QuickView

Students calculate the speed of varying-sized clay balls launched from the catapult.

Standards Addressed

NSTA 5-8
Students develop abilities necessary to do scientific inquiry.

- Students use appropriate tools and techniques to gather, analyze, and interpret data.
- Students think critically and logically to make the relationships between evidence and explanations.
- Students use mathematics in all aspects of scientific inquiry.

Students develop understandings about scientific inquiry.

- Students understand mathematics is important in all aspects of scientific inquiry.

Students develop abilities for technological design.

- Students evaluate completed technological designs or products.

NCTM 6-8
Students understand numbers, ways of representing numbers, relationships among numbers, and number systems.

- Students work flexibly with fractions, decimals, and percents to solve problems.

Students understand meanings of operations and how they relate to one another.

- Students understand the meaning and effects of arithmetic operations with fractions, decimals, and integers.

Students compute fluently and make reasonable estimates.

- Students select appropriate methods and tools for computing with fractions and decimals from among mental computation, estimation, calculators or computers, and paper and pencil, depending on the situation, and apply the selected methods.

Students represent and analyze mathematical situations and structures using algebraic symbols.

- Students develop an initial conceptual understanding of different uses of variables.
- Students recognize and generate equivalent forms for simple algebraic expressions and solve linear equations.

Students understand measurable attributes of objects and the units, systems, and processes of measurement.

- Students understand both metric and customary systems of measurement.

Students apply appropriate techniques, tools, and formulas to determine measurements.

- Students select and apply techniques and tools to accurately find length, area, volume, and angle measures to appropriate levels or precision.
- Students solve simple problems involving rates and derived measurements for such attributes as velocity and density.

Students solve problems that arise in mathematics and in other contexts.

Students recognize and apply mathematics in contexts outside of mathematics.

ITEEA 6-8
Students develop the abilities to apply the design process.

- Students learn to apply a design process to solve problems in and beyond the laboratory-classroom.
- Students learn to make a product or system and document the solution.

Students develop the abilities to assess the impact of products and systems.

- Students learn to design and use instruments to gather data.

NCTE K-12
Students read a wide range of print and nonprint texts to build an understanding of texts, of themselves, and of the cultures of United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment.

Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate texts; they draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies, and their understanding of textual features.

Students adjust their use of spoken, written, and visual language to communicate effectively with a variety of audiences and for different purposes.

Students use spoken, written, and visual language to accomplish their own purposes.

Time Required

45-90 minutes (will vary with class size)

Content Areas

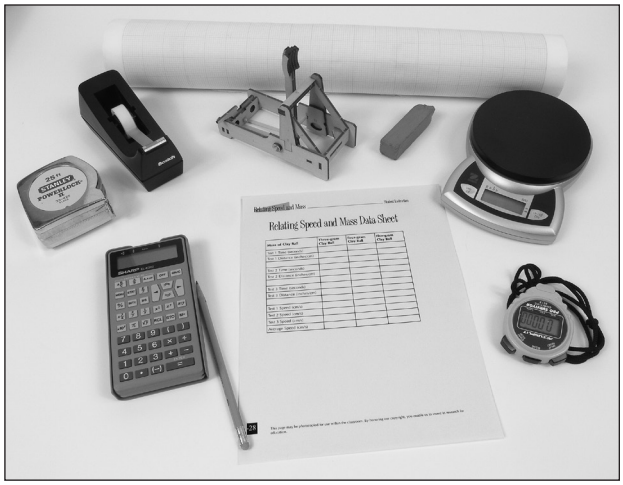
Primary: Math
Secondary: Science, language arts, technology

Vocabulary

- catapult
- centimeter
- gram
- mass
- projectile
- speed

Materials

- "Relating Speed and Mass Data Sheet"
- Pencil
- Calculator
- Built Pitsco Catapult
- Modeling clay
- Digital scale or digital balance
- Stopwatch
- Tape measure
- Pitsco Range Paper
- Tape



Procedure

1 Locate the block of modeling clay. Using the modeling clay, construct three clay balls, each having a mass of three grams, four grams, and five grams, respectively. Measure the mass of each clay ball using the digital scale or digital balance and record these numbers in the "Relating Speed and Mass Data Sheet."

The digital scale needs to be calibrated to zero before any measurements are taken. A quick overview of how to use the balance may be needed.

2 Find an area where the test can be conducted. Roll out approximately six meters of the Pitsco Range Paper and tape the corners of the paper to the surface (floor) to hold it in place. Make a straight line, across the width of the paper, about 30 centimeters from one end.

Make sure the area is free from structures that could obstruct the flight of the projectile. Ideal places are a clear section of a classroom, hallway, or gymnasium.

3 Line up the front of the catapult with the line on the Range Paper. This launch position will act as a measuring point for each firing sequence. Make sure to place the catapult on this line before every launch to obtain accurate measurements.

Be sure to stress the importance of lining up the catapult on the marked line every time the catapult is fired. Failure to due so will result in inaccurate results.

4 Lock the firing arm into the launch position using the trigger. Load the three-gram clay ball onto the firing arm scoop. Using the stopwatch, measure the total amount of time from the release of the trigger to the landing of the clay ball. Record this time in the Test 1 Time field on the "Relating Speed and Mass Data Sheet."

Have students record the exact reading on the stopwatch. This will produce more accurate results. Students will need to work in teams of three for launching, timing, and marking the landing of projectiles.

5 After the first launch is completed, the clay ball should leave a small mark upon the Range Paper. Label this mark appropriately such as "three grams – 1st launch."

One student should operate the catapult while a second student labels the clay ball markings. A third student will operate the stopwatch. The student team should take turns at each station. Different colors of clay can be used to identify the different sizes of clay balls.

6 Repeat this testing process for each clay ball three times, making sure to record the time as well as label the markings appropriately. Three launches will provide enough data to calculate the average speed of each clay ball.

Make certain the students are using a labeling style that will not cause confusion when it comes time to record the measurements.

7 After all of the tests have been completed, use the tape measure to measure the distance, in inches, between the launch position line and the landing point of each test. Fractional measurements should be converted to decimal form. For example, 37-3/4" should read as 37.75". Record these measurements in the corresponding fields of the "Relating Speed and Mass Data Sheet."

Student measurements should be from the starting point to the same spot in the landing point. For example, all measurements should be taken from the launch position line to the front of the clay ball mark.

Measurements in the activity are recorded in inches to help meet standards related to students working between different measuring systems. You can have students measure directly in centimeters if so desired.

8 Using the recorded data, convert all of the distance measurements to centimeters. (**Note:** one inch equals 2.54 centimeters.)

Centimeters = inches x 2.54. The use of a calculator is appropriate for these calculations.

9 Calculate the speed of each test by dividing the distance in centimeters by the travel time of each clay ball. Record the speed of each clay ball in the corresponding fields of the "Relating Speed and Mass Data Sheet." Your answers should be expressed in centimeters per second (cm/s).

cm/seconds = speed. A typical answer might look like this: 190 cm/s.

10 Calculate the average speed of each test. Record these averages to complete the "Relating Speed and Mass Data Sheet."