Dave Pelz Presents

Science + Math

IN SPORTS

Teacher Guidelines Introduction

Professional golfer Phil Mickelson and his wife, Amy, in cooperation with ExxonMobil, have established the Mickelson ExxonMobil Teachers Academy. Through this partnership, ExxonMobil and the Mickelsons strengthen their commitment to fostering the development of a younger generation of scientists, mathematicians and engineers.

The Academy curriculum, developed by the National Science Teachers Association and Math Solutions, focuses on mathematics and science content for third through fifth grades and provides teachers with creative teaching methods to increase student interest and achievement in math and science. For more information about the Mickelson ExxonMobil Teachers Academy, visit the Web site at www.exxonmobil.com and click on the Teachers Academy.

As part of the curriculum, Dave Pelz, former NASA physicist and renowned "Short Game Guru of Golf," developed five specific videotaped vignettes that focus on the importance of math and science in sports and games. Each professionally produced segment includes demonstrations and student interaction as Pelz uses everyday materials to explain various scientific and mathematical concepts. Included are Teacher Guidelines and Student Worksheets for each of the five lessons.

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Lesson 1: The Science of Scoring

Science/Math Concepts: Pelz explores the mathematical relationships between the size of the ball and the size of the goal in different sports. He explains that the larger the goal and the smaller the ball, the easier it is to score. Pelz introduces the concept of using measurement (metrics) in sports and games.

Demonstration: Size of balls in relation to their goals.

Student Interaction: Shooting a soccer ball into containers of various descending sizes.

Props Required: Soccer ball; four containers of descending size – extra large trash can, large trash can, medium trash can, small trash can (smaller opening than a soccer ball).

Classroom Questions:

1. Which container had the highest number of made shots? _____
2. Which container had the fewest number of made shots? _____
3. What would happen if you increased the size of the container and reduced the size of the ball?
   (a) Make more shots (b) Make fewer shots (c) Make the same number of shots (circle one)

Student Worksheet/Homework: Students can conduct the same experiment at home using any ball and four different-size targets. Students track the number of makes and misses after shooting each ball five times. Students fill in a bar chart on the worksheet showing the result for each target.

Terms:

Sphere – A three-dimensional surface, all points of which are equidistant from a fixed point (e.g., a ball).

Metrics – A standard of measurement used by most of the world and in most investigations.

Physics – The science of matter and energy, and of the interactions between the two.

Physicist – A scientist who specializes in physics.

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Lesson 2: Energy Equals Distance

Science/Math Concepts: Pelz discusses the effect of gravity and friction on a rolling ball.

Demonstration: Effect of different surfaces on a rolling ball.

Student Interaction: Rolling a golf ball from a calibrated incline on different surfaces to see how friction and gravity affect the distance the ball travels.

Props Required: golf ball, tape measure, wrapping paper cardboard tube (cut in half lengthwise to create a half-round pipe) marked with numbers so students can accurately judge the roll from different marked points on the incline.

Classroom Questions:

1. On which surface did the ball roll farther? _____

2. What affected the rolling ball the most, friction or gravity? _____

3. Which surface had more friction? _____ Less friction? _____

4. On what kind of surface could you roll a ball the farthest? _____

Student Worksheet/Homework: Students can replicate the experiment at home, rolling balls on two different surfaces and measuring how far the balls travel when dropped from specific points on the incline. They can make their own incline from a cardboard roll or some other device such as a Hot Wheels track. They will complete a graph on the worksheet provided.

Terms:

Potential Energy – The energy that an object has because of its position or condition rather than movement.
Kinetic Energy – The energy possessed by a body because of its movement.
Friction – The rubbing of one object or surface against another.
Distance – The space between two objects or places.

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Lesson 3: The Science of Impact

Science/Math Concepts: Pelz discusses impact angles (how a putter strikes a golf ball) and swing paths and the effect they have on what direction the ball will roll when struck from different angles and paths.

Demonstration: Swing path, aim and impact angles of a putter are demonstrated.

Student Interaction: On a tabletop, students use a straight piece of wood (swing path) and an angled piece of wood (putter "face") to strike a golf ball from different angles. Students mark the spot that the ball rolled off the table from each angle.

