Roller Coasters

Major Concepts: Potential and Kinetic Energy

Minor Concepts: Transfer of Energy

	Content	Skills
Vocabulary:	potential energy	designing experiments
	Kinetic energy	collecting data
	Gravitational potential energy	measuring
	Centripetal force	using models
	Velocity	predicting
	Acceleration	calculations
	Mechanical energy	
	Friction	
	Thermal energy	
	Sound energy	
Technology:	stopwatches	
	Computers	
	Calculators	

Core Content

Physical Science – Motions and Forces

SC-M-1.2.1 The motion of an object can be described by its relative position, direction of motion, and speed. That motion can be measured and represented on a graph.

Program of Studies

Grade 6 Physical Science (Motions and Forces) Students will describe, measure, and represent an objects motion.

Grade 8 Physical Science (Motions and Forces) Students will measure and represent (e.g. graph) forces on objects and motions (e.g. constant speed, changing speed) of objects.

Pretest on potential and kinetic energy

Challenge:

With hearts pounding, hands sweating, and your stomach churning most of us have climbed aboard a roller coaster for the thrill of defying our fears. As you tighten your seat belt, lock the handle bar across your lap and gaze at that first steep hill the only thought in your head, "is it to late to go to the bathroom again?" (Well, that's probably the adults you are with stalling, trying to think of a way to get off before the ride starts.) But you, my bright science students, are only thinking how does this car stay on the track. What is needed to make the ride the best? What factors do designers

of roller coasters consider as they plan the ride? At what height should the first hill be? How steep can the drops be? A loop or two? How long should the ride be?

Let's find the answers.

Task # 1. Designing the first hill.

A basic feature of the roller coaster is to get maximum speed on a down hill fall. Let's take a look at some roller coasters.

It has been said that the shortest distance between two points is a straight line. But is it the fastest? Try different paths to simulate the path of a roller coaster car down the first hill. Design an experiment to determine which path results in the fastest time. Look at paths A, B, and C below, now design your own path that will give you the fastest time.

A. B. C.

First Hill

Hill	Time 1	Time 2	Time 3	Avg.
A				
B				
C				
D				

Task # 2 Design a loop.

The normal force of gravity on your body is the weight you experience, or 1G. By motion, we can cause centripetal force to add to or subtract from the gravitational force. If we counter the gravitational force with 1G away from the center of the earth, you will experience weightlessness. If we add 1G of force in the same direction as the center of the earth, we say you are experiencing 2G's.

Read the following from the Internet from Roller Coaster Physics **141.104.22.210/Anthology/Pav/Science/Physics/book/home.html** Go to weightlessness.

A loop in the path of a roller coaster provides centripetal force that can counter or add to gravitational forces.

Determine how big the loop must be for a steel ball to be weightless at the top of the loop. See the following for ideas. (Go to Roller Coaster Physics Loops)

Try loops of different radii.

Draw and label your design.

Now design a drop that will cause the steel ball at its highest point to experience 1G of force away from the center of the Earth. Draw and label your designs.

Task # 3 Designing a simulated roller coaster ride and describing the motion of the forces on passengers during the ride.

Using a 7meter length of plastic tube, design a simulated roller coaster ride with at least one loop and two hills. Draw and label your design.

A. Total time of ride _____
B. Height of initial drop _____
C. Force at the top of loop _____ in G's
D. Force at the top of the first hill after loop _____ in G's
E. Point of maximum and minimum kinetic energy _____
F. Point of max. and min. potential energy _____
G. Speed after last hill _____

Task #4 Designing a roller coaster on the Internet.

Go to the following site. Funderstanding

www.funderstanding.com/k12/coaster/

Additional Internet resources – Amusement Park Physics

www.learner.org/exhibits/parkphysics/

Amuse Me: Theme Park Physics

Library.thinkquest.org/C005075F/

Open Response

Name _____

Period _____

For this open response you get to choose - either Transfer of Energy or Forces and Motio

Forces and Motion Open Response

Multiple choice - Write the letter to answer each question.

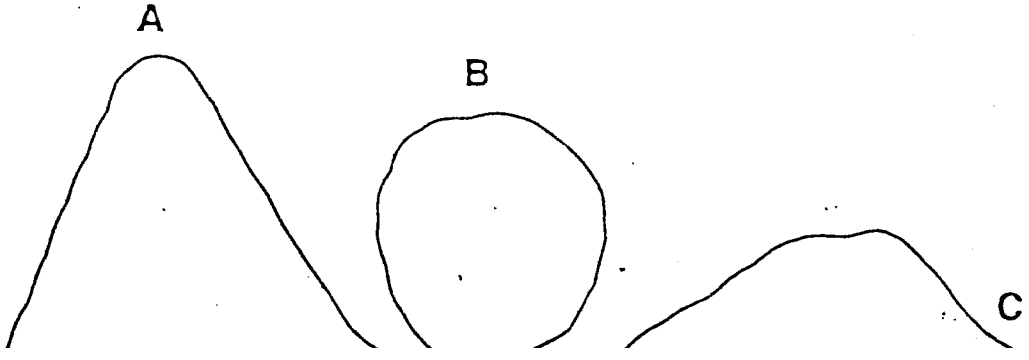
1. Gravitational potential energy is dependent on
   - A. speed and height
   - B. weight and height
   - C. time and weight
   - D. acceleration and kinetic energy

2. A stretched rubber band has
   - A. potential energy
   - B. kinetic energy
   - C. nuclear energy
   - D. electromagnetic energy

3. Velocity is speed and
   - A. motion
   - B. mass
   - C. distance
   - D. direction

4. The property of matter that resists a change in motion is
   - A. inertia
   - B. friction
   - C. gravity
   - D. weight

Below is the diagram of a roller coaster. The roller coaster starts from rest at point A. Describe the forces acting on the roller coaster car at points A, B, and C. Where there is more than one force, indicate which force is greater.



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