



BOUNCING BALLS!

BENCHMARKS and TASKS

SC.B.1.2.4 The student knows the many ways in which energy can be transformed from one type to another.

SC.C.1.2.1 The student understands that the motion of an object can be described and measured.

SC.C.2.2.2 The student knows that an object may move in a straight line at a constant speed, speed up, slow down, or change direction dependent on net force acting on the object.

SC.C.2.2.4 The student knows that the motion of an object is determined by the overall effect of all of the forces acting on the object.

- The student identifies force as any push or pull (e.g., gravity, electricity, and magnetism) that causes objects to change their state of motion. The greater the force is, the greater the change in motion.
- The student describes the motion of an object by its position, direction, and speed.
- The student uses scientific tools (e.g., stopwatch, meter stick) to measure the speed and distance traveled by an object and displays the data in a graphic representation.
- The student traces the flow of energy as it is converted from one form to another (e.g., potential to kinetic) through a system.
- The student demonstrates how inertia (an object's tendency to resist a change in motion), gravity, friction, and mass affect motion.

KEY QUESTION

What will happen if the same ball is dropped from the same height onto the same surface over and over again?

BACKGROUND INFORMATION

Sir Isaac Newton discovered basic laws about how things move. His first law of motion states that objects at rest remain at rest and objects in motion remain in motion unless acted upon by an external **force** - a push or pull - that sets them in motion. **Gravity** is a force that's always pulling things down toward the center of the planet. A tablecloth can be pulled out from underneath a set of dishes, if it is pulled quickly. This is because the dishes have **inertia**, a tendency to remain at rest. A bowling ball, once in motion, will continue in a straight line forever, unless it hits the pins, or **friction** eventually supplies the force to slow it down.

In this activity, a force, gravity, acts upon the ball to pull it down when it is dropped. The force of the surface acts upon the ball to push it back up. The ball changes direction (acceleration). However, the ball does not bounce back to its original height because some **energy** is absorbed by the surface on which it was dropped. Some of the energy is changed into **heat** energy in the collision.

As you hold each ball, it has stored, or **gravitational potential energy**. The higher the ball is held, the greater the amount of potential energy. When you drop the ball, the potential **energy is transformed** to **kinetic energy**, energy of motion.

MATERIALS

Per group of 3

crayons
Bouncing Balls! activity sheet
tape
1 tennis ball
variety of other balls (e.g., Ping-Pong ball, rubber ball)

Teacher

1 kick ball
1 long sheet of white paper
tape

TEACHING TIP

Measurement is never exact. A measurement can always be taken to another, more precise decimal place. Measuring a ball in motion is even more difficult. Students should realize that their measurements are only approximations.

ENGAGE

1. Place a kick ball on your desk and wait for it to move under its own power. Ask the students, Will the ball move on its own? (No way! A body at rests stays at rest unless acted upon by some force.)
2. Stand beside a wall on which you've taped a long strip of paper. Drop the kick ball from chest height while a student marks the height to which the bottom of the ball bounces. Ask students to predict what will happen when you drop the ball again from the same height. Record their predictions and tell them you will return to this after they have had the opportunity to explore this idea .

EXPLORE

1. Explain that students will measure the bounciness of balls by comparing how high each ball bounces. Divide the class into groups of three and distribute the materials.
2. Tape the activity sheet to the wall or to a heavy book so that the sheet stands on a flat surface such as a desk top or floor.
3. Have each of the three group members take turns dropping a tennis ball from the top number (1.0) on Part 1 of the activity sheet onto the surface in front of it while another student watches the numbers and points to the spot to which the bottom of the ball bounced.
4. Tell ball-droppers to mark the activity sheet to show how high the ball bounced.
5. Repeat dropping the tennis ball two more times. Remind each student to mark how high the tennis ball bounced each time.
6. Average the three heights to which the tennis ball bounced. Color the bar graph on Part 2 of the sheet for ball 1, the tennis ball.
7. Let students experiment with three other kinds of balls. Record three tries for each type of ball.
8. Have students label the charts with the type of ball they are using and make a mark to show the level to which the ball bounced each time.
9. Students should color the bar graph in Part 2 to show the data collected for the three other types of balls.

EXPLAIN

What does your data show? (The same ball dropped from the same height onto the same surface always bounces up to about the same point. Gravity acts on the ball the same way each time.)

How high did the tennis ball bounce each time? Why do you think so?

Did all of the balls react in the same way?

What makes the ball bounce? (Gravity pulls the ball straight down when it is dropped. When the ball hits the hard surface [an outside force] it changes direction and is pushed back into the air. An object at rest will remain at rest, and an object in motion will continue moving in a straight line at a constant speed until an outside force acts on it.)

What is this tendency for an object to resist a change in motion called? (inertia)

When did potential energy transform to kinetic energy? (When the balls were held above the table, they had gravitational potential energy. When the balls were released, the potential energy transformed to kinetic energy.)

EXTEND/APPLY

1. Return to the Engage activity. Ask student to look at their earlier predictions and ask if they would like to change them based on what they have learned.
2. Drop the kick ball two more times from the same height and each time have a student mark the bounce height on the paper. Students should be able to see that the same ball dropped from the same height onto the same surface always bounces up to about the same point.



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PART 1

PART 2

1.0	
.9	
.8	
.7	
.6	
.5	
.4	
.3	
.2	
.1	

1.0	BALL 1	BALL 2	BALL 3	BALL 4
.9				
.8				
.7				
.6				
.5				
.4				
.3				
.2				
.1				

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