Props Required: Two pieces of wood, two-by-twos, 0.5 meters long and .25 meters long. The .25-meter piece is cut at a 45-degree angle. Butcher paper, two colored markers to draw swing path and impact angle, stickers to mark where ball rolls off table. NOTE: The Home Depot will cut the two-by-two for a nominal charge.

Student Classroom Worksheet: In-class experiment with worksheet showing path and impact angles. Students mark on the worksheet where the balls roll off the table when struck from different angles/paths and calculate the degrees in each angle on the worksheet.

Classroom Questions:

1. If the impact angle of the "putter" is square and the path is straight, the ball will roll:
   (a) Straight (b) Left (c) Right (circle one)
2. If the face of the "putter" is angled to the left and the path is straight, the ball will roll:
   (a) Straight (b) Left (c) Right (circle one)
3. What is the important science idea to understand from this activity? _____

_____

Terms:

Impact – The striking of one body against another.

Path – The direction that an object moves.

Face Angle – The direction that the face of a putter points when it strikes a ball.

Physics – The science of matter and energy, and of interactions between the two.

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Lesson 4: The Science of the Pendulum

Science/Math Concepts: Pelz discusses pendulums and how he scientifically proved that the vertical putting stroke (straight back, straight through) is superior to the horizontal pendulum putting stroke.

Demonstration: Vertical pendulum swinging along a straight path; horizontal pendulum swinging in an arc along the path demonstrated by "Perfy," Pelz's perfect putting robot.

Student Interaction: Students throw a hacky sack or beanbag with a pendulum motion and a horizontal motion at a strip of tape on the wall to determine accuracy of each throw. Students should hold the hacky sack in their palm with only their thumb for both throws.

Props Required: Hacky sack or beanbag, colored tape or marker, tape measure to measure distance hacky sack lands from center point.

Student Classroom Worksheet: Using data gathered from the in-class experiment, students plot points on a graph where the various throws landed in relation to the center tape on the wall.

Classroom Questions:

1. How many vertical pendulum throws landed less than 40 centimeters from the center line?_____
2. How many horizontal throws landed less than 40 centimeters from the center line?_____
3. Which throw proved more accurate? (a) Vertical pendulum (b) Horizontal (circle one)
4. What advantage do you see for using one type of throw over the other in this activity?_____

Terms:

Pendulum – A body suspended from a fixed support so that it swings back and forth under the influence of gravity.

Vertical – A straight line that forms a 90-degree angle with a horizontal base (up and down).

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Lesson 5: Balance – Not All Balls Are Created Equal

Science/Math Concepts: Pelz discusses the effects of gravity and other variables on balls that are dropped and rolled. The material of which a ball is constructed, as well as the amount of air in a ball, will determine how high it bounces off a consistent surface. The application of weights to one side of a rolling ball demonstrates the effect of gravity.

Demonstration: Dropping and rolling balls, applying weights to balls to affect roll.

Student Interaction: Dropping and rolling balls.

Props Required: basketball, football, soccer ball, baseball, tennis ball and golf ball.

Classroom Questions:

1. Which ball bounced highest? Why? _____

2. Why is it so hard to make a football bounce straight up? _____

3. When we applied weights to the right side of the ball and rolled it, which direction did it roll? Why? _____

_____

4. Other than using weights, how can you make a ball curve left or right? _____

_____

Student Worksheet/Homework: At home, students drop various types of balls from shoulder height on a consistent surface, measure how high the ball bounces and chart the results on a graph.

Terms:

Gravity – The attraction of the mass of the earth upon objects at or near its surface.

