:** Force that opposes motion and can cause a change in energy to heat or sound.
- **Heat Energy:** Energy that changes the temperature of an object, typically caused by friction
- **Mechanical Energy:** Energy that pushes or pulls a material object into a different position
- **Potential Energy:** The amount of stored energy in a physical situation. This could be due to the height of an object that has potential to be converted to kinetic energy because of gravity.
- **Simple Machines:** The six machines that make up all other complex machines. They are inclined plane, wedge, screw, lever, wheel and axel, and pulley.
- **Sound Energy:** Energy that vibrated an object and causes it to make a sound, typically caused by friction.
- **Total Energy:** The sum of kinetic and potential energy at any point in an object's trajectory is equal to the total energy of a system.
- **Rube Goldberg Machine:** A machine made of simple machines to perform a simple task in an indirect and over-complicated fashion.

Pre-Visit Learning Activities:

1. Facilitate a discussion on the physics and principles applied to motion at amusement parks.
 - a. Distance, time, speed, acceleration, mass, force, energy etc.
2. Discuss the concepts behind potential energy and kinetic energy

Website Resources:

- <https://science.howstuffworks.com/engineering/structural/roller-coaster.htm>
- https://www.teachengineering.org/lessons/view/cub_energy_lesson01
- https://www.sciencebuddies.org/science-fair-projects/project-ideas/ApMech_p017/mechanical-engineering/rubber-bands-for-energy#procedure
- <https://printableworksheets.in/worksheet/kinetic-and-potential-energy>

While at Universal:

1. Experience the use of potential energy and kinetic energy on Revenge of the Mummy—The Ride and TRANSFORMERS™: THE Ride – 3D.
2. Compare and contrast the use of mechanical energy for each.



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Post-Visit Learning Activities:

1. Students will create a Rube Goldberg Machine, a contraption that performs a simple task in a very complicated way using a chain reaction of energy transfers.
 - a. Machine should pop a balloon
 - b. Should use simple machines (lever, pulley, inclined plane, wedge, screw, and wheel and axle)
 - c. Must identify where mechanical energy converts to heat energy or to sound energy
 - d. Must identify the highest and lowest points of potential energy and the highest and lowest points of kinetic energy

Assessment:

	Emerging	Competent	Advances
Machine must function to complete task	Machine does not accomplish a simple task	Machine accomplishes a simple task with a simple set of steps	Machine accomplished a simple task with an extremely complex set of steps
Must have at least 3 different simple machines	Has less than 3 different simple machines	Has 3 simple machines	Has more than 3 simple machines
Must identify at least 2 positions when energy transfer happens from mechanical to heat or sound	Students identify less than 2 different positions	Students identify 2 different positions	Students identify more than 2 different positions
Must identify the highest and lowest points of potential energy, and the highest and lowest points of kinetic energy	Students identify only highest and lowest point of potential energy OR kinetic energy	Students identify only highest and lowest point of potential energy and kinetic energy	Students identify the change in kinetic and potential energy through the duration of the machine operation
Machine works as intended	Machine takes more than 3 tries to work	Machine takes 2-3 tries to work	Machine works as intended on the first try