week 4

Cow-a-Bungee

Create a bungee jump (from the top of a bookshelf or tall cabinet) whose object has the most caroms from one jump.

Subjects and Skills

- Graphing lines using x- and y-axes (plotting coordinate points on a graph, slope, y-intercepts, creating a function)
- Kinetic energy, potential energy, gravity, rebound, carom

Materials

- Rubber bands
- Tape
- Rulers
- Graph paper
- Plastic animal (preferably a cow) or other "bungee jumper" object
- Bungee jumping site (bookshelf or other tall object)

Vocabulary

- Slipknot
- Bungee
- Potential energy
- Kinetic energy
- Gravity
- Carom
- Rebound
- Synthetic
- Slope
- x-axis
- y-axis
- y-intercept

Purpose

Applying statistics and algebraic functions to gain an understanding of the relationship between elasticity and energy will give students a better understanding of mathematical principles.

Objectives

Students will:

- determine the number of rubber bands needed to allow an object to bungee,
- plot coordinate points on a graph,

- learn the basic concepts of slope and y-intercepts,
- create a function, and
- solve equations to make predictions.

Activity Preparation

1. Run off activity sheets.
2. Gather materials and place them in two different areas of the room.
3. Bookmark websites to be used in class.
   a. http://www.iwillknot.com and/or http://www.wikihow.com/Make-a-Slip-Knot
   b. http://encyclopedia.kids.net.au/page/ho/Hooke's_law
   c. http://inventors.about.com/cs/inventorsalphabet/a/rubber_2.htm
   d. http://teachertube.com/viewVideo.php?title=Barbie_Bungee&video_id=198832
   e. http://www.metacafe.com/watch/46124/bungee_jumping_in_new_zealand

Activity Procedure

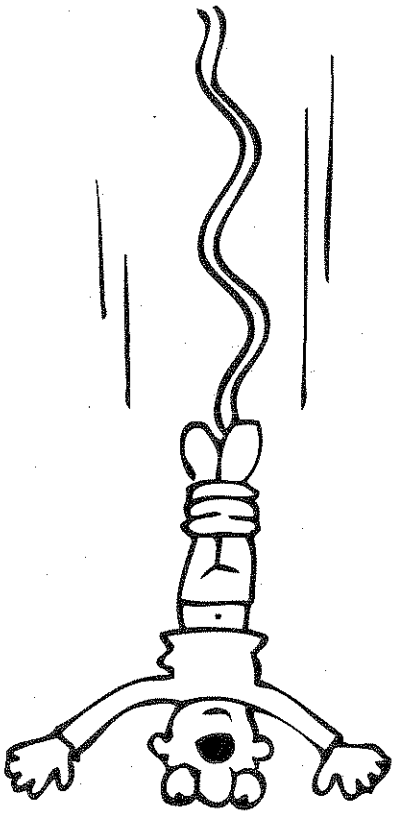
1. Hold up a rubber band and ask the students to brainstorm its possible uses.
2. Demonstrate how the rubber band is able to move by being stretched and released.
3. Distribute rubber bands to students to practice slipknots. Teach students to make a slipknot with Link a. and/or the instructions on the activity sheet. Continue the discussion of rubber bands.
4. Review the concepts of kinetic and potential energy.
5. Distribute graph paper to introduce or review the terms/concepts of x-axis, y-axis, y-intercept, and slope. You can discuss these as simple concepts: The x-axis is the horizontal line; the y-axis is the vertical line; the y-intercept is the exact pair of coordinate points at which a line crosses over the y-axis; the slope is the steepness of a line from one coordinate point to another.
6. Optional: Introduce Hooke's law of elasticity (this states that the extension of a spring is in direct proportion with the load applied to it). For more information, visit Link b.
7. Discuss information on the history of rubber and/or synthetic elastic from Link c.
8. Show the images that come up when you run an image search for the phrase "bungee jumping." Show the video (01:27) of Barbie bungee jumping at Link d. You may also show a video (01:51) at Link e. of the

jump from Kawarau Suspension Bridge, the site where bungee jumping gained popularity in 1988.