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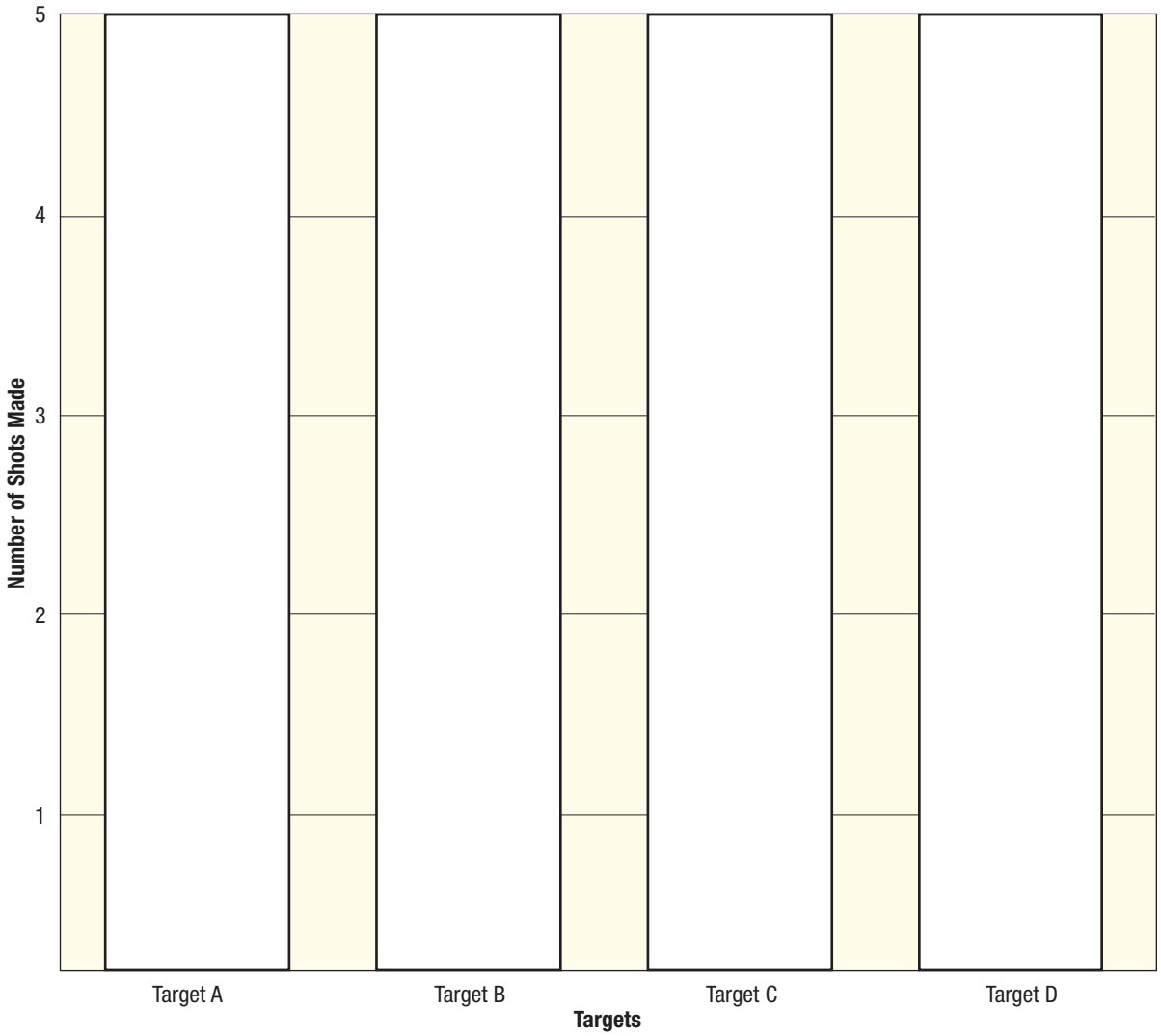
Student Worksheet

Lesson 1: The Science of Scoring

Conduct an experiment using any ball and four different size targets. Track the number of makes and misses after shooting the ball five times at each target. Fill in the bar chart below with your data.



Questions:

1. Which target had the most made shots? A B C D (circle one)
2. Which target had the fewest made shots? A B C D (circle one)
3. Which target was most difficult to hit and why? _____

