

The Circumference/Diameter Ratio

Content: Pre-Algebra

Topic: Determine the relationship between the circumference and diameter of a circle using both real-world and simulated data.

Objectives:

The student will be able to:

Day 1

1. construct a circle using Geometer's Sketchpad software
2. measure the circumference and diameter of circles
3. create a table of values based on the data generated by Geometer's Sketchpad

Day 2

4. measure the circumference and diameter of various circular items
5. create a table of values based on data
6. identify the dependent variable and the independent variable

Day 3

7. plot both sets of data using Geometer's Sketchpad software
8. analyze the data (both computer generated and real-world)
9. discover the "Circumference Conjecture"

Materials:

- Geometer's Sketchpad software
- Round objects
- Meter stick or metric sewing tape
- Sewing thread or thin string to measure the circumference of each round object

Introduction:

The relationship of circumference and diameter will be introduced by giving student groups a diagram of a circle and asking them to measure the circumference and diameter of the circle using various measuring devices such as string, tape measure, ruler, or etc. The students have been introduced to Geometer's Sketchpad in a previous activity.

Procedure:

Day 1

1. The students will be assigned to teams of two.
2. Using the attached activity sheet, each team will respond by using data obtained with the Geometer's Sketchpad software.
3. Each team will provide the instructor with a disk containing the activity data.
4. The instructor will provide feedback on the disk.

Day 2

1. The students will continue with same team member using a new activity sheet.
2. Using the guidelines provided on the activity sheet, each team will provide the instructor with data as indicated.
3. The instructor will provide feedback on activity sheet.

Day 3

Each team will use Think, Pair, Share to analyze the relationship of the circumference to the diameter by responding to the questions on the worksheet.

Closure

A total group discussion will follow the team investigations. The students will provide the instructor with team answers to Day 3 investigation worksheet.

Assessment:

Day 1

Instructor will review Geometer's Sketchpad activity disk and provide feedback which includes an indication of mastery or non-mastery of the activity material.

Day 2

Instructor will check for accuracy of the circumference to diameter ratio and provide feedback which includes indication of mastery or non-mastery of the activity material. Students will need to redo the activity sheet if non-mastery is indicated.

Day 3

Instructor will check for understanding of the Circumference Conjecture by reviewing Day 3 data investigation sheet and by the quality of the large group discussion. Instructor will give students feedback which indicates mastery or non-mastery of the material.

Websites for Further Investigation

You may wish to view the following sites for pre-lesson ideas or extended lessons for circles:

http://www.mathgoodies.com/lessons/toc_vol2.shtm

<http://turnbull.mcs.st-and.ac.uk/~history/Java/Circle.html>

www.merlot.org

<http://archive.ncsa.uiuc.edu/Edu/RSE/RSEorange/Piactivities.html>

GEOMETER'S SKETCHPAD
THE CIRCUMFERENCE/DIAMETER RATIO
DAY 1 ACTIVITY SHEET

Sketch:

Step 1

Construct AB

1. Click on the point icon in the tool box. Move the arrow to a position on the screen and click. Place a second point on the screen.
2. Click on the arrow icon.
3. Select the two points by holding down the shift key and clicking on both points.
4. Construct the line segment by selecting **line segment** in the **Construct** menu.

Step 2

Construct the midpoint of the segment

- Select the line segment by clicking on the segment with the selection arrow.
- Select **Point at midpoint** from the **Construct** menu.

Step 3

Construct circle CB

- Click on the circle icon in the tool box. Move the arrow to Point C, hold down the left mouse button, and drag to create the circle. Be sure the cursor is positioned directly on point B when you release the mouse button.

Step 4

Measure the circumference of the circle

- Click on the circle with the selection arrow and select **circumference** from the **Measure** menu.

Step 5

Measure AB (the diameter of the circle)

- Click on the line segment (diameter) and select **diameter** from the **Measure** menu.

Step 6

Make the circle small; then select, **in order**, the diameter measurement and the circumference measurement (hold down the shift button as you select both measurements) and choose **Tabulate** in the **Measure** menu.

Step 7

Make the circle a little larger; then double-click inside the table to add another entry.

Step 8

Repeat step 7 three or four more times.

Step 9

Save sketch on disk for further investigation. Give disk to instructor at end of this activity.

**THE CIRCUMFERENCE/DIAMETER RATIO
DAY 2 ACTIVITY SHEET**

Names of Team Members _____

For this investigation, you will need the following materials:

- Five round objects of various sizes
- Meter stick or metric sewing tape
- Thin string

Step 1 With the thread and meter stick (or sewing tape), measure the circumference and diameter of each round object to the nearest millimeter (tenth of a centimeter).

Step 2 Using the table below, record the circumference (C) and diameter (D) measurements for each round object.

Name of object				
Circumference (C)				
Diameter (D)				
C/D				

Step 3 Calculate C/D and record the answers in your table.

Step 4 Calculate the average of your C/D results _____

**THE CIRCUMFERENCE/DIAMETER RATIO
DAY 3 INVESTIGATION WORKSHEET
COMPARING DAY 1 AND DAY 2 DATA**

Names of Team Members _____

Step 1 Go to Geometer's Sketchpad and open the Sketch from Day 1.

Step 2 Click inside the table once to select it; then choose **Plot Table Data** in the **Graph** Menu. Click **OK** in the Plot Point dialog. Describe the points that appear on the graph. If you don't see all the points, drag the point at (1,0) to scale your axes.

Step 3 Construct a ray from the origin of the graph to one of the points on the graph. (Select the two points by holding down the shift button. Click on the line segment icon in the tool box and click on the ray icon. Select **Ray** from the **Construct** Menu. Click on select arrow to leave segment icon.) Measure and record the slope of this ray. What ratio does this slope represent?

Step 4 Select, in order, the diameter measurement and the circumference measurement. Choose **Plot as (x,y)** in the **Graph** Menu. Change the color (use the Display menu) of this point so you can distinguish it from other points on the graph. Drag to change your circle and watch the plotted point. How does this demonstrate that the circumference/diameter ratio is the same for all circles? _____

Step 5 Long ago, mathematicians named the circumference/diameter ratio with the Greek letter π (pi). Copy and complete the following conjecture: If C is the circumference and D is the diameter of a circle, then there is a number π such that $C = \underline{\hspace{2cm}}$. Because $D = 2r$, where r is the radius, then $C = \underline{\hspace{2cm}}$. This is the Circumference Conjecture.

Now that we see the relationship between the circumference and the diameter from Day 1 data, we will plot our data from Day 2 using Geometer's Sketchpad and compare the results.

- Step 1 Select a new sketch
- Step 2 Select **plot points** from the **Graph** menu
- Step 3 Enter your real-world data from your Day 2 table and click OK. If you do not see you points, drag the point at (1,0) to scale your axes.
- Step 4 Construct a ray from the origin of the graph to one of the points on the graph. (Select the two points by holding down the shift button. Click on the line segment icon in the tool box and select the ray icon. Place the cursor on the origin and click) Measure and record the slope of this ray. What ratio does this slope represent? _____

- Step 5 How does the slope (ratio) of your Day 2 data compare to Day 1? Are there differences or similarities? Explain why? _____

Adapted from: Key Curriculum Press; Discovering Geometry with Geometer's Sketchpad

Linda May-Gerard
Garrett Community College