Grade 6 Angle size

6.SS.1	
Demonstrate an understanding of angles by • identifying examples of angles in the environment • classifying angles according to their measure • estimating the measure of angles using 45°, 90°, and 180° as reference angles • determining angle measures in degrees • drawing and labelling angles when the measure is specified.	1. Provide examples of angles found in the environment. 2. Classify a set of angles according to their measure (e.g., acute, right, obtuse, straight, reflex). 3. Sketch 45°, 90°, and 180° angles without the use of a protractor, and describe the relationship among them. 4. Estimate the measure of an angle using 45°, 90°, and 180° as reference angles. 5. Measure, using a protractor, angles in various orientations. 6. Draw and label a specified angle in various orientations using a protractor. 7. Describe the measure of an angle as the measure of rotation of one of its sides. 8. Describe the measure of angles as the measure of an interior angle of a polygon.

Clarification of the outcome:

- ✦ The outcome primarily concerns measuring the size of an angle using a protractor (with degrees as the unit). Essential to this is understanding that angle measurement involves measuring the amount of rotation between two line segments. The outcome also concerns a less important aspect, namely, angle jargon (various types of angles).
- ✦ Students have difficulty with angle measurement for at least two reasons: (1) angle size is not understood as a measure of rotation and (2) the protractor is used without understanding how it works.

Required close-to-at-hand prior knowledge:

- ✤ Knowing what angles look like.
- ✤ Understanding what a rotation is.

SET SCENE stage

The problem task to present to students:

Organize students into groups. Ask them to invent a way of measuring the size of an angle and to prepare a short presentation of their method. Tell them that some of them will be asked to present their method.

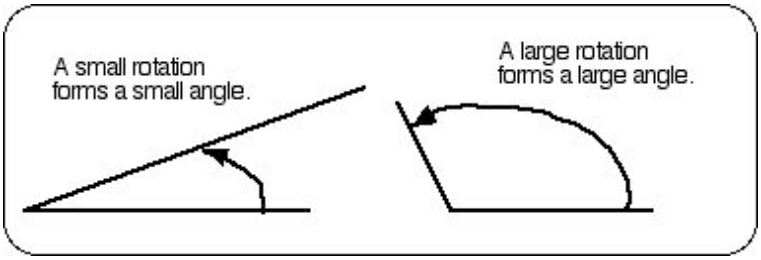
Comments

DO NOT PROVIDE OR MENTION PROTRACTORS. If a student knows about protractors ask that student to imagine protractors do not exist.

DEVELOP stage

Activity 1: Revisits SET SCENE and addresses indicators 1 and 7.

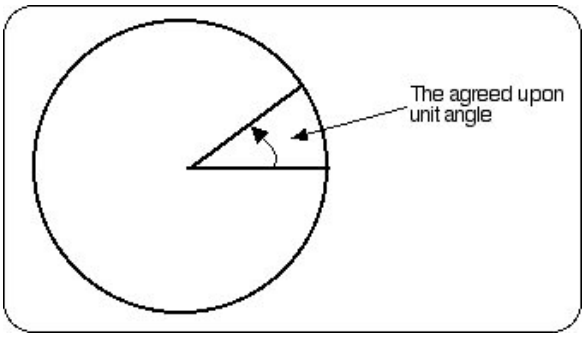
- Ask the groups to present their method for measuring the size of an angle. Discuss their methods. Hopefully, at least one group will have invented a method that involves measuring rotation. If no one invented a method that involves measuring rotation, introduce the idea. No matter how it arises, ensure that students realize that angle size involves measuring rotation and that it is does not involve the lengths of the two arms that form the angle (see diagram).



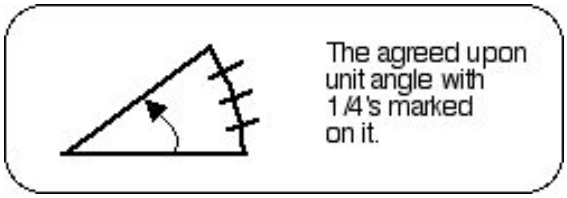
- Ask students to identify angles in the environment. Discuss why it might be useful to measure the size of an angle.

Activity 2: Addresses achievement indicator 7.

- Discuss what might be an appropriate size for a unit angle (ensure a reasonably large unit angle is agreed upon). Ask students to draw a circle and then use it to draw the agreed upon size of a unit angle (see diagram). Ask students to invent a name for the unit angle (for example, a 'turnee'). Discuss about how many of the unit angles would measure a whole rotation (all the way around the circle).