_____

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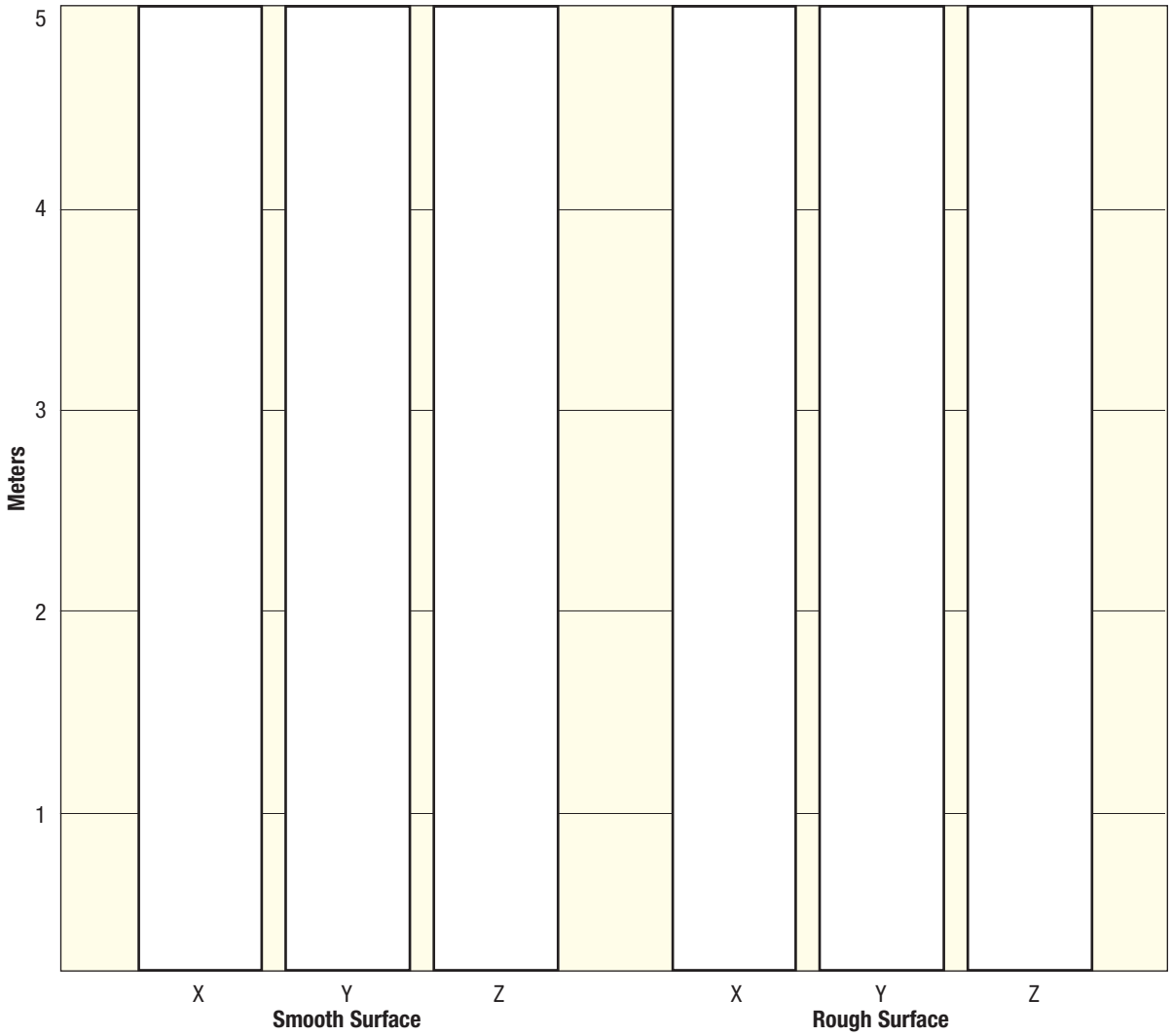
Student Worksheet

Lesson 2: Energy Equals Distance

At home, conduct an experiment by rolling a ball on two different surfaces (smooth and rough) and measure how far the ball rolls when released from different points on an incline. Fill in the graph below charting the distance traveled on the smooth surface and the rough surface when released from three different points (X, Y, Z) on the incline.



