Active Learning Community Partnership

Ramp Exploration

STEM Focus Area: Forces and Motion
Learning Goal: Youth will investigate how a push or a pull (applied forces) can make things move.

LEARNING ENVIRONMENT

Activity Duration: 50 minutes
Class Size: Large or Small
Type of Space: Indoor
Age of Youth: K-2 (ages 5 to 9 years)

Guiding Question: *What is the question to explore OR the problem or challenge to solve?*
Design and Build a Ramp that lets the ball to roll down the ramp.
Challenge #1: Can you make it roll faster? Challenge #2: Can you make it roll slower?

Through this activity, youth will:

- Design, build, and test ramps of different heights;
- Investigate how the height of a ramp changes the speed of a ball rolling down it;
- Participate in a Think-Pair-Share activity to reflect on this active learning experience.

Facilitator Checklist in the Learning Environment:

- ✓ **Predict and hypothesize**
- ✓ **Develop and use models**
- ✓ **Measure materials**
- ✓ **Observe**
- ✓ **Investigate**
- ✓ **Record observations**
- ✓ **Analyze and infer**
- ✓ **Share and communicate data**
- ✓ **Interpret data**
- ✓ **Test and revise**
- ✓ **Draw conclusions and relationships**
- ✓ **Have voice and agency, make decisions and guide their own learning**

PREPARATION

Facilitator prep:
When was the last time you played on a slide? Here's a chance for you to revisit the fun, because a slide a ramp. So grab a willing friend and a ball to explore ramps together as you experience and observe how things roll and slide down an inclined plane. You can also learn more about the science of inclined planes by watching this 7-minute video from Kids Academy: https://www.youtube.com/watch?v=y6VjHcOX8_o

Common Misconceptions to be aware of:

- Objects which are not in motion have no force applied to them. (The force of gravity is always present.)
- The surface on which an object rolls does not affect its motion. (Ramp angles affect motion.)

In this STEM active learning experience, youth will work in small groups of two to design, build, and test ramps in order to both increase and decrease the speed of the ball rolling down it. You'll need to gather and prepare all of the Ramp Exploration materials before class putting them into separate boxes for each small group. Organizing the materials before class begins in this manner will help make your facilitator work easier and eliminate youth spending too much time finding their materials.

It is important that youth have the opportunity to explore ramps (inclined planes) before they attempt to build their own. This could be achieved by building a ramp system and allowing youth to experiment with it during free play time. You could also go on a Ramp Scavenger Hunt on your playground and search for ramps. Both activities will help get everyone thinking about ramps and how they work.

Literacy Connection: Read Michael Dahl's nonfiction book Roll, Slope, and Slide: A Book About Ramps to provide a great hook that will prompt student's interest in learning more about ramps before you begin this activity. *(available on Amazon).*

Materials
Youth Materials: Facilitator will need to prepare a Materials Box for each youth team.

- 2 ramp pieces of the same length (heavy cardboard, wood, cove molding, or toy car tracks);
- Two each of a variety of three balls made of different materials (tennis balls, racquet balls, plastic balls, etc.)
- Several thick books, wooden blocks, or small boxes (*used to adjust the ramp height)*;
- Empty soup cans with smooth edges *(used as targets at bottom of the ramps);*
- Masking tape; and
- Ruler

- Ramp Exploration recording sheets (download here)

Room: This activity needs a lot of open floor space to allow youth teams the freedom to test and retest the engineering of their ramp systems.

Content:

- A force is a push or a pull on an object.
- Pushes and pulls can have different strengths and directions.
- Gravity is a force that pulls objects to the Earth.
- A ramp or inclined plane is a flat surface that always has one end higher than the other.

Angle of Incline: The steeper a ramp becomes, the more quickly an object will roll or slide down the incline and farther it will roll after leaving the ramp. A ball rolling down the steeper ramp (the one propped up on the taller boxes/books) will travel farther than a ball rolling down a less steep ramp.

Knocking Over Obstacles: A ball's ability to move or knock something over depends on momentum. The momentum of a ball depends on how fast the ball is going and how heavy it is. If two different balls are rolling at the same speed, the heavier ball has more momentum. If two balls the same weight are rolling, the ball that is rolling faster has more momentum.

