Experiment 15

Sum of the Angles

In this experiment, the sum of the interior angles of a polygon is a linear function of the number of sides in the polygon. The number of sides is the *independent variable*, and the sum of the angles is the *dependent variable*. Students of all abilities seem to enjoy creating their own polygons and measuring the angles.

Teaching Notes

Equipment

straightedges, 1 per student

circular protractors, 1 per student

We suggest making several copies of the blackline master on overhead-transparency sheets. Mark the center dot and the 0-degree line in color. Students find the thin transparencies easier to use than actual protractors.

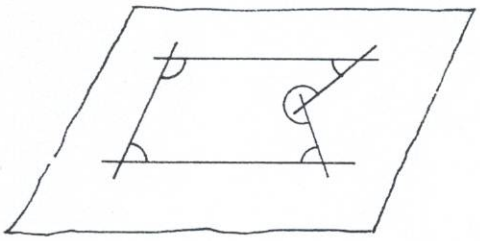
angle copiers (optional)

After making a copy on a transparency, cut out the circular part. With a razor blade, cut the semi-circular tabs. Slide the circle under the tabs. The circular part should turn freely. Mark the stationary line in color. Some students prefer to "copy" the angle and then measure the copy.

calculators, 1 per group

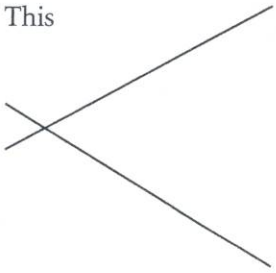
scratch paper, a large amount

graph paper, 1 sheet per student

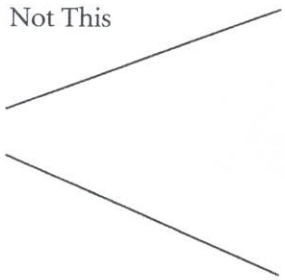


Procedure

This



Not This



Have each student use a straightedge to draw an acute angle, mark the angle, and then measure it with a protractor. (Don't begin by passing out a page of angles to be measured; it is important that students draw and mark each angle.) Measuring to the nearest degree is sufficiently accurate. Lines of angles should cross; otherwise, there is a tendency to fill in the gap freehand. This may drastically affect the measurement of the angle.

After successfully measuring several acute angles, have students draw and measure some reflex angles.

Groups of three work particularly well with this experiment. Starting with a 4-sided polygon, each student draws a polygon; the number of sides is the *independent variable*. Next, each student measures the interior angles, lists the measurements, and finds their sum, the *dependent variable*. At least one of the polygons should be "fancy," that is, shaped like an arrowhead (containing a reflex angle).

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Teaching Notes, page 2

Calculators are essential to add the angles. If one student's results vary widely from the others in the group, the mistake could be a faulty measurement, the omission of an angle, or the miscounting of the number of sides. Listing the angles to be added and then using the calculator minimizes addition mistakes.

Then, group members enter their data for the 4-sided polygon and take either the average or the middle value. Starting with a polygon of 4 sides is suggested because some students may remember the formula for the sum of the angles of a triangle. Repeat for polygons with 5, 6, 7, 8, and 9 sides. When plotting their points, students will need a large scale for the y-axis.