Questions:

1. Which surface had the least amount of friction?_____ How do you know?_____
2. How much farther or shorter did Ball Z roll than Ball X on the smooth surface?_____ Rough surface?_____
3. How much farther did Ball X roll on the surface with the least friction?_____

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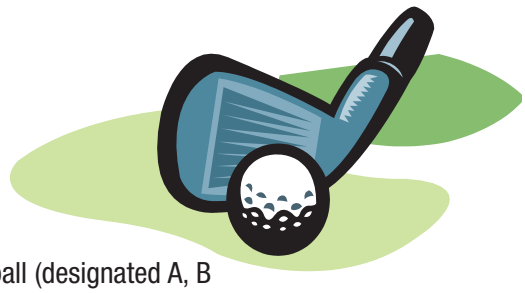
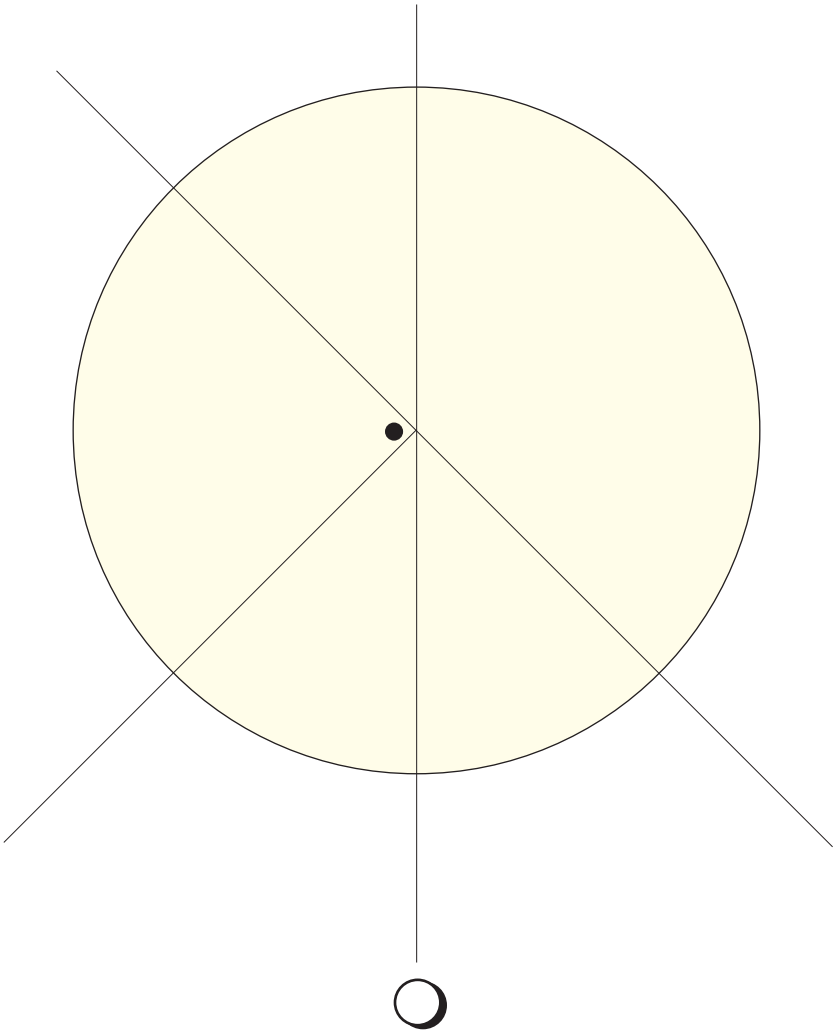


Student Worksheet

Lesson 3: The Science of Impact

Observe the in-class experiment and plot the points where each golf ball (designated A, B and C) rolls off the edge of the paper when struck by different face and path angles. Determine the number of degrees in each angle plotted on the worksheet and fill in that number accordingly.



Questions:

1. If the impact angle of the "putter" is square and the path is straight, the ball will roll:
   (a) Straight (b) Left (c) Right (circle one)
2. If the face of the "putter" is angled to the left and the path is straight, the ball will roll:
   (a) Straight (b) Left (c) Right (circle one)
3. What is the important science idea to understand from this activity? _____