9. Put students into small groups, and assign group numbers.
10. Discuss the activity sheet and the team challenge, addressing any questions that students may have.
11. Students will collect data using bungee cords of varying lengths of rubber bands that will allow an object to fall as close as possible to the ground without hitting it. As each drop occurs, students record and graph their data, and then conduct an analysis to determine the linear equation. This may work best if you have numerous challenge sites of the same height in order to save time. Also, all teams should use the same object or objects of standard weight in order to make the challenge fair.
12. Have students complete their activity sheets once the challenge is completed. If students are ready, introduce and/or review the concepts of slope and y-intercept. Discuss the relationship between the graph and the experiment.
13. If you wish, assign one of the activities suggested in Extend the Learning With Bungee Jumping: Activities.

Name: _____ Date: _____

Cow-a-Bungee



GOAL

- Create a bungee jump (from the top of a bookshelf or tall cabinet) whose object has the most caroms from one jump.

MATERIALS

- Rubber bands
- Tape
- Rulers
- Graph paper

TIME TO CREATE

- 20 minutes

INDIVIDUAL ACTIVITY

Read the following information, highlighting key terms and ideas, and complete the activities.

The word bungee means "thick and squat." Bungee jumping originated on the Pacific island of Pentecost as a ritual. For centuries, the native men tested their manhood by jumping from tall bamboo towers, approximately 20–30 meters (260–400 yards), with vines tied to their ankles. Bungee jumping arrived in the United States in 1979 when members of the Oxford University Dangerous Sports Club jumped from the Golden Gate Bridge on elastic latex cords.

The height of the bungee above the ground creates a certain amount of potential energy. When the jumper jumps off, this potential energy is converted into kinetic energy and will continue to increase the speed during the fall. The bungee cord will kick in during the carom, or rebound, process and will begin transforming the kinetic and potential energy to elastic energy, which is stored in the cord and is the reason it stretches. Once the bungee stops, most of the potential energy and all of the kinetic energy have been converted to elastic energy.

You may already know that a rubber band is an elastic loop of natural or synthetic rubber used to hold objects together. But did you know that the use of rubber has been around for thousands of years? The Olmecs, a pre-Columbian civilization in South America, utilized the natural latex from the Hevea tree around 1500 B.C. Later, the Mayan people used this latex, or rubber, for various purposes. Latex, the sap of certain plants—specifically, the rubber tree—when exposed to the air, hardens and become rubbery. The rubber band was not officially invented until 1845, when a man by the name of Stephen Perry invented the rubber band to hold papers and envelopes together.

Today, we use both natural and synthetic rubber. Natural rubber is the latex that is extracted from rubber trees, similar to how the Mayans accessed rubber. Synthetic rubber is made from refining byproducts of petroleum. Most of the rubber produced today is synthetic.

Place a rubber band on your desk and draw its relaxed shape in the space provided.

Name two different ways we use rubber today.

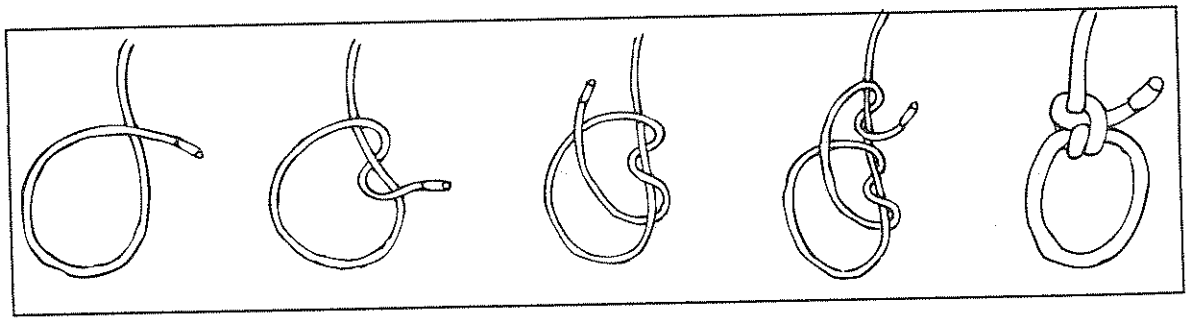
1. _____

_____

2. _____

_____

Continue to practice making a slipknot with your rubber band. If you need a reminder about how to make a slipknot, here are some illustrations:



TEAM CHALLENGE

Participants will work in teams of two or three to create a bungee jump for a plastic animal (or a substitute object). The bungee must be designed for the participant (object) to safely bungee from the top of a typical bookshelf or tall structure. No part of the participating bungee-jumper (object) may touch the ground, and neither can it touch any other object (e.g., bookshelf), during the bungee process. The participant must carom (rebound) at least once; however, the challenge is for your bungee to have the most caroms.