Extension

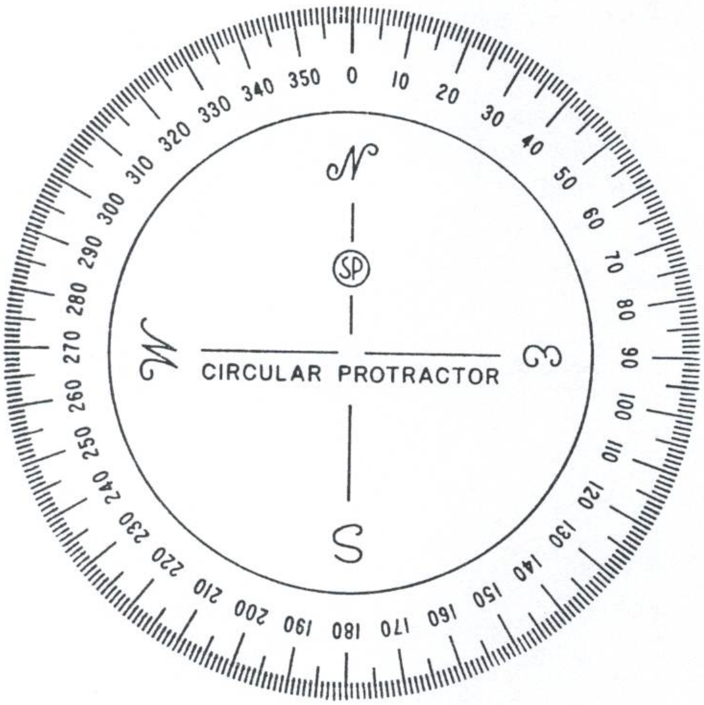
Ask students what their equations predict for the sum of the angles in a triangle. Take an average of the answers.

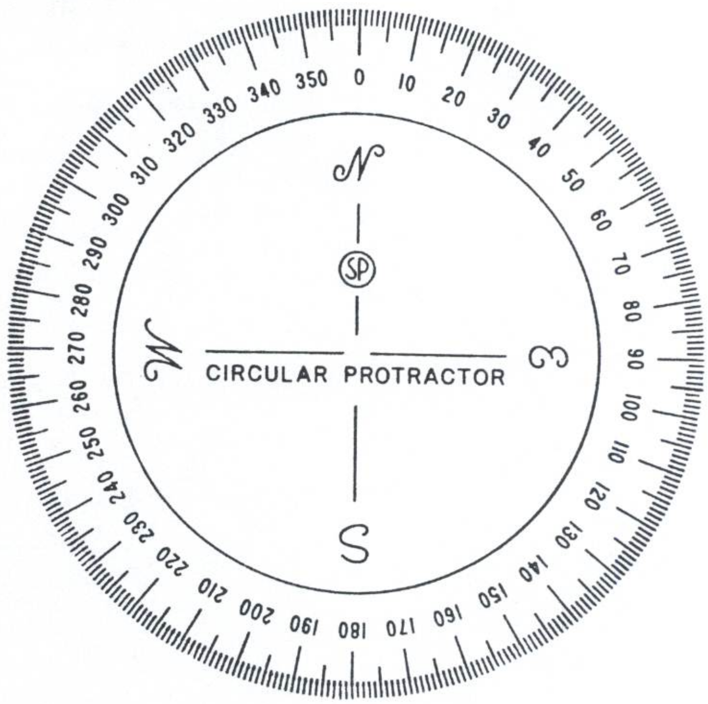
A class average of the slopes and intercepts should produce a line very nearly the theoretical equation of

