Activity

Brackitz Ramps I – Engineering Lesson
Grades K-2

Objective:

Students will design ramps and observe how the slope and length of a ramp affects the speed of a ball traveling down the ramp. Each ramp must have the ball roll slowly for part of the ramp's distance and roll quickly for part of the distance.

Vocabulary Used in This Activity:

Ramp, angle, slope, length

NGSS Standards (Grades K-2):

- **K-PS2-2 Forces and Interactions: Pushes and Pulls**
  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.

- **3-PS2-2 Motion and Stability: Forces and Interactions**
  Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

- **MS-PS3-2 Energy**
  When the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system (i.e., relative amounts of potential energy by position).

Common Core Math Standards:

- **Kindergarten: Describe and Compare Measurable Attributes**

  CCSS.MATH.CONTENT.K.MD.A.1: Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.

- **Second Grade: Measure and Estimate Lengths in Standard Units**

  CCSS.MATH.CONTENT.2.MD.A.1: Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.

  CCSS.MATH.CONTENT.2.MD.A.3: Estimate lengths using units of inches, feet, centimeters, and meters.

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Time Needed:

Two days of 40-60 minutes each day.

Materials and Supplies:

- Brackitz components
- Models or videos of objects going down ramps
- Chart paper or board
- Small identical ball for each group (golf ball, lacrosse ball, ping pong ball)
- An engineering journal for each group to write and draw ideas for their ramps
- Protractor or angled level to measure angle of ramp slope
- Stopwatch to measure the time the ball moves over part of the ramp
- Tape measures to measure the different lengths of the ramp

Background:

- Have students give examples or view examples (videos?) of objects traveling down a ramp or hill. Such examples could be a sled or skier going down a hill, a child sliding down a playground slide, or a car rolling down a hill, like a Soap Box Derby race car.
- Ask the students to think about what they observed:
  - What caused the objects to move down the hill or ramp?
  - What could change how fast or slow something goes down a hill or ramp? List these answers on the board as a guide to help the students design their ramps. If not mentioned by the students, ask the students to consider if the steepness or length of a ramp would affect the object's speed.
- Show students how to create a very simple ramp for a small ball (golf ball, lacrosse ball, ping pong ball). Have groups of 2-3 students all build this simple ramp using Brackitz components and test them with the same type of ball.
- Ask students to think of how they would modify the simple ramp to make the ball go faster over a section of the ramp. Record their ideas on class chart paper or a board.

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- Ask them to consider how they would modify the ramp to make the ball go slower over a section of the ramp. Record these ideas on the class chart.
- **NOTE:** students may need to be shown how to measure distance with a ruler and angles with a protractor or calibrated level. They may also need to practice using a stopwatch and how to mathematically calculate speed by dividing distance by time.

Challenge:

- Inform students that they are to design a new toy ramp for the Brackitz company. Their new toy is to be a ramp that will let a ball roll slowly for part of the ramp's distance and then roll quickly for part of the distance. Tell them it doesn't matter if the ball goes fast or slow first as long as there is a definite change in the ball's speed on the ramp.
- **ASK:** Have students describe the problem in the **ASK** section of their journals.
- Tell the students they can use as many components as they want, but the total length of the ramp can be no more than 3 feet (or one meter).
- **IMAGINE:** Have students begin designing their ramps in the **IMAGINE** section of their journals.
- **PLAN:** Have students list the materials and steps they will use to design their ramps in the **PLAN** section of their notebooks.
- Have students build and test their designs. Use tape measures and stopwatches to record and calculate distance, time and speed of their ball for the slow and fast parts of their ramp.
- Use a protractor or calibrated level to measure and record the angle of the slope of the different sections of the ramp.
- Have students measure and record the speed (divide distance by time) of the ball over the slow and fast part of their ramps, and the angles of the fast and slow parts of their ramps.

Conclusion/Reflection:

- Ask students to demonstrate their ramps to the others in class.

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- **CREATE:** Have them explain how they designed their ramps to have a fast and a slow part. Did their idea work?
- What did they have a problem with in their challenge? How did they solve it?
- **IMPROVE:** What new ideas do they have to make the ball speed up and slow down?
- How is speed is related to the slope of the ramp?

Optional Ideas:

- Video the balls going down the ramps for discussion and more accurate observation and timing.
- Provide other materials to help speed the ball up or slow it down (i.e., cardboard inserts or similar for the ramp to make the surface smoother; use felt or other fabric to make the surface rougher).
- Try different types of balls.

Resources:

Book: *Roll, Slope, and Slide: A Book About Ramps* (Amazing Science: Simple Machines) Paperback – January 1, 2006 by Michael Dahl

Activity

Brackitz
Engineering Journal

Name(s): _____

Grade Level: _____ Teacher: _____

Date Started: ____/_____/_____

Date Completed: ____/_____/_____

ASK:

Describe the problem your design needs to solve.

_____

_____

_____

_____

_____

_____

_____

_____

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IMAGINE:

Draw some sketches of some possible solutions. Include notes about your ideas.

_____

_____

_____

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PLAN:

List the materials and tools you will use in your design.

