PARACHUTES

Lesson Plan: Parachutes, Circles And Pi…Oh My!

Grade Level: 6-7

Subject Area: Science and Math

Time required: ***Preparation:*** 1 hour
Activity: 1 hour

National Standards Correlation:

Science (grades 5-8)

- Science as Inquiry Standard: Abilities necessary to do scientific inquiry.
- Science as Inquiry Standard: Understanding about scientific inquiry.
- Unifying Concepts and Processes: Change, constancy, and measurement.

Math (grades 6-8)

- Representation Standard: Create and use representation to organize, record, and communicate mathematical ideas.
- Measurement Standard: Understand measurable attributes of objects and the units, systems, and processes of measurement.
- Measurement Standard: Apply appropriate techniques, tools, and formulas to determine measurements.

Summary: This is a two part lesson plan. First, students will explore with different size circles to discover the relationship between diameter and circumference. Students will be introduced to the concept of pi (π). During the second part of the lesson, students will construct simple parachutes using the circle patterns (of varying sizes). Students will predict the effect that the area of a circular parachute has on the time of its descent.

Objectives: Students will:

- Find the diameter of a variety of different sized circles
- Find the circumference of circles with various sizes
- Explore the relationship between diameter and circumference
- Develop a formula to find the circumference, when diameter is given
- Construct several circular parachutes with different diameters
- Record and organize data
- Test fly the parachutes
- Record results
- Determine if there is a relationship between diameter of the parachute and time of descent

Background: Circumference: The circumference of a circle can be found by multiplying π times the diameter of a circle. What is π? It is the ratio between the circumference and diameter of a circle (commonly referred to as the value 3.14). Pi(π): The value of π was first established around 2000 BC as 3.160493827... Various Babylonian and Egyptian writings suggest that each of the values 3, 3 1/6, 3 1/7, 3 1/8 were used in different circumstances. Many mathematicians throughout history worked and improved on the notion of π. Ludolph van Ceulen (c. 1610) gave an estimate

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that was accurate to 34 decimal places. The digits were later used to adorn his tombstone. Today, in the age of supercomputers, hundreds of millions of digits are known. In part two of this lesson, students will be using π to calculate the area of a circle. The formula for the area of a circle is: area= πr^2, where r=radius.

Materials:

Each group of students will need:

- A variety of different size circles
- Metric or standard graph paper (large, chart-sized sheets work best and make a great display)
- Pencil and paper
- Markers
- Masking tape
- White plastic garbage bags
- Kite string
- Tape or round stickers to attach strings to parachute
- Paper clips or other objects to use as weights

Procedure:

A. Warm-up

The day before the activity, ask students to bring in 3 or 4 round objects that can be easily traced. For example: a roll of masking tape, a lid to a jar, a paper cup (items such as apples or balls are much harder to use). Or, cut circular templates out of cardboard or heavy paper. Make 5 or 6 circles with different diameters for each group to use.

B. Activity I

1. Students will arrange circles in order from smallest to largest.

2. On graph paper, students will draw an x and y axis. Label the x axis “Diameter” and the y axis “Circumference”.

3. Students will identify the diameter of the circle. Place the smallest of the circles on the graph paper so that the diameter of the circle falls across the x axis. With one end of the diameter at 0, place a mark on the x axis to show the length of the diameter.

4. Students will record the circumference of the circle on the y axis. Place a mark with a pencil on the edge of the circle so that the student will know where to begin and end. The student will place the cut-out circle “standing up” on the y axis so that it can be rolled along the axis. Place the mark at 0 and roll the circle up the axis until the circle has made one full turn. Mark the y axis there.

5. With a marker and ruler draw a straight line up from the point on the x axis and over from the point on the y axis until those two lines intersect.

6. Each group will measure and record results, using each of their 5-6 circles.

7. Draw a line connecting intersecting points for all circles.

8. Ask students: Why is it that all of the points fall on or very close to that line? Answer: They all fall on the same line because every circle has the same ratio between its diameter and circumference. The circumference is always about 3 times the length of the diameter. The actual formula is: π x diameter. Depending on the ability level of the student, 3 or 3.14 is a good working estimate for π).

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9. Give students a circle with yet a different diameter. Students will measure the diameter and predict the circumference. Check the prediction by recording the diameter and circumference on the graph.

C. Activity II

1. Select one of the circles used in Activity I to use as a pattern for constructing a parachute.

2. First, students will find the diameter, radius and circumference of the circle. Next, brainstorms a class to try to figure out how the **area of a circle** is determined. Possible ideas: a. Trace the circle onto graph paper, and count the number of squares that are covered by the circle, or b. Break down the circle into rectangles using a ruler. Find the area of each rectangle and estimate what is leftover.

3. Each group of students will select one of the methods to estimate the area of the circle.

4. Now, give students the formula for area : area = πr^2, where r=radius. Students will calculate area of the circle using this formula. How close was their estimate?

5. Now students will use the circle pattern to make a parachute. Trace onto a white garbage bag. Cut out the circle and decorate, using markers.

6. Carefully fold the circle in half, and half again. Pinch the folds along the circumference of the circle.

7. Open the circle. Cut four pieces of string that are 2 times the circumference of the circle. Attach one end of each string to each “corner” of the circle (the pinch marks). Tie the other ends to a paper clip.

8. Students will work in groups to drop the parachutes and record the time of descent for each parachute. All parachutes will be dropped from the same height.

D. Wrap-up

Determine which student’s parachute has the slowest time of descent. Discuss what factors influence time of descent.

Assessment/ Evaluation:

Students will be evaluated based on ability to explain the relationship between the diameter and circumference of a circle. Given any diameter, student should be able to calculate circumference.

Extensions:

1. Will a rectangular parachute with the same area as the circular parachute fall faster or slower?

2. Have students cut a small hole out of the top center of their parachute. Does this affect the accuracy of the landing? The time of descent? How did this change the area of the area of the parachute?

3. How does tying multiple parachutes to an object affect its time of descent?

4. Using the original parachute, try adding weight to see how this affects the time of descent.

5. Everyone is familiar with the "Egg Drop". Turn it into a parachute drop. Have the students design a parachute system that will gently deliver an egg (unbroken) to the ground. A small basket or cup would be helpful to hold the egg. Aim for the lightest weight possible.

Resources:

Pi Throughout the Ages (teacher resource), http://ernie.bgsu.edu/~carother//2.html

Math Forum: Ask Dr. Math (teacher and student-friendly), http://forum.swarthmore.edu/dr.math/tocs/.middle.html

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