NATIONAL MUSEUM
OF THE UNITED STATES AIR FORCE™

Parachutes, Circles, and π

First, students will explore with different size circles to discover the relationship between diameter and circumference. During the second part of the lesson, students will construct simple parachutes using circle patterns of varying sizes.

LESSON PLAN

Learning Objectives

The 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
- Determine if there is a relationship between the diameter of a parachute and the time of its descent

Grade Level: 5-7

Ohio Learning Standards/Mathematics (2017)
Geometry
5.G.1: *Use a pair of number lines called axes.*

Geometry work with circles
7.G.4:a.: Explore and understand the relationship among the circumference, diameter, area, and radius of a circle.
7.G.4.b.: Know and use the formulas for the area and circumference of a circle and use them to solve real-world and mathematical problems.

Ohio Learning Standards/Science (2018)
Physical Science - Forces and Motion
5.PS.1.: Change in movement of an object
6.PS.1.: Matter has properties of mass and volume

Purpose

Students will be using parachutes to explore the formula for the circumference and area of a circle and will also practice scientific inquiry by experimenting with parachutes of varying sizes.

Materials

- Poster sized graph paper
- Sturdy cardstock/cardboard
- Plates, pie plates, other round objects
- Pencils and markers
- Scissors
- A drawing compass for each team
- A ruler for each team
- White plastic bags
- Paper clips or washers
- String

Procedure:

A. Activity I

1. Have students, working in teams, create a number of different sized circles (maybe 5 or 6) on cardstock using a drawing compass or, for larger circles, by tracing plates, pie pans, etc.

2. On graph paper, have students 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 its circumference. The circumference is always π times the length of the diameter, the actual formula being $2\pi r$.

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.

3. Next, have students find the area of the circle using the formula πr^2.

4. Now students will use the circle pattern to make a parachute. Trace onto a white garbage bag. Cut out the circle and use markers to label the parachutes with their diameters and area.

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

6. 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 large paper clip or washer.

7. 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 and area.

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 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. 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.

Resource:

How NASA uses π:

https://www.jpl.nasa.gov/edu/learn/list/oh-the-places-we-go-18-ways-nasa-uses-pi/