



Science Unit | Grades 10-12 | Lesson 2: The Physics of Roller Coasters

Lesson Description

Imagine yourself rushing through the air at over 65 mph feeling weightless as you descend from a loop that made your stomach jump with excitement. You have just experienced one of Silver Dollar City's wild roller coasters! Have you ever thought about how fast you were going as you fell? Welcome to the wonderful world of physics where every inch of track and every bit of speed counts. Test out some of Silver Dollar City's coasters and learn the facts as you figure out the velocity as they fall. Who ever said learning can't be fun?

Concepts

Solving equations
Velocity

Objectives

Students will:

- Evaluate expressions by substituting values for variables.
- Simplify expressions using correct order of operations.
- Calculate the velocity of certain roller coasters around Silver Dollar City.

Content Standards

National Standards in Science (Physics)

- **Standard 10:** Understands forces and motion.
 - Benchmark 8, Grades 9-12: Knows that laws of motion can be used to determine the effects of forces on the motion of objects (e.g., objects change their motion only when a net force is applied; whenever one object exerts force on another, a force equal in magnitude and opposite in direction is exerted on the first object; the magnitude of the change in motion can be calculated using the relationship $F=ma$, which is independent of the nature of the force).



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Course Level Expectations: 2.B.1 (Physics)

An object that is accelerating is speeding up, slowing down, or changing direction.

Time Required

Varies by student – Use teacher discretion to determine appropriate grade level

Materials

- Student Activity Sheet from the Kids-U-Cation website
 - Writing utensil
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Procedures

1. (Teachers) Print off the student activity sheet from the Kids-U-Cation website.
 2. Ride each of the roller coasters listed.
 3. Use facts given in the packet to solve the equations.
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Closure

Review the key points of this lesson by discussing the following:

- Why is important to know the velocity of the ride on each drop?
 - Go over the order of operations to make sure students did the equations correctly.
 - Discuss why accurate math figures are imperative for the safety and enjoyment of the ride.
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Assessment/Independent Practice

Give an assignment or test of your choosing.



Name/Date: _____

The Physics of Roller Coasters

Imagine being on a roller coaster as it slowly climbs to the top of a hill and suddenly drops so quickly that it takes your breath away and makes your stomach feel like it's in your head. When a roller coaster climbs to a certain height and then drops, it gains speed as it falls. Use the equations below to solve the problems and forget about imagining roller coasters...go experience it for yourself!

If we ignore friction, the height and speed are related by the equation:

$$H_i - H_f = v^2 / 19.6$$

(H_i = initial height, H_f = final height, v = velocity)

1. Suppose the roller coaster climbs to an initial height of 100 meters. Use the equation and the information in the chart to find the velocity of the coaster.

H_f (meters)	V (meters/sec)
15	
50	
60	
75	

Answer the questions about Silver Dollar City's roller coasters below. Show your work.

2. Powderkeg's tallest drop is 110 feet, or 33.5 meters. Assuming ground level is 0 meters, what is Powderkeg's greatest velocity?

3. Wildfire's tallest drop is 115 feet, or 35.01 meters. Assuming ground level is 0 meters, what is the greatest velocity of this coaster?



The Physics of Roller Coasters Silver Dollar City Branson, Missouri



Powderkeg – A compressed air-launch coaster

Launch Speed:	0 – 53 mph in 2.8 seconds
Track Length:	3,506 feet
Ride Duration:	2 minutes, 53 seconds
Top Speed:	64 mph
Tallest Vertical Drop:	110 feet
Number of Trains:	3 trains carrying 16 passengers each
Height Restrictions:	42 inches and taller
Ride Manufacturer:	S&S Power Inc. of Logan, UT

Powderkeg



Wildfire

Wildfire – The Multi-loopin' phenom

Track Length:	3,073 feet
Ride Duration:	2 minutes, 16 seconds
Top Speed:	66 mph
Tallest Vertical Drop:	115 feet
Number of Trains:	2 trains carrying 24 passengers each
Height Restrictions:	52 inches and taller
Ride Manufacturer:	Bolliger & Mabillard of Monthey, Switzerland

Giant Swing

Giant Swing – Sudden acceleration & back-to-back positive & negative G-forces.

High Speed Launch Height:	75 feet
Ride Height:	64 feet (static) 81 feet (motion)
Ride Duration:	60 seconds
Top Speed:	64 mph
Capacity:	32 passengers at 8 per chair group
Height Restrictions:	48 inches and taller
Ride Manufacturer:	S&S Worldwide, Inc.

