Rollercoaster Investigations

CPALMS lesson plan development initiative

3rd – 5th Grades

Florida Sunshine State Standards

3rd Grade

SC.3.P.10.2 - Recognize that energy has the ability to cause motion or create change.
SC.3.E.5.4 - Explore the Law of Gravity by demonstrating that gravity is a force that can be overcome.
LAFS.3.SL.1.1 – Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly.

4th Grade

SC.4.P.12.1 - Students will recognize that a marble on a rollercoaster changes its position and direction as it travels down the path.
SC.4.P.12.2 - Students will calculate the speed of the marble as it completes the path.
SC.4.N.1.1 - Students will investigate a question concerning a design component of their rollercoaster and its impact on the speed of the marble as compared to the speed over a straight track**.**
SC.4.N.1.5 - Students will compare the method of rollercoaster design used by their peer groups to that of their own.
LAFS.4.SL.1.1 - Students will effectively engage in class and group discussions expressing their own ideas while designing the rollercoasters and explaining the science content they are learning and building upon others**.**
LAFS.4.SL.1.3 - Students will identify the reasons and evidences their peer groups provide for creating their rollercoaster design.

5th Grade

SC.5.P.10.2 – Investigate and explain that energy has the ability to cause motion or create change.
SC.5.P.13.1 – Identify familiar forces that cause objects to move, such as pushes or pulls, including gravity acting on falling objects.
SC.5.P.13.2 – Investigate and describe that the greater the force applied to it, the greater the change in motion of a given object.
SC.5.P.13.3 – Investigate and describe that the more mass an object has, the less effect a given force will have on the object's motion.

Objective:

This activity will allow students to explore the motion and speed of an object. While constructing a rollercoaster and using the Scientific Method, students will create their own question and then investigate it, finding out whether the speed of an object is affected by the track it follows.

Key Words – rollercoaster, speed, investigation, collecting data, testing, questioning, force

- A quick assessment for the understanding of gravity: Pick up a book and drop it on the table. When the students calm down, ask them "Why did the book fall to the table?" Other questions that could be asked: "When I held onto the book, what force was I overcoming?" "Why didn't the book float up when I released it?" All the answers are gravity. Then ask, "Why did it stop on the table and not go to the ground?" The desk is pushing back with more force than the gravity is pulling down the book. These questions should allow you to determine if the students have the necessary knowledge of gravity.
- A quick assessment for the understanding of friction: You will need a clipboard or other flat, slick surface, an object that will slide easily and one about the same size that will not (bar eraser) OR a piece

of rubber type cabinet liner (something that will provide a lot of friction) and an object to slide. Tilt the clipboard and slide the object down. Then put down the rubber cabinet liner and try to slide the object. Ask, "Why doesn't it slide?" (Friction) "If you tilt the clipboard more, do you think the object will eventually slide over the rubber? Why?" (The force of gravity was greater than the friction.)(CPALMS)

Background

Theme parks have been an exciting place for people to visit for over a hundred years. A roller coaster is a theme park ride where guests sit in a series of wheeled cars that are joined together. The cars then move along a pair of rails supported by a wood or steel frame. The cars are then move up a steep incline by a linked chain. Once the wheeled cars reach the top of the incline, they roll free of the chain and are forced downward by gravity through a series of drops, rises, curves, and turns. Finally the cars are braked to a stop at the starting point, where the guests exit and new guests get on. Many people have said that roller coasters are the most exciting and heart racing ride at a theme park. Do you agree? Let's find out together.

Design

Designing a roller coaster ride is considered the most important part of the manufacturing process. Because each roller coaster is exclusive to the park it is being built for, every detail must be designed completely from the ground up.

Roller coaster engineers must think about what kind of riders will use the coaster. For example, if the roller coaster is designed for small children, the bumps and curves should be gentle, and the cars' speed should be relatively slow. Older children and adults usually want a slightly faster ride with lots of turns and moderate forces. Ultimate thrill seekers want extreme heights and speeds.

Roller coaster designers not only create the look of the ride but how much space will need to be available for the coaster. Roller coasters do not only take up tons of ground space, but also a lot of air space. Designers must take into consideration the general terrain, other surrounding rides, power lines, access roads, lakes, trees, and other obstacles. Due to a high demand for thrill rides, many amusement parks over the years have expanded and added new rides that a new roller coaster often has to be designed to go around, under, over and through existing rides and walkways

Most roller coasters today are created on a computer. One of the most important parts to a roller coaster is the height of the first incline. It must be calculated to give the cars enough energy to propel them all the way through the ride and back to the starting point. The vertical and horizontal forces that the loaded cars apply on the track need to be calculated at every point to assure that the support structure is acceptable.

With technology and creativity, designers are pushing rides to the extreme, creating never used features, making roller design more challenging and exciting. A working model of the new features must be built for testing out the design and data collection. Once the model is constructed at the manufacturer's facility, weighted test cars are equipped with data collecting devices and are then propelled through the test section of the track at the desired speed. Once all the results are calculated and examined, the designers may change or modify their original design before building the final product.

After all the calculations, design, and testing are complete, designer's use a computer-aided drafting (CAD) program to help create very specific drawings for each of the thousands of parts that will be used to build the new roller coaster.

References:
http://www.madehow.com/Volume-6/Roller-Coaster.html