



What's Your Angle?

(Measurement)

Objective

Using inductive reasoning, students will devise procedures for using a protractor to measure the number of degrees in an angle.

Overview of the Lesson

Students make estimates of the measurement of various angles created with angle wheels. They use quarter rotations and half rotations as points of reference. The angle wheels are used to create visual images of the sizes of various angles. Later, the protractor is introduced as a tool commonly used to measure the size of angles except, the students are not told how to use it. By applying a special technique using a hinged mirror, students determine the number of degrees in several angles which are printed on a worksheet. Since they now know the measurement of these angles, they use inductive reasoning skills to construct their own method for effectively using the protractor to measure angles.

Materials

Each Group:

- ① Angle wheel
- ② Hinged Mirror
- ③ Protractor
- ④ Angle Measurement Activity Sheet

Teacher:

- ⑤ Large demonstration angle wheel

Procedure

Begin the class by asking students to state some circumstances when a person may need to have a working knowledge of angles and their measurements. Suggestions will probably include names of persons who work in certain careers such as tilers, pilots, architects, and engineers. However, encourage them to also describe uses that they and/or their parents may have. These could include home projects such as constructing a picture frame or a dog house, understanding angles for maximum success when flying a kite, or writing directions for describing turns in a scavenger hunt.

Distribute one angle wheel to each pair of students. An angle wheel is similar to a fraction wheel except that the numbers on the back represent the number of degrees in the angle depicted on the front.

In this part of the lesson, students should work in pairs to play an estimation game involving the size of angles. Their task is to estimate the measurement of various angles within 5 degrees. One student sets the angle wheel at a specific angle, while the other student estimates the measurement of this angle. Ensure that students understand that in order to score a point, “within 5 degrees” means that their estimate is at most 5 degrees greater or at least 5 degrees smaller than the actual number of degrees in the angle presented by their partners. After each estimate, the students change roles. This game allows each student to build on and perfect their “angle size sense.” For example, they may already be able to identify right angles and straight angles and know that a right angle measures 90° and a straight angle measures 180° . They should be able to apply this knowledge to create a sense of the size of any angle. Students can analyze their scores to assess how accurate their “angle sense” is.

Mathematically Speaking . . .

Angles are formed when two rays intersect. The point of intersection is called the vertex. Angles are measured in degrees: the symbol for degrees is “°” and the symbol for angle is “ \angle .” Angles are either named by the capital letter located at the vertex, or by three capital letters (particularly if there is more than one angle emanating from the same vertex). A lower case m is the symbol for “measurement of.” Therefore, $m \angle A = 90^\circ$ is read, “The measurement of angle A is 90 degrees.”

Introduce the protractor as a special tool, scaled to be used to measure the number of degrees in an angle. Provide each pair of students with one protractor, a hinged mirror (two small mirrors taped together) and a worksheet. Depending on the level of experience your students have in visualizing and estimating angle sizes, you may wish to first build on the process of using pattern blocks of regular polygons to compute the number of degrees in a given angle.

- ☛ Place the hinged mirror in an upright position on the desk.
- ☛ Position the pattern block on the desk so that its vertex and two sides coincide with the vertex and two sides of the hinged mirror.

- ☛ Students then look in the mirror and count the number of polygons that it takes to rotate around the point. This will include the actual polygon and all of the additional polygons reflected in the mirror.
- ☛ Since there are 360° in a circle, students should then divide 360° by the number of polygons counted. The result is the number of degrees in an angle of the regular polygon. For example, if the equilateral triangle is used, students will see that it takes six equilateral triangles to rotate around the point. Therefore, each angle of the triangle will measure 60° .

Distribute one Angle Measurement Worksheet to each pair of students. Their first task is to *estimate* the size of each of these angles. These estimates are recorded on the worksheet. Next, have the students follow the procedure described above to measure the angles on the worksheet (only this time they place the mirror so that its sides coincides with the sides of the angle. After they have determined and recorded the measurement of each of the angles, they are to use inductive reasoning to discover how to position the protractor on the angle to get the correct measurement. Once they have discovered a way to place the protractor to accurately measure an angle, each pair of students is responsible for writing an organized set of instructions on how to use a protractor .

Finally, have the student pairs exchange instructions. Each set of instructions are analyzed and critiqued.

Extensions & Connections

Give students graph paper and have them draw a rectangle. Have them draw the two diagonals. Label the two triangles formed, and measure the angles of each triangle with a protractor. Have students look for patterns.

Have students draw any two straight lines that intersect. Measure the four angles formed. Have them write their observations.

Resources

Burns, Marilyn. *About Mathematics*. (1992) Math Solutions Publications, Sausalito, California.

Ideas for Online Discussion

(Some ideas may apply to more than one standard of the **NCTM Professional Standards for Teaching Mathematics**.)

Standard 1: Worthwhile Mathematical Tasks

- 1 *What's Your Angle* utilizes a variety of materials: angle wheel, mirrors, protractors, etc., designed to enable students with different learning styles to gain the concept of angle measurement. Share some mathematical tasks which you have successfully used that allow for the diversity of learning styles.

Standard 3: Students' Role in Discourse

- 2 Many times students get very excited about finding patterns and making discoveries. Suggest some inductive reasoning activities that you have used successfully with students.

Standard 5: Analysis of Teaching and Learning

- 3 Even under ideal conditions, when kids are engaged in doing worthwhile mathematics, the allocated time is often not enough. *Within your present working situation, how do you deal with the problem of time? What conditions exist, if any, that enable you to be flexible in terms of time?*
- 4 Describe your classroom. *Is it a place where students are encouraged to interact? Are students involved as active learners and engaged in learning worthwhile mathematics? What one thing will you do next week to improve an already successful learning environment?*
- 5 Incorporating a mathematical task that spans the range of ways that students learn can create a major management challenge for a teacher. Think about some of your most challenging experiences when you were attempting to create the "perfect" learning environment for **all** of your students. Briefly describe one of them, and what you learned from the situation.

Rotate the circles
around the center.