The teacher will select groups of two or three for the team challenge and will assign a number to each group. Once teams have been selected, the teacher will record the start time. You will have exactly 20 minutes to get your supplies, make your team's bungee, and record the information. Your goal is to make a bungee jump from the top of a bookshelf or tall cabinet and to have the most caroms from one bungee jump.

A designated plastic participant must carom at least once and must not touch any object or the ground throughout the process.

Start Time _____:_____ + 20 Minutes = _____:_____ End Time

1. Attach a rubber band to the participant (object) by creating a slipknot, or double loop, to wrap around the object. Securing one rubber band to another with a slipknot will create a double loop.
2. Continue to attach more rubber bands to the first one in order to lengthen the cord. Measure the distance the object falls on the first drop. Repeat the jump two more times and record the distance.

Number of Rubber Bands	3	5	7
Distance in Inches			
Number of Caroms			

3. What is the average for the distance of the three jumps? _____
4. Continue adding rubber bands and measuring the distances. Use graph paper to plot the information. Label the x-axis as Number of Rubber Bands Used, and the y-axis as Distance in Inches.
5. Connect the points.
6. Predict the distance of the drop if you were to use 100 rubber bands. How did you get this prediction? _____
7. Express the equation for how to predict the distance of the drop (y) from how many rubber bands are used (x). _____
8. What is the slope of your equation? _____
9. What is the y-intercept of your equation? _____
10. How many rubber bands did you need for the participant to have a successful bungee? _____
11. What could be done to improve your team's bungee? _____

EXTEND THE LEARNING WITH BUNGEE JUMPING: ACTIVITIES

1. **Effects of gravity.** Consider the effects of gravity, and consider the speed at which a bungee participant falls during the jump. What is the speed 1 second after the jump starts? What is the speed at the bottom of the jump? Do research so that you can write a paragraph about how gravity affects the speed of a jump.
2. **Bungee jumping in reverse.** How do you apply the concepts we have already learned when thinking about bungee jumping in reverse? Review the video at http://www.snotr.com/video/1022 and write a paragraph about the differences in speed, elasticity, distance of carom, and so on.
3. **Bungee evolution.** Bungee jumping has evolved so that there are now many ways for thrill seekers to get their adrenaline fix: There is horizontal bungee jumping, reverse bungee jumping, and more. Using the concepts we've learned about, think of another way bungee jumping could evolve. Draw a picture of your new sport, labeling the parts of the picture and providing written explanation where necessary.
4. **Hooke's law of elasticity.** Research Hooke's law online. Make a list of the ways this law is useful to engineers and designers, including potential applications.
5. **Bungee interactive games.** Visit one of the following sites to play an interactive bungee game:
   - Bungee Rescue: http://www.freeworldgroup.com/games6/gameindex/bungee-rescue.htm
   - Bungee Bandit: http://www.newgrounds.com/portal/view/260318
6. **Experiment on stress of elastic limit.** Stress is an applied force that causes a material to be deformed (bent out of shape). Elastic materials are able to return to their original shape after being deformed, but even a rubber band has an elastic limit. If the rubber band is stretched too much, it doesn't return to its original shape. The elastic limit of a material is the maximum force on a material that results in the material returning to its original shape after the force is removed. Any stress less than the elastic limit will result in the material returning to its original shape. Any stress greater than the elastic limit will result in the material not returning to its original shape. Study the effects of the elastic limit on different-sized rubber bands, balloons, gummy worms, and other elastic items. Decide the stress limits in relationship to the item's elastic limit. Using a ruler, record the length of the object before the stress was applied, and at its furthest stretch mark. Experiment with five objects and record your results.