1. _____
2. _____
3. _____
4. _____
5. _____

PLAN:

Describe or list the steps you will use to complete your design:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

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PLAN:

Draw your Final Solution. Include labels and measurements if possible.

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DATA:

Slow Part of the Ramp

1. Angle of the ramp at the slowest part: _____ degrees
2. Distance the ball traveled over the slowest part of the ramp: _____ inches
3. Time that the ball traveled over the slowest part of the ramp: _____ seconds
4. Speed of the ball over the fastest part of the ramp (divide the distance by the time): _____ inches per second

Fast Part of the Ramp

1. Angle of the ramp at the fastest part: _____ degrees
2. Distance the ball traveled over the fastest part of the ramp: _____ inches
3. Time that the ball traveled over the fastest part of the ramp: _____ seconds
4. Speed of the ball over the fastest part of the ramp (divide the distance by the time): _____ inches per second

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CREATE:

1. Did your design work the way you thought it would? _____

2. What problems did you have with your design?

_____

_____

_____

_____

_____

3. How did you solve your problems?

_____

_____

_____

_____

_____

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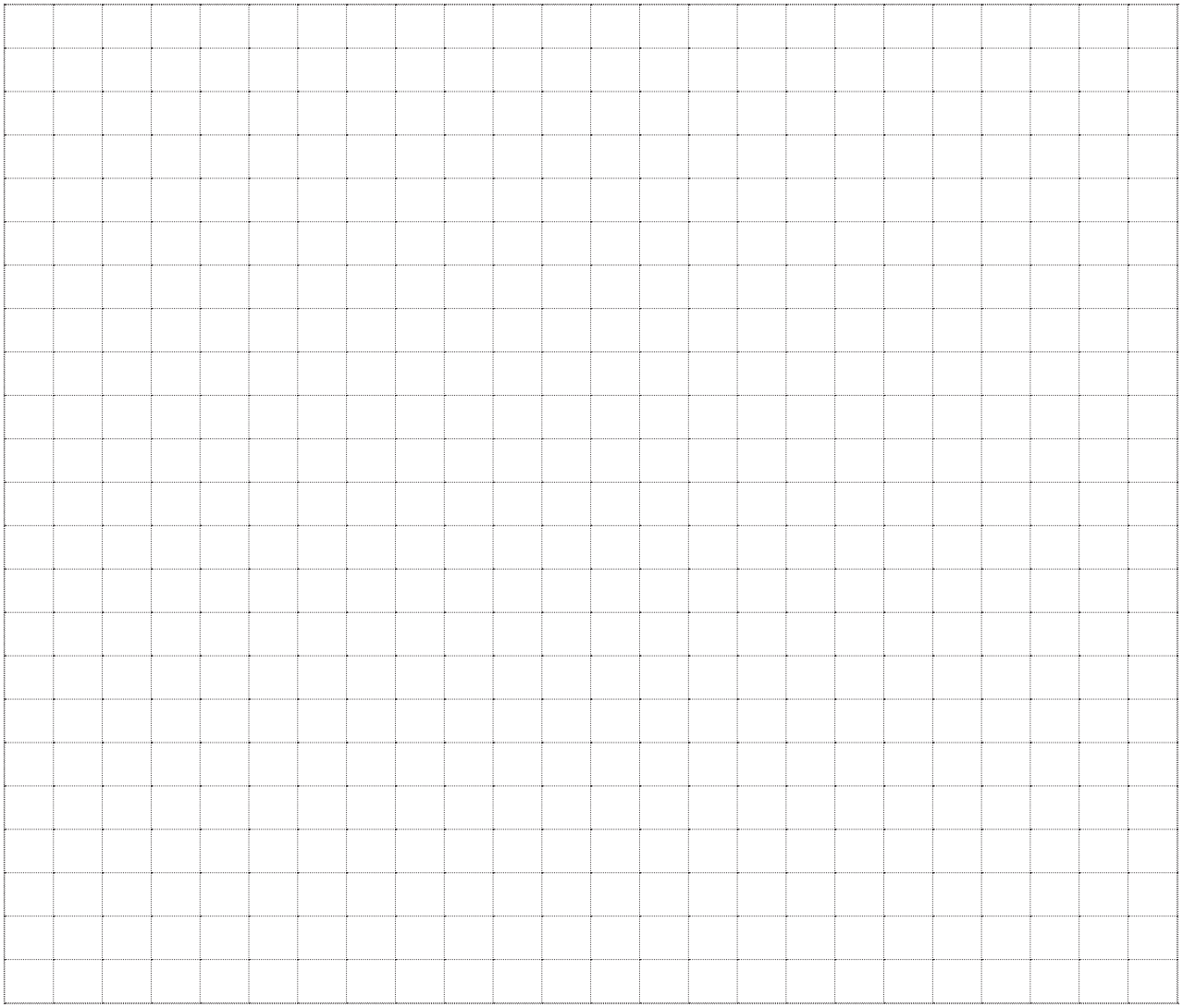
IMPROVE:

Show and tell how you would make your design better or different.



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