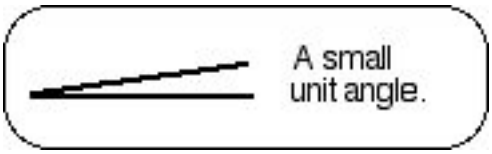
- Have students cut out the unit angle from the circle (see diagram). Discuss cutting the unit angle into 1/4's. Have students mark 1/4, 1/2, and 3/4 of the unit angle on it (see diagram). Draw a medium angle on the board. Ask a student to measure its size to the nearest 1/4 of the unit angle. Discuss results.



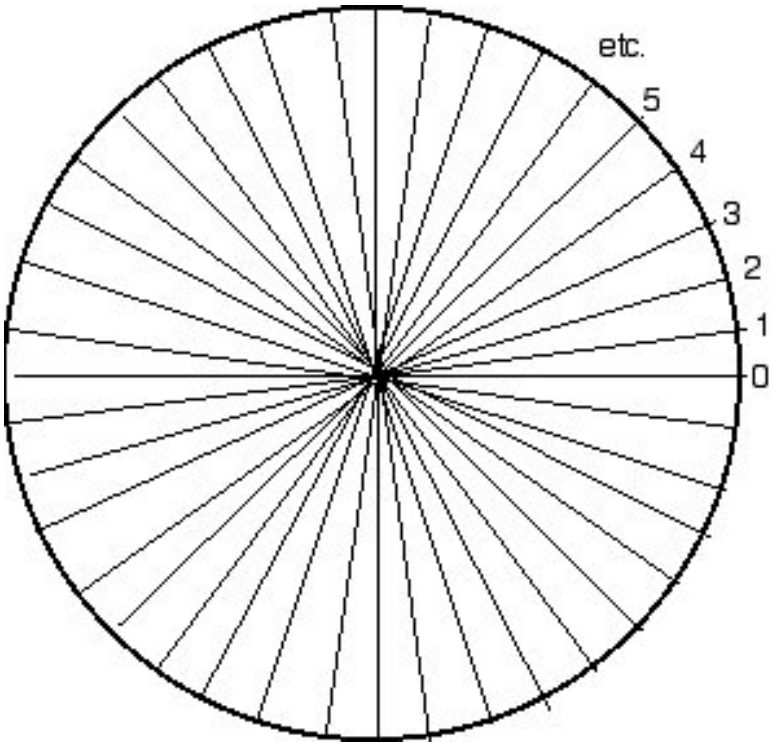
- Organize students into groups. Have each group draw small, medium, and large angles. Have them measure the size of the drawn angle using their unit angle. Note that students will have to approximate fractions of the unit angle to the nearest 1/4.

Activity 3: Revisits SET SCENE and addresses achievement indicators 5 and 7.

- Discuss why a small unit angle is more appropriate (reduces the need to use fractions when measuring angles). Show them the relatively small unit angle that you used to make the angle measuring device that you will hand out to them (see below).



- Organize students into groups. Provide each group with a copy of the circle shown here that you prepared ahead of time on TRANSPARENCIES (N.B.). Call the circle an angle measuring device. Discuss how the circle was marked off into unit angles. Discuss the need for a zero place to begin measuring angle size (relate this to the zero place on a ruler). Provide three angles (small, medium, large) drawn on paper. Ask each group to measure the size, using the angle measuring device. Discuss results.



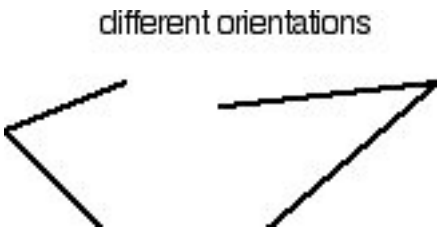
- Ask students to compare the circle method for measuring the size of an angle to the method they invented in the SET SCENE task. Discuss the advantages and disadvantages of the methods.

Comments

The angle measuring device shown here is a protractor that includes the top and bottom half of the circle. A normal protractor consists only of the top half of the circle. The size of the unit angle shown is about 9 times the size of a degree. Use your judgement when deciding upon a suitable size for the unit angle.

Activity 4: Addresses achievement indicators 5, 6, and 7.

