

## Provocation: Build A Roller Coaster

### Objective(s):

Can you create a roller coaster that allows a marble to travel from the starting point to the end point using various forces (push, pull, gravity)?

### Activity that involves problem-solving and strategic thinking:

Students will use a variety of building materials and/or recycled materials to build a roller coaster.

Students will reflect on how their different design choices affect the marble's motion.

### Standards/Objectives addressed:

- **NGSS 1-PS2-1:** Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- **NGSS 1-PS2-2:** Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.
- **NGSS 2-PS1-1:** Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- **NGSS 2-PS2-1:** Define a simple design problem that can be solved by applying scientific ideas about magnets.

### Background knowledge needed:

- **Basic Forces:** Understanding push and pull actions through everyday examples.
- **Gravity:** Recognizing gravity as a force that pulls objects downward.
- **Friction:** Knowing that friction opposes motion and can vary with different surfaces.
- **Materials Properties:** Familiarity with various materials (e.g., plastic, wood) and their observable characteristics.
- **Measurement Skills:** Basic skills in measuring height and distance using simple tools.
- **Teamwork:** Experience in collaborating, sharing ideas, and listening to peers.

### Materials:

- Foam Pipe Insulation
- Marbles
- Cardboard
- Tape (masking or duct tape)
- Scissors
- Rulers
- Markers or crayons

- Various surfaces (e.g., carpet, tile, sandpaper): To test how different surfaces affect motion.
- Containers or trays: For collecting and testing marbles at the start and end of the coaster.

**Prompts – questions or statements to elicit engagement:**

- What happens when you push a toy car? How fast can you make it go?
- Can you think of a time when you used a push or pull to move something? What did you do?
- How do you think gravity affects the way a marble rolls down a hill?
- What materials do you think will work best for our roller coaster? Why?
- If your marble doesn't make it to the end, what changes can you make to improve your design?
- How do different surfaces change the way objects move? Can you predict what might happen?

**Vocabulary:**

Force, Motion, Gravity, Friction, Push, Pull, Speed, Direction, Design, Height, Distance

**Reflection prompts:**

- What did you learn about how forces affect motion?
- What was the most surprising thing you discovered during the project?
- How did your design change from your original plan? Why?
- What challenges did you face while building your roller coaster?
- How did working with your group help you learn more about force and motion?

**Extensions:**

**Explore Simple Machines:**

Investigate how simple machines (like levers and pulleys) use force. Students can create models using everyday objects to demonstrate how these machines work.

**Paper Airplane Challenge:**

Students will design and build various paper airplanes, testing how changes in design (wing shape, size) affect flight distance and stability, exploring the forces involved in flight.

**Pendulum Experiment:**

Using string and a small weight (like a washer), students can create pendulums of different lengths and measure how the length affects the swing speed and distance.

**Friction Experiment:**

Set up a slope with different surfaces (sandpaper, carpet, plastic) and have students roll marbles down each slope. They will observe how friction affects the speed and distance traveled.