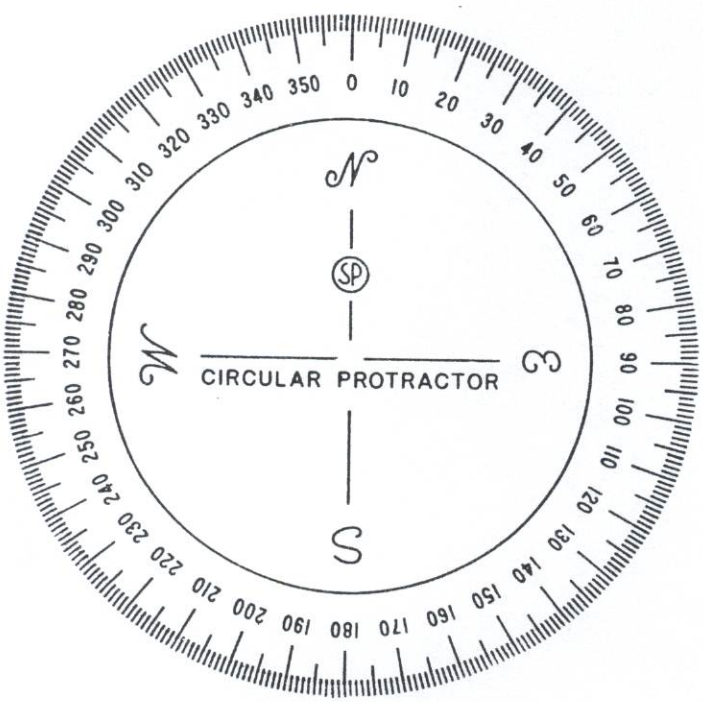
$$y = 180x - 360.$$

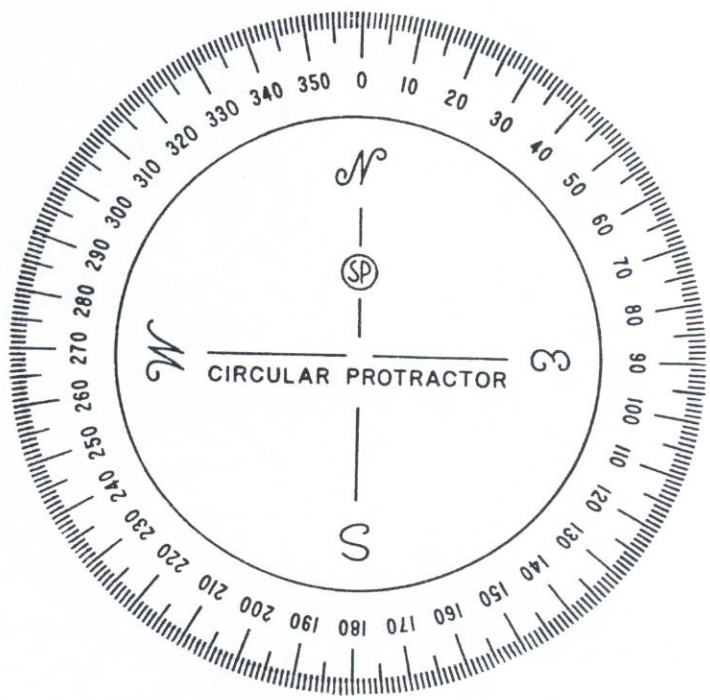
Ask: What is the meaning of the intercept? There are no 0-sided polygons. In the other experiments, it made sense to consider all positive values of the independent variable. Here it makes sense to consider only (integer) values greater than 2.

A square (or any 4-sided polygon) can be cut into two triangles. What is the minimum number of triangles a 5-sided figure can be cut into? The independent variable is the number of sides, the dependent variable is the minimum number of triangles. Students can use their old polygons or draw new ones. The result is linear.









Protractor line art courtesy of Newell Office Products Group.

