

Lesson 1: Introduction to Rollercoaster Design

Background

The design and construction of roller coasters is a very complicated and drawn out process. However this process can be broken down into fairly simple concepts of physics, to include energy conservation and kinematics (Newton's laws). This lesson is meant to get students excited about roller coasters and introduce them to the basic physical concepts that are required to understand how they work.

Concepts

1. Introduction to Basic Physics vocabulary as it relates to roller coaster design.
2. Ability to Draw and understand a basic Free Body Diagram

Student Learning Objectives	NYS Standards
Define forces affecting motion	
Relate forces to everyday experiences – including roller coasters	
Draw and understand basic Free Body Diagrams	

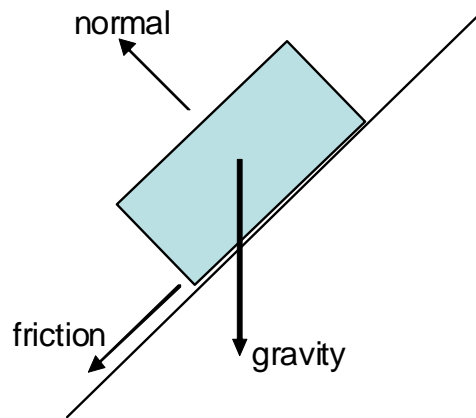
Key Terms

Force	Friction	Gravity
Normal Force	Free Body Diagram	Engineering

Activities

- Show video on roller coasters running when students come into class.
<http://attraction.canadaswonderland.com/public/fun/videos.cfm>
Magnum XL200 Roller Coaster 1st Person Video -
<http://www.youtube.com/watch?v=5dHvIEzeLyk&feature=related>
<http://www.glenbrook.k12.il.us/GBSSCI/PHYS/mmedia/qt/energy/coastmac.html>
or simulation
http://www.vesamotex.net/RollerCoaster/math_science.htm
- Introduction – (<10 min) Introduce yourself to students, Brief description of your research, Goals of program, Final project description, and describe the overall reason and goal of why you are there

- Show example of model roller coaster with simple components, let kids release cars and observe motion. Mention terms like gravitational force, friction, energy, velocity etc.
- Discussion – what forces affect roller coaster and rider? (gravity, friction, normal). Draw free body diagram to illustrate these forces for a block moving up an incline. (See also video depiction at <http://www.glenbrook.k12.il.us/gbssci/Phys/mmedia/circmot/rcd.html>)



- what kinds of knowledge and skills would it take to design a new roller coaster?
- Introduction to Engineering (<10 min) – explain different fields of engineering involved in roller coaster design
- Wrap up and review objectives, teaser for next lesson and collect worksheets (<5 mins)

- *Next Lesson:* Now that we understand the basic forces affecting roller coaster design what do we do next? - Learn more about these! Friction, Energy and Conservation of Energy etc. We have described the problem and the results that we want now we must gather information about the physics and energies controlling roller coasters and eventually learn to build one.

Reflective Notes

Factor in settle time, worksheet may need to be adapted for each classroom's experience level, remind students to bring the worksheet for the next day.

Final Project
Creating your own Roller Coaster

Name: _____.

Date: _____ Period: _____.

Task:

Design and build a roller coaster with the supplied boards and track. You should include as many elements (loops, drops, hills, etc) in the design as possible. Your car must remain on the track throughout the run, and the car should not run off the end of the track, it should stop on the track.

Deliverables:

- Scale Drawing of the roller coaster.
- Theoretical calculations of the kinetic energy of the car on the track at the bottom of valleys and the potential energy at each peak
- Estimation of friction factors based on difference in theoretical car performance and actual results.
- Presentation of the roller coaster design, to include a name, seating, safety data, and highlights of the coaster design. (some of this will be made up)
- Presentations will be made on the last day of the unit to the class. Presentations can be done in PowerPoint, or on a poster, the choice is yours.
- Each group will give one presentation, but each individual will identify his or her specific contribution.
- Scale Drawings and Calculations are due by the end of class on _____.

You will be graded on:

- Teamwork
- Individual Contribution
- Originality of Design
- Completeness of Presentation
- Accuracy of Calculations
- Scaled Drawing