

# The Amazing Trampoline Act

*Make a trampoline that will provide an object with the highest rebound.*

## Subjects and Skills

- ◆ Physical science
- ◆ Kinetic energy, potential energy, friction
- ◆ The history of trampolines (recreational, in wars)

## Materials

- ◆ Fabric scraps
- ◆ Sheets of plastic
- ◆ String or yarn
- ◆ Coffee containers
- ◆ Rubber bands
- ◆ Shoe boxes
- ◆ Paper clips
- ◆ Golf balls or marbles

## Vocabulary

- ◆ Tether
- ◆ Trampoline
- ◆ Rebound
- ◆ Kinetic energy
- ◆ Potential energy
- ◆ Bounce
- ◆ Friction

## Purpose

Understanding how bounce is created and how physics affects rebound is important in engineering. Students will apply kinetic and potential energy and Newton's laws of gravitation to their trampoline designs.

## Objectives

Students will gain a better understanding of:

- ◆ the history of the trampoline,
- ◆ kinetic and potential energy,
- ◆ friction,
- ◆ creating rebound,
- ◆ finding measurements to the nearest 1/8 of an inch, and

- ♦ applying the equation  $E = KE + PE$  (total energy = kinetic energy + potential energy).

### 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.funny-games.biz/trampoline.html>
  - b. <http://www.cbc.ca/kids/games/trampoline>
  - c. <http://scratch.mit.edu/projects/goalkeeper/1519921>
  - d. <http://scratch.mit.edu/projects/dapontes/843278>

### Activity Procedure

1. Start off the lesson by asking, "What do Eskimos (Inuit-Yupiks), fire fighters, and circus performers have in common?" After students guess, say that they all use a form of trampolines either for recreation or for their careers. Ask if students have ever jumped on a trampoline. After discussion, distribute the activity sheet. To further discussion, ask how Eskimos might have used trampolines. (Eskimos would use a walrus skin to play with their children. They would throw the child up into the air and then catch them with the walrus skin.) Ask how fire fighters use trampolines (to help people jump out of burning buildings).
2. Continue reading the history of trampolines. Discuss ways trampolines have been used in the military: They helped train aerial awareness through providing aerial orientation, reduced fears of falling, gave practice being upside down and revolving in midair, developed balance and body control while being in midair, and provided mental and physical conditioning (e.g., cardiovascular endurance, muscle tension in arms, legs, and abdominals).
3. Discuss the concept of rebound. Rebound means to spring or move back.
4. There are several interactive trampoline games to demonstrate bounce. Go to Link a., Link b., and/or Link c.
5. Review kinetic and potential energy. (Kinetic energy is the movement of an object. Potential energy is energy stored in an object.) With the trampoline example, potential energy is the energy in the stretched springs; kinetic energy is the action of the net and/or the object on the net.
6. Ask students to explain bounce (a change in direction of motion after hitting an obstacle) and friction.
7. Review the answers for Question 9. When a ball is held up in the air it has **potential** energy but no **kinetic** energy. When it is let go, it starts falling because of **gravity**, and as it falls its **potential** energy is reduced, while its

kinetic energy increases. After it hits the ground, the ball should bounce back a little lower than the height at which it was dropped. So after the first bounce, it has less potential energy than it did originally because of **friction**. When the ball bounces, it changes shape slightly. The compression and change in shape is friction that converts some of the kinetic energy in the form of heat, or thermal energy.

8. Help students understand  $E = KE + PE$  (total energy = kinetic energy + potential energy) with the interactive at Link d.
9. Review the team challenge, answering any questions that students may have. Hold the challenge in whatever manner is easiest and most appropriate for your classroom.
10. Once the challenge has been completed, allow students to finish their activity sheets.
11. If you wish, use *Extend the Learning With Trampolines: Teacher Guide* to help you guide the students to create their own trampoline computer games.

# The Amazing Trampoline Act

## GOAL

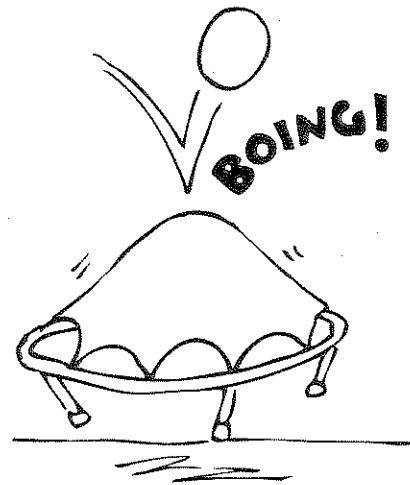
- Make a trampoline that will provide an object with the highest rebound.

## MATERIALS

- Fabric scraps
- Rubber bands
- Sheets of plastic
- Shoe boxes
- String or yarn
- Paper clips
- Coffee containers
- Golf balls or marbles

## TIME TO CREATE

- 20 minutes



## INDIVIDUAL ACTIVITY

Read the following, highlighting important information, and then answer the questions.

What do Eskimos (Inuit Yupiks), fire fighters, and circus performers have in common? They all use a form of trampolines for either recreation or their careers.