Angle Copiers

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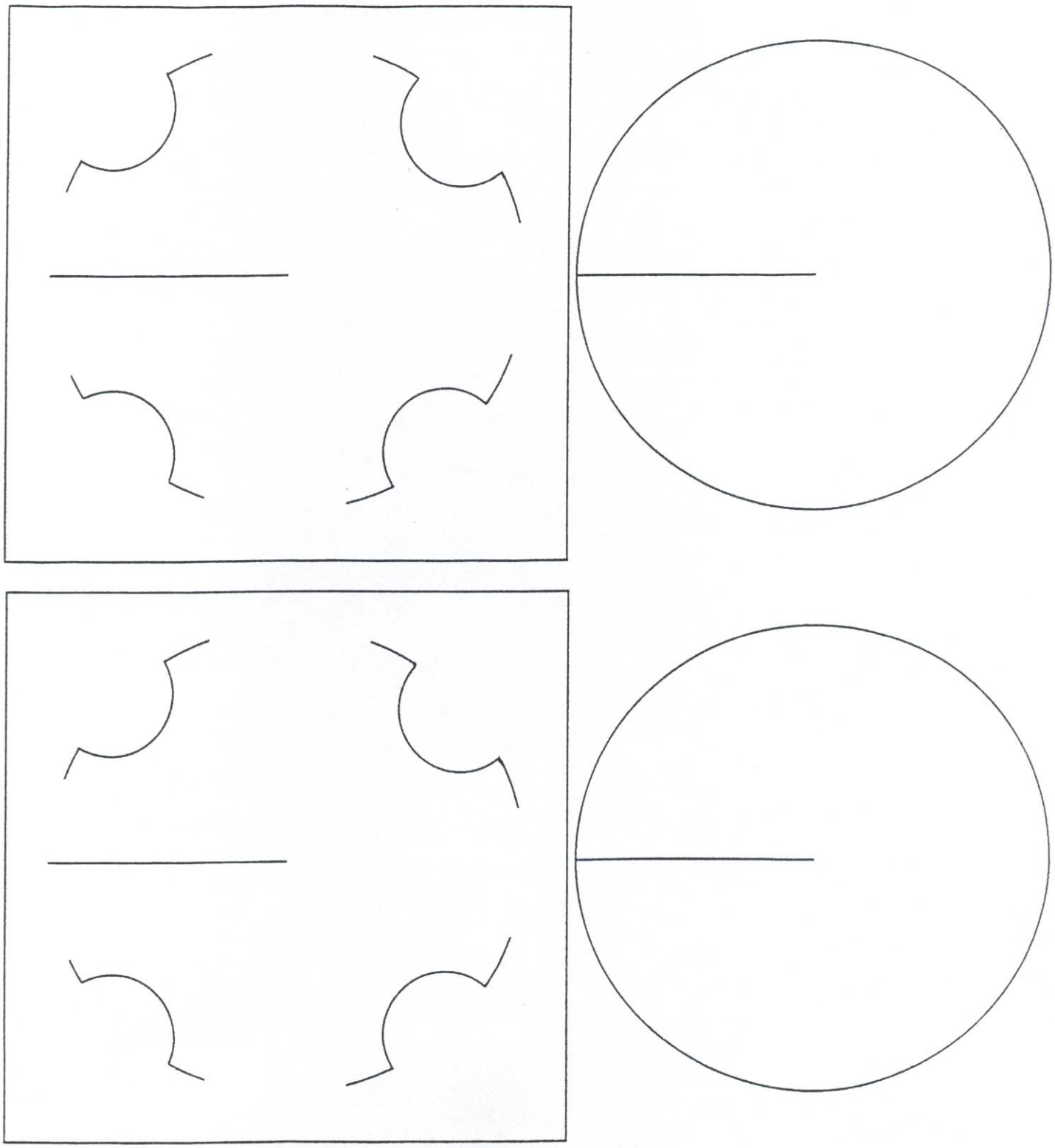

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Name _____

Partner _____

Collect the Data

Draw a diagram of the experiment, indicating variables.

Describe the procedure for the experiment.

The independent variable, x, is _____ Units _____

The dependent variable, y, is _____ Units _____

Equipment (labels and measurements) _____

Please attach the paper with your polygons.

Data Collection

Independent _____	Dependent _____		
	Trial 1	Trial 2	Trial 3

Points to Be Graphed

x	y

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Find the Equation

After plotting your data on graph paper, draw a straight line through two of your points. Choose the line that best fits your data. Circle the points on your graph and copy their coordinates below.

Your points: (____, _____) and (____, _____)

Use these points to find the equation of your line. Show your work.

Find the slope of the line.

Find the y-intercept of the line.

Write the equation of the line.

$y =$ _____ $x +$ _____ $\quad\quad$ $y =$ _____ $x +$ _____

rational form $\quad\quad$ *decimal form*

Rewrite the decimal form of the equation, using the names of the variables instead of x and y.

_____ = _____ _____ + _____

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Interpret the Data

Write the decimal form of your equation here. $y =$ _____ $x +$ _____
Use this equation to answer the questions. Show your work.

1. What would be the sum of the angles for a polygon with 12 sides?

   _____

2. How many sides would be needed to have the sum of the angles be 2160°?

   _____

3. How many sides would be needed to have the sum of the angles be 2530°?

   _____

4. On the back of your graph, draw a polygon with 12 sides that has all square angles. Try: 

   What is the sum of the angles for this polygon? _____

   Does it match the answer from your equation? _____

5. Does it make sense to have values for the independent variable less than 3? Why or why not?

   _____