Vocabulary:

Inclined Plane: An inclined plane, also known as a ramp, is a flat supporting surface tilted at an angle, with one end higher than the other, used as an aid for raising or lowering a load. The inclined plane is one of the six classical simple machines defined by scientists. Throughout history, humans have developed several devices to make work easier. The most notable of these are known as the Six Simple Machines: wheel and axle, the lever, the inclined plane, the pulley, the screw, and the wedge, although the latter three are actually just extensions or combinations of the first three.

Engineering: Engineering is the use of scientific principles to design and build machines, structures, and other items, including bridges, tunnels, roads, vehicles, and buildings.

Ramp: A ramp is a slope or inclined plane for joining two different levels, as at the entrance or between floors of a building.

Motion: In physics, motion is the phenomenon in which an object changes its position over time. Motion is mathematically described in terms of displacement, distance, velocity, acceleration, speed, and time.

Force: In physics, a force is any interaction that, when unopposed, will change the motion of an object. A force can cause an object with mass to change its velocity, i.e., to accelerate. Force can also be described intuitively as a push or a pull.

Inquiry:
Youth are to be encouraged to design their ramps and test the movement of the balls on their own without explicit direction from the facilitator thus eliciting youth to ask their own questions to guide this learning experience. Some potential questions to pose to youth throughout this activity include:

- How can you change the speed of the ball as it moves down the ramp?
- Can you find a way to make the ball go faster on the ramp? Slower?
- Are you helping the ball down the ramp or just letting gravity do the work?
- Are your results the same every time you roll the ball down the ramp?
- What happens if you move the soup can target further away from the end of the ramp?
- What would happen if your ramp was flat?

Facilitator Checklist for Preparation:

- ✓ Organization: I practiced the activity/technology, prepared materials/extras/place to record youth ideas, completed an activity (including timings).
- ✓ Materials: Materials are appropriate for teaching the learning goals; youth will be able to use them and will think they are appealing.
- ✓ Space Utilization: The space is set up appropriately for the activity and there will be no safety issues or distractions.
- ✓ Relevance: I have researched why the content matters to youth's everyday lives.
- ✓ Content Learning: I have become familiar with the content.
- ✓ Inquiry: I have become familiar with how authentic, age-appropriate inquiry practices look in this activity.

INTRODUCTION TO ACTIVITY (15 MINUTES)

Introduce the following vocabulary words.

1. **Force**
   Definition: Force is a push or a pull on an object.
   Example: When you pull a wagon full of pumpkins, you are using a "pull" force.
   Ask: Do you use a Push or a Pull force to pedal a bicycle? To close a door?

2. **Motion**
   Definition: Motion is an object changing position.

Example: When I push the pencil on my desk, it is in motion.
Ask: How would you move your desk to the back of the room?

Talk about today's Learning Targets with the class so that youth are aware of your expectations.

- ✓ "I can design and build a ramp that will let an object move."
- ✓ "I can observe the characteristics of a moving object."
- ✓ "I can change the speed of an object moving down a ramp."
- ✓ "I can share the results of my ramp experiment with the rest of the class."

Ask youth if they have ever experienced using a ramp before. Great examples of ramps in everyday life can be found at https://www.softschools.com/examples/science/inclined_planes_examples/481/

Divide youth into science investigation groups of two. Show the teams their Ramp Materials Box that you have already prepared for them to use with this experiment.

Facilitator Checklist for Introduction to Activity:

- ✓ Space Utilization: I will use the space informally avoiding the lecture hall format.
- ✓ Purposeful Activities: This intro section gets youth on track for the learning goal.
- ✓ Content Learning: If age appropriate, I will accurately present content.
- ✓ Inquiry: In this or another section of the activity, youth carry out one or more inquiry practices.
- ✓ Relationships: I will make each youth feel welcome.
- ✓ Relevance: In this or another section, I will guide the youth in a sustained discussion of how the activity relates to their everyday lives.
- ✓ Youth Voice: In this or another section, I will allow youth the opportunity to make decisions about their learning experiences.

