THE CIRCUMFERENCE-DIAMETER RATIO OF A CIRCLE

**Purposes:**
- to develop techniques for measuring the circumference and diameter of a circular object
- to use data to construct a graph
- to find the slope of a graph
- to analyze error in an experiment

**Procedure:**

**I. Taking Measurements**

A. Find at least 6 circular objects in the classroom. They should be of many different sizes. Each object should be available to all and not be someone’s personal property.

B. Measure the diameter and circumference of each one. Use metric units only. You should use the same units for both diameter and circumference. It is strongly recommended that you use centimeters. Record your data in the table to the right.

C. Select one of the objects you measured and put an asterisk next to its name in the table to the right.

D. Write your measurements for your selected object on a slip of paper, but DO NOT WRITE THE OBJECT’S NAME.

<table>
<thead>
<tr>
<th>name of object</th>
<th>circumference</th>
<th>diameter</th>
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**II. Comparing Measurements**

A. The “A” and “B” groups will now trade slips of paper. That is, groups 1A and 1B swap. Groups 2A and 2B swap etc.

B. Look at the measurements on the slip of paper you received. See if you can identify which object it describes. If you can find it, write down its name here: __________________  (You might have to go back and take more measurements.)

**III. Making a graph (data analysis)**

A. Plot a graph of the circumference of the circles versus the diameter of the circles. That expression means that you should put the circumference on the y-axis and the diameter on the x-axis.

B. Draw a “best-fit” line for the points on the graph. Your instructor will explain how.
IV. Finding the slope of the graph
A. Select two points that actually line on your best-fit line. One should be near the beginning and the other near the end of the line. Don’t use data points unless they fall right on the line.
B. Use the difference between the y values of these points as \( \Delta y \) or “rise”.
C. Use the difference between the x values of these points as \( \Delta x \) or “run”.
D. Find the slope of the line using the equation: (Show all work for the calculation.)

\[
\text{slope} = \frac{\Delta y}{\Delta x} \quad \text{OR} \quad \text{slope} = \frac{\text{rise}}{\text{run}}
\]

V. Results and analyzing error
A. What makes it so difficult to measure circular objects?

What is harder? measuring the diameter or the circumference? Why?

What specific techniques can you use to make it easier to measure circular objects and get reliable results?

B. What value to you think you were supposed to get for the slope of the graph?

How far off was your group?

C. Is the relationship between diameter and circumference of a circle a direct proportion? Explain your answer.

D. Why could it be difficult for some students to identify the specific object being described by another group’s measurements (as in part II of this activity)?
List as many reasons you can think of below:

E. Is the ratio of the circumference of a circle to its diameter a “fundamental ratio of nature”? Defend your answer.