VIRTUAL ROLLER COASTER

> MASS/INERTIA  > WORK
> FORCE          > INERTIA
> SPEED          > CENTER OF GRAVITY
> HEIGHT         > VELOCITY
> FRICTION       > ENERGY
> GRAVITY

MODULE OVERVIEW:
This is one of many culminating activities for the Physics Pathway. Students will take their understanding of the following concepts: Mass/Inertia, Force, Speed, Height, Friction, Gravity, Work, Inertia, Center of Gravity, Velocity, Energy and apply that knowledge to the creation of a successful virtual roller coaster.

LEARNING OUTCOMES:

Standard:
Mass/Inertia, Force, Speed, Height, Friction, Gravity, Work, Inertia, Center of Gravity, Velocity, Energy

Grade 6 Common Core math standards (Statistics and Probability)
Grade 6 Common Core math standards (The Number System)

Knowing:
How are physics concepts applied to roller coasters?

Doing:
Students will apply learned knowledge of physics concepts to create a successful virtual coaster.

Creating Meaning:
Students articulate physics concepts when riding coasters at an amusement park (Magic Mtn., SM Pier, Disneyland, etc...) Students connect with these concepts when skateboarding or dealing with other aspects of everyday life. Science is not just a school subject...it’s necessary and must be applied when designing and making in the real world.
LESSON PLAN STEPS SUGGESTIONS

PHYSICS

PRIMER ACTIVITY:
Guiding questions/prompts:

SCHEDULE/ TIME
• Several weeks

STUDENT ACTIVITY
• Students will complete all sequence-required activities in the PHYSICS pathway: Mass/Inertia, Force, Speed, Height, Friction, Gravity, Work, Inertia, Center of Gravity, Velocity, Energy

STUDENT ARTIFACTS
• N/A

TEACHER FACILITATION
• (See PHYSICS pathway activities)

SELF ASSESSMENT
• Students assess confidence levels in their ability to articulate through the process of building their coaster and have a solid understanding of how these concepts apply.
PRIMER ACTIVITY:
Guiding questions/prompts: “Let’s start exploring how we might apply what we have learned about physics.”

SCHEDULE/ TIME
• 20 mins

STUDENT ACTIVITY
• Students watch No Limits Coaster Simulation (download free version) or No Limits Coaster VIDEO
This simulation will be used to engage and excite learners and to help generate a cumulative vocabulary list for the PHYSICS pathway through discussion and brainstorming. This list will also be created by drawing from vocabulary discovered in earlier activities.

STUDENT ARTIFACTS
• N/A

TEACHER FACILITATION
• Teacher provides demo and facilitates discussion and vocabulary development. What are you feeling as you ride a coaster? What makes it fun? What increases the speed?

MATERIALS
• Simulation, video, whiteboard

SELF ASSESSMENT
• Students express confidence in their ability to articulate through the process of building their coaster and have a solid understanding of how these concepts apply.
LESSON ACTIVITY:
Guiding questions/prompts: “What concepts must be applied to and are necessary in the creation of roller coasters?”

SCHEDULE/ TIME
- 30 - 45 mins

STUDENT ACTIVITY
- The JASON Project (coaster creator)
  http://content3.jason.org/resource_content/content/digitallab/4859/misc_content/public/coaster.html
  Students have the opportunity to use and examine their understanding of physics concepts to create a successful roller coaster.
- Students have the opportunity to use and examine their understanding of physics concepts to create a successful roller coaster.

STUDENT ARTIFACTS
- A successful coaster and accurate articulation of concepts that apply to its creation.

TEACHER FACILITATION
- Teacher is fairly hands-off during this activity and spends most of the time questioning students about concepts for assessment. However, there is a need, before getting started, to demonstrate how the game works (look at buttons for creating loops, changing height, making more track, etc...)
  - “What is adding/taking energy away from your system?”
  - “How does friction apply here?”
  - “What types of energy are we dealing with?”
“What causes energy to be dissipated in this model? Why is it constantly increasing over time in this model?”

“What is the RELATIONSHIP between PE and KE?”

- Students may have some difficulty transferring concepts in the beginning, but as they experiment with the coaster builder, we can expect that we will see more knowledge transfer and also have the ability to see where remediation may be necessary.

**MATERIALS**
- Pads, laptops

**NOTES:** This coaster allows for mass to be added/subtracted in the form of the number of cars you choose for your coaster. It also has a nicely color-coded, real-time graph for KE (Kinetic Energy), PE (Potential Energy), and DE (Dissipated Energy). The coaster also must be stopped at a certain point by taking energy out of the system or the player is NOT successful.

**SELF ASSESSMENT**
- Students assess their ability to express an understanding of the concepts that affect their coaster. “Did I feel confident as I talked through the process or did I struggle with vocabulary and accuracy?”
EXTENSION ACTIVITY:
Guiding questions/prompts:

SCHEDULE/ TIME
• 45 mins (this can be done concurrently as students finish coaster attempts)

STUDENT ACTIVITY
• Students now use the statistics that are given at the end of a successful coaster attempt to plot aspects of their experiment and draw connections between cause and effect in the scoring process:

   HILLS, LOOPS, SCREAMS, TOP SPEED, STOP ACCURACY, TOTAL SCORE:

(Use classroom charts and apply common core math standards to averaging, graphing, plotting, etc...)

STUDENT ARTIFACTS
• Charts and graphs

TEACHER FACILITATION
• Teacher helps to facilitate discussion and answer questions.

SELF ASSESSMENT
• Students gauge their own success (or desire to improve) through final statistics or personal satisfaction with coaster. Students can also decide that certain statistical areas are more important to their “virtual riders” and may wish to pursue a coaster that is rich in “loops” or “screams” in order to make the coaster more fun. How do we increase our top speed? What makes the riders scream more?
Making It Matter:

First roller coaster inventor: http://kids.britannica.com/coasters/i_thomp.html

Things to Think About:

What, if anything, can be applied to the way a river runs down from the mountains? What about other amusement park rides? Can we apply this to creating others?

Supporting Media, Links, and Resources:

http://www.learner.org/interactives/parkphysics/parkphysics.html
Contextualizes physics concepts through multiple rides.
Roller coaster sim shows how certain concepts affect design.

CA Companies that built coasters - check out Morgan.

Roller Coaster Database: http://www.rcdb.com/rhr.htm

Lance Mountain skateboarding video: http://vimeo.com/18647409

OK Go video (Rube Goldberg): http://www.youtube.com/watch?v=qybUFnY7Y8w&feature=relmfu

http://www.funderstanding.com/slg/coaster/ - Simulation to design fun, safe coaster

http://kids.discovery.com/games/build-play/build-a-coaster

Shoot for the Moon: The Making of Space Mountain, Paris (1/5)
http://www.youtube.com/watch?v=Cb-swg8PnkQ

Mega Builders-Tatsu at Six Flags Magic Mountain (1/2) 32mins
Originally aired on Discovery Channel prior to or near the opening of Tatsu at Six Flags Magic Mountain in 2006.
http://www.youtube.com/watch?v=1Hm4nRzhYi8

Mega Builders-Tatsu at Six Flags Magic Mountain (2/2) 27mins
Originally aired on Discovery Channel prior to or near the opening of Tatsu at Six Flags Magic Mountain in 2006.
http://www.youtube.com/watch?v=jRr2LvEWtjE&feature=relmfu

Green Lantern Six Flags Magic Mountain 4mins
Footage by Six Flags Great Adventure - Green Lantern Front Seat POV Six Flags Great Adventure New Jersey - B&M Stand Up Roller Coaster
http://www.youtube.com/watch?v=60zmOyBo3U