- Tell students that the circle they used to measure angles is a whole circle version of a protractor. Hand out protractors and let students examine them. Discuss a protractor as the top half of the circle they used to measure angle sizes.
- Discuss the degree as the name of the unit of angle, Ask students how many degrees is a flu rotation. Ensure they realize that 360 degrees is a full rotation (in other words, the circle is marked off into 360 degrees). Discuss why there are 360 degrees in a whole rotation by relating the matter to the fact that the earth rotates around sun in 365 days (a whole rotation) but 360 is a nicer number to work with because it has many factors (e.g. 2, 3, 4, 5, 6, 8, 10, 12, etc.).
- Discuss why there is an outside ring and an inside ring of numbers on the protractor (allows you to measure rotation clockwise or counterclockwise) and why both rings go from 0 to 180 (180 is half of 360 and 1/2 a rotation is 180 degrees, whether you measure clockwise or counterclockwise).
- Provide an angle drawn on paper. Have students measure its size clockwise and counterclockwise (this involves using each arm of the angle as a zero side). Discuss results.
- Organize students into groups. Ask them to draw a variety of angles, using the protractor (e.g. draw an angle of 35 degrees). Discuss results.
- Have each group draw a variety of angles freehand HAVING DIFFERENT ORIENTATIONS (see example) and then measure their size using a protractor. Discuss some of the results, paying attention to the fact that an angle's orientation does not affect its size.



Comments

One purpose for activity 4 is to have students understand what a protractor is, and not just be able to use it to measure angles.

Activity 5: Addresses achievement indicators 3, 4, and 5.

- Organize students into groups. Have each group sketch freehand a 45^o, 90^o, and 180^o angle (cannot use a protractor). Ask students to think about the relationship between the three angles. Discuss their thinking. [90 is twice 45, and so on.]
- Provide students with a variety of drawn angles having different orientations. DO NOT PROVIDE PROTRACTORS. Ask students to estimate the size, using 45, 90, and 180 as reference angles Discuss results.
- Challenge students to draw an angle, given its size (e.g. draw a 72^o angle). Allow them to check the size of their drawn angle using a protractor. Discuss results. Repeat five times, involving a different angle size each time.

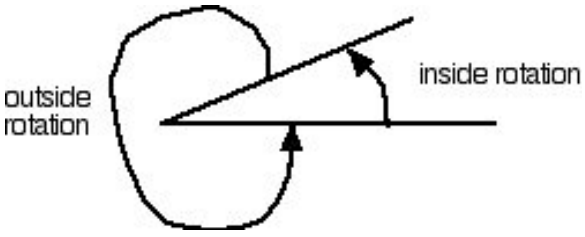
Activity 6: Addresses achievement indicator 2.

- Have students examine two collections of angles, where the angles have different orientations, one collection consisting only of acute angles with the word ‘ACUTE’ pasted above the collection. The other collection does not contain any acute angles and has the words ‘NOT ACUTE' pasted above the collection. Have students define an acute angle. [angle less than 90^o]
- Have students examine two collections of angles, where the angles have different orientations, one collection consisting only of right angles with the word ‘RIGHT’ pasted above the collection. The other collection does not contain any right angles and has the words ‘NOT RIGHT' pasted above the collection. Have students define a right angle. [angle = 90^o]
- Have students examine two collections of angles, where the angles have different orientations, one collection consisting only of obtuse angles with the word ‘OBTUSE’ pasted above the collection. The other collection does not contain any obtuse angles and has the words ‘NOT OBTUSE' pasted above the collection. Have students define an obtuse angle. [angle greater than 90^o but less than 180^o]
- Have students examine two collections of angles, where the angles have different orientations, one collection consisting only of straight angles with the word ‘STRAIGHT, pasted above the collection. The other collection does not contain any straight angles and has the words ‘NOT STRAIGHT' pasted above the collection. Have students define a straight angle. [angle = 180^o]
- Have students examine two collections of angles, where the angles have different orientations, one collection consisting only of reflex angles with the word ‘REFLEX’, pasted above the collection. The other collection does not contain any reflex angles and has the words ‘NOT REFLEX' pasted above the collection. Have students define a reflex angle. [angle between 180^o and 360^o]

Comments

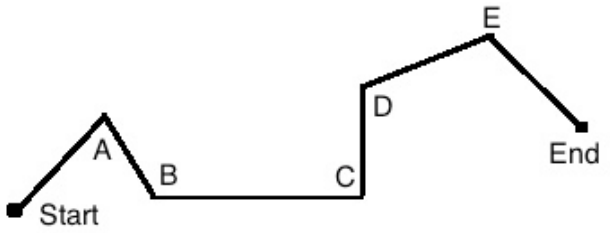
Discuss, at least once, why the orientation of an angle does not affect its size (amount of rotation determines size). After one discussion, if students realize that orientation does not determine size, there is no need to discuss the matter again.

