



4-H Club GO TO Resources



Month Year

Lesson Objectives:

Club members and parents will:

Investigate the relationship between the height of a ball rolling down an incline and its stopping distance when it rolls off the incline

Time: 20 –30 minutes

Equipment and supplies:

- A 2-meter ramp (ex: 5/8 inch aluminum channel) with support about 1/2 meter high
- Marble or steel ball
- Meter stick
- Carpet floor, or piece of flat carpet strip

Preparations:

- Review Lesson
- Gather equipment and supplies

Speedy Science

Discussion:

Mechanical energy is the product of force and distance. When we exert a force to change the energy of an object, we do *work* on an object. A measure of that work, or change in energy, is force x distance. Elevate a ball and we do work on it. With a force equal to its weight we lift it a certain height against gravity. The work done gives it *energy of position*—gravitational potential energy. Raise it twice as high and it has twice the energy. Another way of saying it has twice the energy is to say it has twice the ability to *do* work. When it rolls to the bottom of the incline it can do work on whatever it interacts with. If it has twice the energy, it can do twice the work. An easier-to-visualize example is that of a crate sliding onto a factory floor. In sliding, it does work on the floor and heat it up as it skids. This work is the force of friction x distance of sliding. The question is raised: Will it skid twice as far if it has twice the energy? We'll answer this question not by sliding crates down a ramp, but by rolling balls down inclines and then onto a carpet.

Procedure:

Step 1: Mark the ramp at 30 cm, 60 cm, 90 cm, and 120 cm from the bottom end. Assemble the ramp so that when you roll a ball down it, the length of it rolls onto is sufficient to stop it. Experiment to see how far this is.

Step 2: Release the steel ball at each of the intervals along the ramp. Measure the vertical height from the

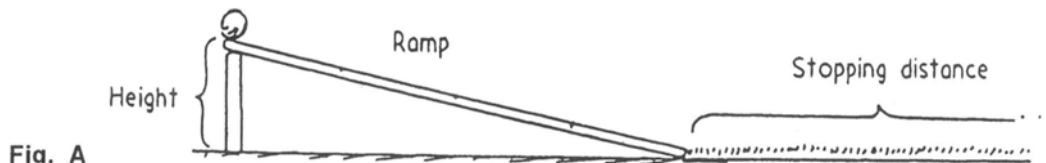


Fig. A

floor or table. Roll the ball three times from each height and record the stopping distances in Step 2 Data Table.

Step 3: Change the angle of the ramp, but launch the ball from the *same vertical height* that you did for the previous ramp position.

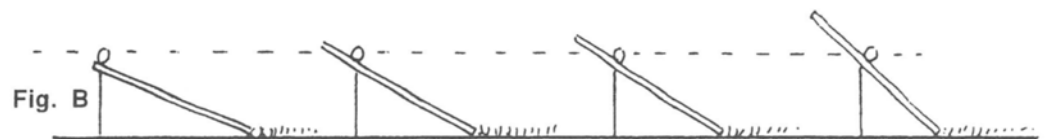


Fig. B



Going Further: On the graph paper provided by your instructor, construct a graph of average stopping distance (vertical axis) versus height (horizontal axis) for the ball in step 2.

Summing Up:

1. Do the graphs indicate direct proportions between height of release and stopping distance?

2. Would you get the same relationship between distance up the ramp (parallel to the ramp rather than height) and stopping distance? Why or why not?

3. How did the stopping distances for the different balls compare? How did the relationship between release heights and stopping distances compare?

Step 2 DATA

Initial Position of Ball (cm)	Initial Height of Ball (cm)	Stopping Distance (cm) Trial 1	Stopping Distance (cm) Trial 2	Stopping Distance (cm) Trial 3	Average Stopping Distance (cm)
30					
60					
90					
120					

Step 3 DATA

Initial Position of Ball (cm) *	Initial Height of Ball (cm) **	Stopping Distance (cm) Trial 1	Stopping Distance (cm) Trial 2	Stopping Distance (cm) Trial 3	Average Stopping Distance (cm)

*Because the angle is different, these will no longer be 30cm, 60cm, 90cm, and 120cm.

**These values must be the same as the value in the STEP 2 DATA table.

University of Illinois Extension — Unit 2 — Boone, DeKalb, Ogle Counties

Boone County Extension Office

205 Cadillac Court, Unit 3

Belvidere, IL 61008-1733

Phone: 815-544-3710

Program Coordinator: Melissa Irwin

Email: mmirwin@illinois.edu

DeKalb County Extension Office

1350 West Prairie Drive

Sycamore, IL 60178-3166

Phone: 815-758-8194

Program Coordinator: Nicole Groezinger

Email: groezing@illinois.edu

Ogle County Extension Office

421 W Pines Rd, Ste 10

Oregon, IL 61061

Phone: 815-732-2191

FAX: 815-732-4007

Program Coordinator: Jodi Baumgartner

Email: jbmgrtnr@illinois.edu

Unit 2 Educator: Johnna Jennings

Email: jbennin@illinois.edu



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Sources & Additional Lesson info:

4-H Club GO TO Resources is being offered to 4-H clubs in Boone, DeKalb and Ogle Counties as a way to enrich and enhance 4-H experiences and programming at the club level. It is the goal of the Extension staff to assist 4-H leaders and officers in providing simple hands-on activities on a monthly basis that can broaden the 4-H club experience and as a result heighten positive youth development.

The “Rolling Stop” activity was adopted from the Conceptual Physical Science Explorations Curriculum. Energy: Transformations, pages 19-20. Publisher: Pearson

Prepared by: Jodi Baumgartner, 4-H Youth Development Program Coordinator

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