ACTIVITY ENGAGEMENT (20 MINUTES)

Challenge youth to design and build **two different ramps** that are both the same length, but different heights using the materials provided. (*Ramps will be the same length because your Materials Box will only contain ramps (cardboard, wood, etc.) of the same length.)*

After the ramps are built, ask youth to suggest how they might compare the two ramps giving youth voice and agency in this active learning experience. Some examples might be:

- Youth might want to race balls down the ramps and see which one gets to the end of the ramp first or which ball goes the farthest;
- They might want to use the soup can as a target placed at the end of each ramp or some distance away from the end of the ramp and see if the balls can knock it down; or

- They could suggest using masking tape to create a finish line some distance from the bottom of the ramp and mark where each ball stops (before or after the finish line).

Next give youth the “Ramp Exploration” recording sheets and instruct them to choose how they are going to compare the two ramps from the examples discussed or using another method of their own. Ask teams to use side one of the recording sheet to draw and/or write about their ramps as they build and test them.

Remind youth as they’re experimenting with their two ramps that all scientists test their results several times and record data as they’re experimenting.

Challenge youth to let gravity to do its work to pull the balls down the ramps instead of allowing students to push the balls down the ramps.

Encourage youth to test different heights of ramps with different balls.

After about 10 minutes of open exploration, ask each team to crete a finish line 12” from the bottom of their ramp with masking tape. **Their final problem to solve will be to create a ramp that lets a ball stop on the finish line** (or as close to it as they can get).

A fun way to engage parents in your work is to create an Instagram account for your program that restricts subscriptions to families only. Then as the youth are constructing and testing their ramps, take photos of their work and post the photos on Instagram with questions for the families to ask their children. Possible photo tags could be:

- *What kind of ramp did you build today?*
- *What happened to the ball that rolled down you ramp?*
- *What surprised you about the ramp you built?*
- *What did your ramp make you wonder about?*

Facilitator Checklist for Activity Engagement:

- ✓ Space Utilization: I will use the space informally avoiding the lecture hall format.
- ✓ Participation: All youth will have access to the activity.
- ✓ Purposeful Activities: This core section helps youth to move toward the learning goal.
- ✓ Engagement: This activity has youth physically engaged with their hands while engaged with their minds.
- ✓ Inquiry: In this or another section of the activity, youth carry out one or more inquiry practices.
- ✓ Reflection: If appropriate, I will ask youth questions during the core activity tht will help them make sense of what they are learning.
- ✓ Relationships: I will take steps to share my enthusiasm and create a nurturing, safe learning environment.
- ✓ Relevance: In this or another section, I will guide the youth in a sustained discussion of how the activity relates to their everyday lives.

- ✓ Youth Voice: In this or another section, I will allow youth the opportunity to make decisions about their learning experiences.

FINAL REFLECTION AND RELEVANCE (15 MINUTES)

Think-Pair-Share

#1) Ask youth to sit quietly and think about the ramp experiment they just did (1 minute).

#2) Next ask youth to sit facing each other and talk to each other about what they now know about ramps with these prompting questions. What surprised them the most? What questions do they still have about ramps? What was the coolest thing they learned about ramps? (4 minutes)

#3) Next ask the youth teams to complete the back side of the Ramp Exploration recording sheet in drawings or text to record the discoveries that they have just discussed. (3 minutes)

#4) Ask each youth to share one special thing from today's Ramp Exploration activity with the class (giving each student an opportunity to present). (5 minutes)

Be sure to allow the last 2 minutes for clean-up.

Facilitator Checklist for Activity Reflection & Relevance:

- ✓ Space Utilization: Again, I will use the space informally.
- ✓ Participation: I will prompt youth who do not have access to the activity to participate.
- ✓ Purposeful Activities: The closing section helps youth to reach the learning goal.
- ✓ Content Learning: I will help youth make connections between different ideas. I will create opportunities for youth to ask questions/provide ideas that show a deeper level of understanding.
- ✓ Inquiry: In this or another section of the activity, youth carry out one or more inquiry practices.
- ✓ Reflection. I will provide youth with a sustained opportunity to make sense of their learning.
- ✓ Relevance: In this or another section, I will guide the youth in a sustained discussion of how the activity relates to their everyday lives.
- ✓ Youth Voice: In this or another section, I will allow youth the opportunity to make decisions about their learning experiences.

NGSS STANDARDS RELEVANT TO THIS ACTIVITY

PS2.A: Forces and Motion

- Pushes and pulls can have different strengths and directions. (K-PS2-1), (K-PS2-2)
- Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (K-PS2-1), (K-PS2-2)