There is an issue for any angle about which angle is the one in question. There is the "inside" rotation and the "outside" rotation (see diagram). You need to make clear which rotation is being considered.



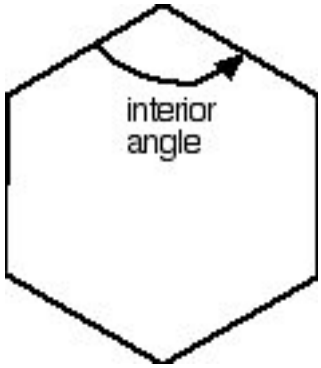
Activity 7: Addresses achievement indicators 2 and 4, and practice.

- Provide students with a path (see diagram) that includes the types of angles developed in activity #6 (straight angle not included).
- Have students estimate and record the angle size. Have students label each angle as acute, right, obtuse, or reflex.



Activity 8: Addresses achievement indicators 2, 5, and 8, and practice.

- Provide students with pictures of a variety of regular polygons (e.g. equilateral triangle, square, regular pentagon, hexagon, octagon). Discuss what an interior angle of a polygon is (see diagram).
- Ask students to measure the interior angle of each polygon and indicate which type of angle it is (acute, obtuse, etc.). Discuss results.



Activity 9: Assessment of teaching.

- Ask students to draw: (1) an acute, (2) a right, (3) an obtuse, (4) a straight, and (5) a reflex angle. Ask them to measure the size of each angle using a protractor and to record the measurement beside the angle they drew.

If all is well with the assessment of teaching, engage students in PRACTICE (the conclusion to the lesson plan).

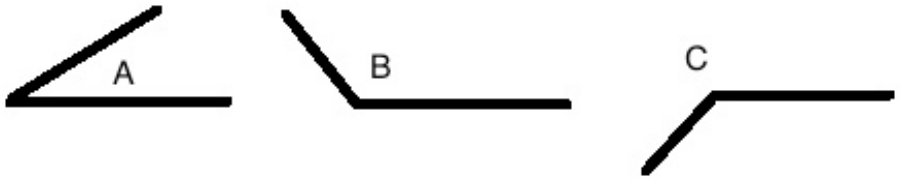
An example of a partial well-designed worksheet follows.

The worksheet contains a sampling of question types. More questions of each type are needed.

The MAINTAIN stage follows the sample worksheet.

Question 1.

Measure the size of each angle using a protractor, Write the measurement beside the angle.



Question 2.

a) An angle is 35 degrees. What type of angle is it? _____

b) An angle is 90 degrees. What type of angle is it? _____

c) An angle is 112 degrees. What type of angle is it? _____

d) An angle is 180 degrees. What type of angle is it? _____

e) An angle is 200 degrees. What type of angle is it? _____

Question 3.

a) Draw an angle of 50 degrees by estimation.

b) Draw an angle of 150 degrees by estimation.

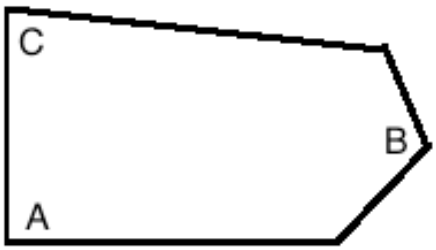
Question 4.

Measure the labelled interior angles of the polygon. Indicate the type of angle it is.

Angle A is _____ degrees Type is: _____

Angle B is _____ degrees Type is: _____

Angle C is _____ degrees Type is: _____



MAINTAIN stage

Mini-task example

Every so often:

- Provide pictures of a couple of angles. Ask students to estimate the size, confirm the size using a protractor, and name the angle type (e.g. acute).

Rich-task example

Have students make a simple transit. Have them use it to make a map of the school yard, showing places of interest (e.g. playground structures, trees, etc.). Students need to select a reference point in the school yard that serves as the zero point and a zero line that runs through the zero point. Have students measure and then indicate the distances from the zero point to places of interest. Have students measure, using the transit, and then indicate angles from the zero line to places of interest. Have students display their maps.

Comments

Surveyors use transits when surveying property. A simple transit can be made by using a cardboard tube from paper toweling as the sighting tube (glue cross-hairs made from black thread across one end of it and a thin rod on top of it). Pin the tube to a piece of heavy cardboard on which a semicircle has been marked off in degrees (use a protractor to mark off the degrees). Refer to the diagram.