The actual creation of the trampoline in its modern form is credited to two men: George Nissen and Larry Griswold. Around 1935, Griswold, an assistant gymnastics coach at The University of Iowa, and Nissen, a tumbler on The University of Iowa gymnastics team, developed the idea of a “bouncing rig” from observing trapeze performers practice with tumbler nets. The men altered the tumbler net by attaching a large piece of stretched canvas to an iron frame, using coil springs as a tether, and created the “bouncing rig.” On a trip to Mexico, Nissen heard the word *trampolin*, which means diving board in Spanish. Nissen liked the sound of it and decided to change the spelling and call his new bouncing rig a trampoline. In addition to being used by fire fighters, gymnasts, and circus performers, during World War II, trampolines proved to be an integral part of military training for both pilots and naval cadets.

Do you remember why Sir Isaac Newton is famous? If you think it’s because he discovered the law of gravity, you’re partially correct. Newton did not actually discover gravity; he merely defined it mathematically. Newton’s Law of Universal Gravitation explains that the greater an object’s mass, the greater its gravitational force.

1. What is the purpose of a tumbler net? \_\_\_\_\_
2. How might trampolines have helped with training pilots during World War II? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

3. Define rebound. \_\_\_\_\_  
\_\_\_\_\_
4. How would you measure the rebound of an object such as a golf ball? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
5. Approximately how long would it take for a.) a feather dropped from your school's roof to reach the ground? \_\_\_\_\_ b.) a rock dropped from your school's roof to reach the ground? \_\_\_\_\_ What is the difference in your estimations? Explain why there might be a difference in the amount of time for these items to reach the ground. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
6. Kinetic and potential energy are related to Newton's ideas. Briefly explain the energies below.  
Kinetic: \_\_\_\_\_  
Potential: \_\_\_\_\_
7. Explain kinetic and potential energies using a trampoline as an example. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
8. What is bounce? \_\_\_\_\_  
\_\_\_\_\_
9. When a ball is dropped and hits the floor, it stops. At this point, the molecules of the ball will be compressed in some places and stretched apart in others; this is an example of friction. Friction is the force that creates resistance when coming into contact with a moving object. Complete the following sentences: When a ball is held up in the air it has \_\_\_\_\_ energy but no \_\_\_\_\_ energy. When it is let go, it starts falling because of \_\_\_\_\_, and as it falls its \_\_\_\_\_ energy is reduced, while its \_\_\_\_\_ energy increases. After it hits the ground, the ball should bounce back a little lower than the height at which it was dropped. So after the first bounce, it has less potential energy than it did originally. Why? \_\_\_\_\_
10. The equation  $E = KE + PE$  (total energy = kinetic energy + potential energy) can be used to find the energy of the jump. In the jump, kinetic energy decreases due to the velocity of the jump, and potential energy increases. Therefore, the greater the speed and force of the jump, the larger the jump will be. Think about how the design of a trampoline could cause the greatest rebound of an object. List the elements that are important for this to occur: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## TEAM CHALLENGE

Participants will work together in teams of two or three for 20 minutes to make a trampoline that provides the highest rebound of a golf ball or a marble. Each team will have three tries.

When the teacher starts the time, your team will have exactly 20 minutes to gather your supplies and build your trampoline. When the teacher signals that the time is up, stop working immediately and take your trampoline to the test site. Any team that continues to work after time has been called may be disqualified.

Start Time \_\_\_\_\_: \_\_\_\_\_ + 20 Minutes = \_\_\_\_\_: \_\_\_\_\_ End Time \_\_\_\_\_

Record measurements to the nearest  $\frac{1}{8}$  inch of the height of the rebound.

Trial 1: \_\_\_\_\_ inches

Trial 2: \_\_\_\_\_ inches

Trial 3: \_\_\_\_\_ inches

After the challenge, complete the following questions:

1. What materials did your team use that would provide the best advantage? \_\_\_\_\_
2. What was the difference between the highest and the lowest rebounds for your team? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
3. Record the class's lowest rebound. \_\_\_\_\_
4. Record the class's highest rebound. \_\_\_\_\_
5. What was the difference between the class's lowest and highest rebounds? \_\_\_\_\_
6. What makes a trampoline provide a better rebound? \_\_\_\_\_
7. What design modifications could be made to make a better trampoline? \_\_\_\_\_
8. How might trampolines and/or the principles of trampolines help us in the future? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## EXTEND THE LEARNING WITH TRAMPOLINES: TEACHER'S GUIDE

Guide students in designing a bouncing ball or pong game. Visit <http://scratch.mit.edu>. Designed with learning and education in mind by the Massachusetts Institute of Technology, Scratch is a free program that makes it easy to create interactive stories, animation, games, music, and art. Students will develop important design and problem-solving skills, apply creative thinking, reason systematically, and work collaboratively.

A teacher's forum is available at <http://scratched.media.mit.edu/discussions/new-forum> for collaboration, teaching strategies, and information. Even if you don't consider yourself a techie, your students will definitely benefit from learning their way around the techie world. The trampoline lesson is a great segue into the technical arena. Tell students they will be navigating this site in order to create their own games involving the concepts they have learned in this lesson, keeping it fairly open ended.

It's best to schedule the time in a computer lab and allow the students to navigate the site and figure it out largely on their own. You do not actually need to know how to use the site—you only need to facilitate. Print the information at <http://www.smm.org/ltc/files/simplegame.pdf> to guide students along this extension project.