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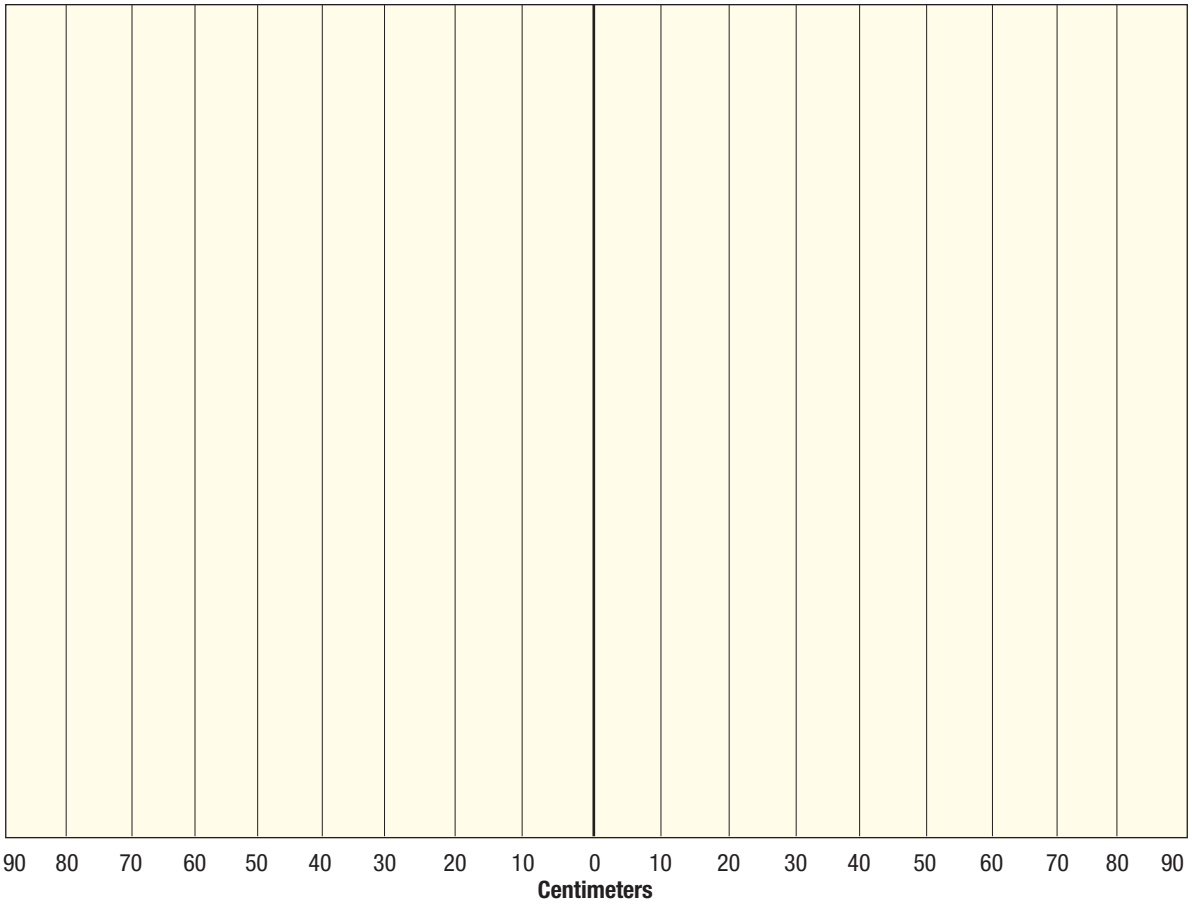
Student Worksheet

Lesson 4: The Science of the Pendulum

Using data gathered from the in-class experiment, plot points on the "wall" below representing where the two throws of each person landed in relation to the tape on the wall in the classroom. Place the initials of the person who made the throws on the vertical line above the number. If more than one person's throw landed in the same place, simply stack their initials above the first person's throw on the same line. Use different colors for the "vertical pendulum" throw and "horizontal" throw results.



