ROCKIN’ AND ROLLIN’ RAMPS

OVERVIEW
In this activity, students will explore the force and motion of a roller coaster by designing ramps, collecting data, and changing variables while using a ball and simple materials.

LEARNING OBJECTIVES
- Students will demonstrate understanding of how gravity and friction impact roller coasters by completing a series of experiments and recording their data.

VOCABULARY
- FORCE – a push or pull between two objects
- GRAVITY – force that pulls objects towards the center of a physical body that has a lot of mass
- MOTION – changing location or moving from one place to another
- FRICTION – a resistance force that slows or stops motion when objects rub together
- NEWTON’S 1ST LAW OF MOTION (LAW OF INERTIA) - an object in motion tends to stay in motion unless acted upon by an unbalanced force
- KINETIC ENERGY – energy associated with motion

MATERIALS
- Materials for ramps: paper towel tubes, pool noodles (cut in half), pipe insulation (cut in half) or other material that can hold a ball in place
- Sandpaper, waxed paper, aluminum foil (for ramp) or other material
- Ping Pong balls or marbles
- Double stick tape
- Meter stick
- Books or wooden blocks (for stacking)
- Gravity/Friction Ramp Testing Data Sheet (included)

SET-UP
→ Provide supplies where students can easily access them. Each team of students should have at least (3) different ramps for testing purposes. One ramp without anything added to the surface and then two others with different liners (sand paper, aluminum foil, etc.). You may want to assemble some examples for them to make or have them pre-assembled.
→ Create a simple data sheet for recording information or use the included Gravity/Friction Ramp Testing Data Sheet. Make enough copies for all teams.
→ Clear a space that teams can test their ramps either on desks or tables. You may find that floor space is needed for success.

LESSON PLAN
1) Explain to the class that they are going to do some research and experiments that look at how roller coasters work. Ask who likes riding roller coasters and have them explain what it is that they like about them.

2) Explain that when a person rides on a roller coaster there are many forces at work; going over what a force is.
3) Once forces have been introduced, explain that the main force present on a roller coaster is gravity;
   a. The force of gravity takes over once a roller coaster goes over the top of its first hill, pulling the roller coaster
down towards the Earth. Explain that roller coasters do not have engines, so it is the interaction of forces that
actually make a roller coaster work.

4) Ask the students what they think makes a roller coaster slow down. Discuss what friction is and how it slows the roller
   coaster down.
   a. Introduce and explain Newton’s 1st Law of Motion; the Law of Inertia, in regards to roller coasters.

5) When it’s time to begin the activity, explain that each team will be testing ramps lined with different materials in order to
   study what materials create more friction. Each group will need to find a place to work with plenty of space and set up
   their testing area, as well as designate one group member to be the official data recorder. Students should use the
   Gravity/Friction Ramp Testing Data Sheet or a data sheet created for them to record their information.

6) The students will complete three separate tests;
   a. The first test will be testing ramps that are laid out flat. Explain to the students that while they will be applying a
   bit of force to the ball, they do not want to push it. Measure and record the distance the ball travels on the data
   sheet.
   b. The second test will raise the ramp a small amount (small hill). This can be accomplished by using a textbook or
   other book. Before testing the ramps, be sure to record the height of the small hill on the data sheet.
   c. The final test will be to raise the ramp to create a large hill. Students can stack another book on top of their last
   and record the height on their data sheet. Proceed with testing each type of ramp and recording their data.

   Educator Note: Student teams should use the same ball for all three tests recording as they go. If time allows, have
   student teams complete a separate ramp testing data sheet using a different type of ball (if available) and compare
   results.

7) Once all the challenges are completed, facilitate a class discussion to get students to think about their testing results.

   Example questions:

   • What did you notice about raising the ramps?
   • Which materials seemed to create the most friction? How do you know?
   • What would you predict would happen if your ball was heavier? Lighter? Why?
   • If you were designing a roller coaster where would you use the materials you tested? Why?

SUGGESTED READING/ ADDITIONAL RESOURCES

- *Forces Make Things Move* by Kimberly Brubaker Bradley
- *And Everyone Shouted “Pull”* by Claire Llewellyn
- *Push and Pull, Fast and Slow* by Darlene R. Stille
- *Newton and Me* by Lynne Mayer
# Gravity/Friction Ramp Testing Data Sheet

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<thead>
<tr>
<th></th>
<th>FLAT SURFACE MEASURES: ______ cm</th>
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