Questions:

1. How many vertical pendulum throws landed less than 40 cm from the center line?_____
2. How many horizontal throws landed less than 40 cm from the center line?_____
3. Which throw proved more accurate? (a) Vertical pendulum (b) Horizontal (circle one)
4. What advantage do you see for using one type of throw over the other in this activity?_____

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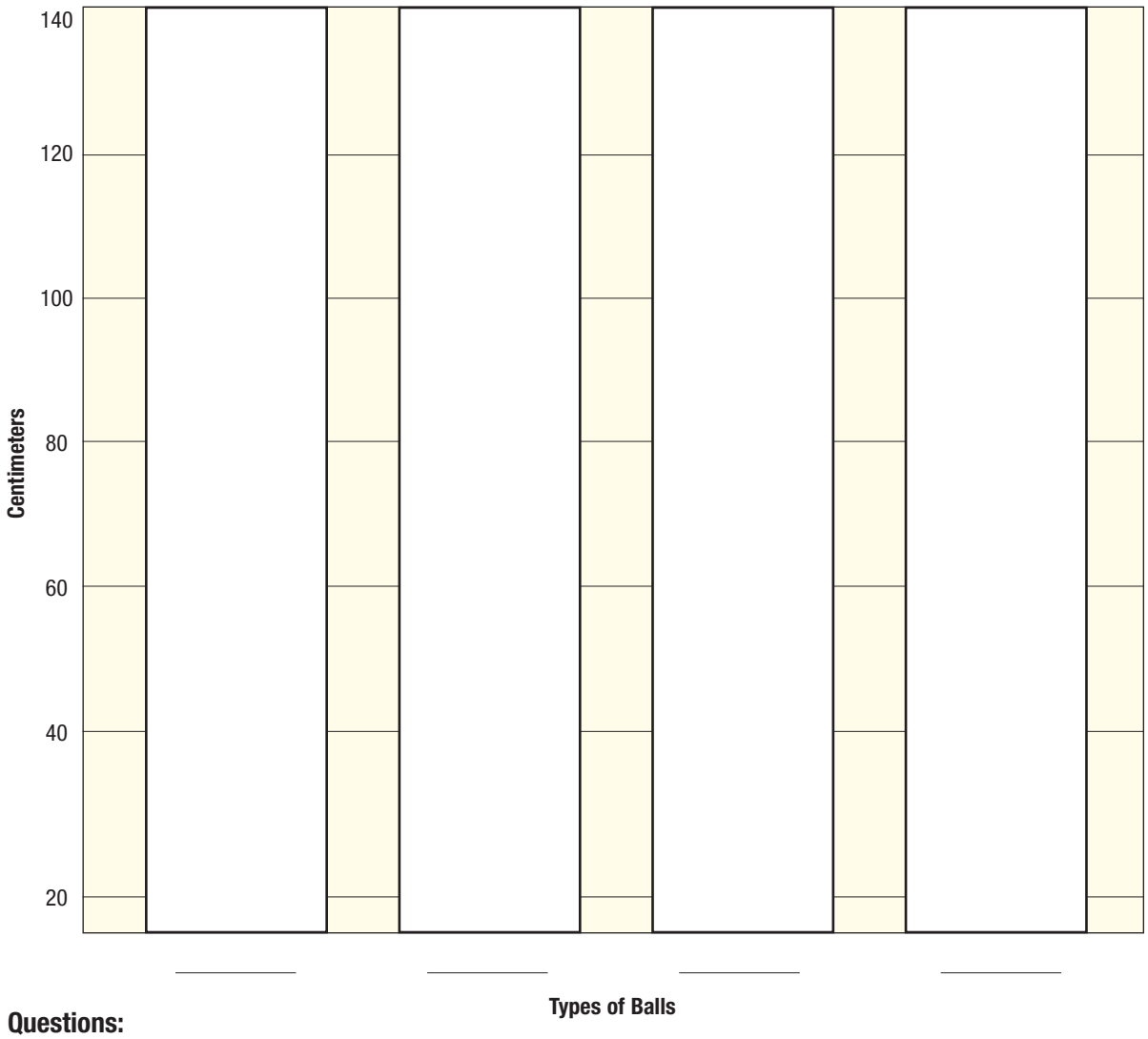
Student Worksheet

Lesson 5: Balance — Not All Sports Balls Are Created Equal

At home, drop four different balls from shoulder height on a consistent surface and measure with a tape measure how high (from the ground to the top of the ball) each ball bounces. Chart the results on the graph below labeling the balls and fill in the blank on the bottom of the chart with the kind of ball used.



Questions:

1. Which ball bounced highest?_____ Why?_____
2. How much higher did the highest ball bounce than the lowest ball?_____
3. What is the average bounce height? (HINT: Add all four heights and divide by four.)_____