

Grade 6 Sum of interior angles

6.SS.2	
Demonstrate that the sum of interior angles is <ul style="list-style-type: none">• 180° in a triangle• 360° in a quadrilateral	<ol style="list-style-type: none">1. Explain, using models, that the sum of the interior angles of a triangle is the same for all triangles.2. Explain, using models, that the sum of the interior angles of a quadrilateral is the same for all quadrilaterals.

Clarification of the outcome:

- ◆ The outcome concerns “theorems” (truths) about the sum of the interior angles of a triangle and of a quadrilateral (4-sided polygon). These truths should be “discovered” by students rather than by the teacher telling them.
- ◆ The sum of the three angles of a triangle add to 180 degrees, no matter what the triangle looks like.
- ◆ The sum of the four angles of a quadrilateral (4-sided shape) add to 360 degrees, no matter what the quadrilateral looks like.
- ◆ There is no need to unpack the outcome into two parts (triangle and quadrilateral) because the “truths” for the two parts are strongly connected.

Required close-to-at-hand prior knowledge:

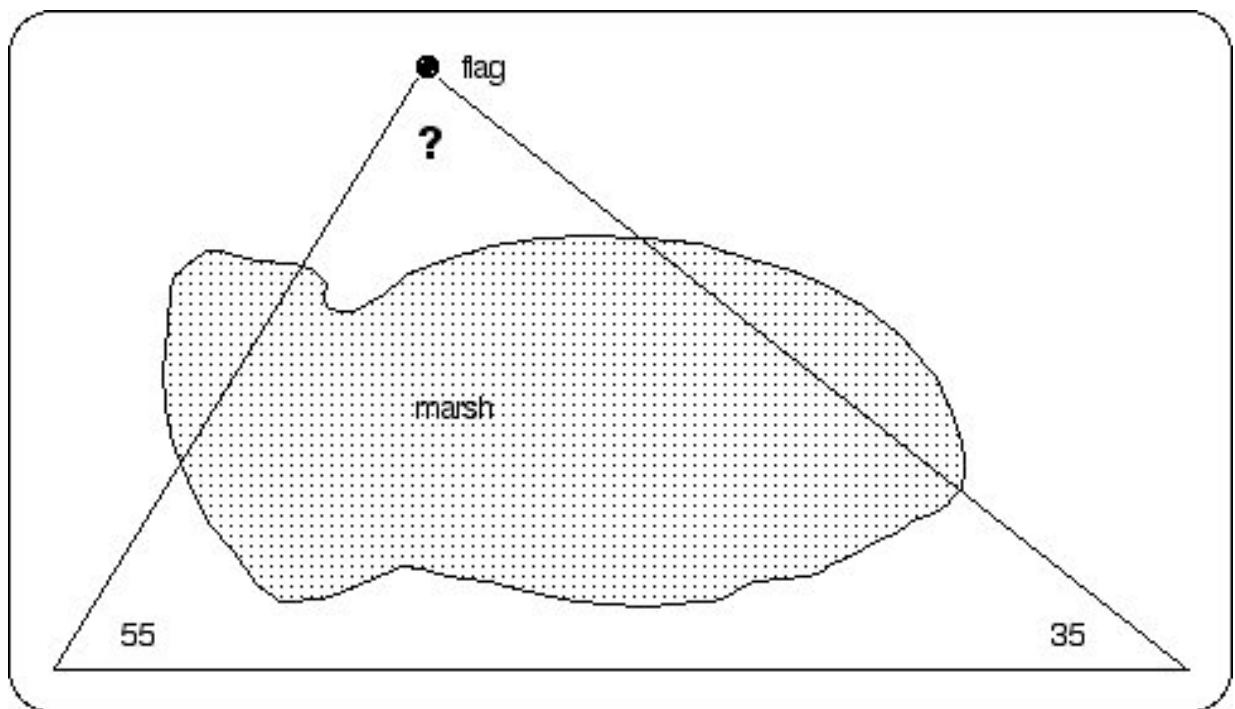
- ❖ Understands angle measurement.
- ❖ Can use a protractor to measure angle size.
- ❖ Knows what interior angles of a polygon are.
- ❖ A straight angle (a line) is 180 degrees.

SET SCENE stage

The problem task to present to students:

Have students solve the following problem by drawing the situation and measuring the angles.

A surveyor lays out a baseline 100 metres long on one side of a marsh. There is a surveying flag on the other side of the marsh. The two ends of the baseline and the flag form a triangle. The surveyor measures the angle from one end of the baseline to flag. The angle is 55 degrees. The surveyor measures the angle to the flag from the other end of the baseline. That angle is 35 degrees. The surveyor needs to know the measure of the third angle of the triangle. How many degrees is it?" (see diagram).



Comments

The problem concerns a situation that does occur (in this case, in surveying work). The hope is that this can provide a context for addressing the unstated students question “*Why are we learning this?*”

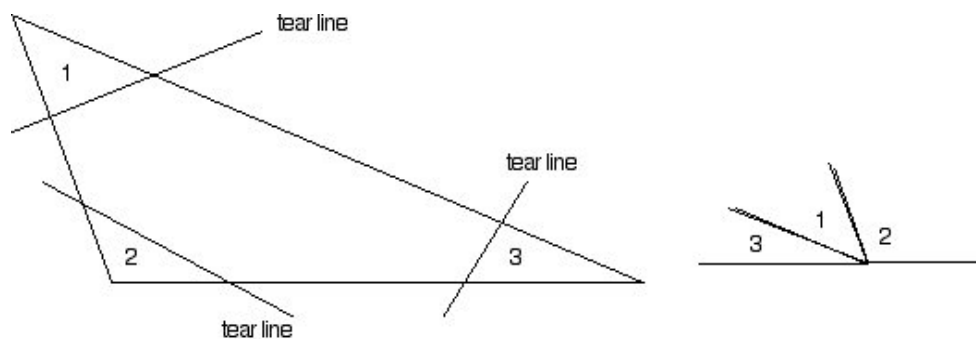
DEVELOP stage

Activity 1: Revisits SET SCENE and addresses achievement indicator 1.

- ◆ Discuss students' solutions to the SET SCENE task. Discuss if they notice anything that might be true about the three angles of a triangle. [Do not reveal the "secret" yet.]
- ◆ Organize students into groups. Assign a different triangle to each group (e.g. a scalene, a right triangle, an acute, etc.). Ask each group to measure the angles of its triangle and then add them up. Ask the groups to present their results.
- ◆ Discuss whether it is reasonable to conclude that the sum of the angles of a triangle is 180 degrees.

Activity 2: Addresses achievement indicator 1.

- ◆ Organize students into groups. Assign a different triangle to each group (e.g. a scalene, a right triangle, an acute, etc.). Ask each group to write the numbers 1, 2, 3 in the angle corners, snip the corners off each triangle, and then arrange the corners in a line if possible (see diagram). Ask the groups to present their results.
- ◆ Discuss whether it is reasonable to conclude that the sum of the angles of a triangle is 180 degrees. [For this, students must understand that a line is 180 degrees.]



Activity 3: Addresses achievement indicator 1.

- ◆ Provide an isosceles triangle. Ask students to measure the two base angles (the two angles that are equal). Ask them to predict the third angle of the triangle. Have them to confirm their prediction by measuring. Discuss their thinking. Repeat with a different isosceles triangle.
- ◆ Provide an equilateral triangle. Ask students to determine the size of each angle without measuring. Discuss their solutions.

Activity 4: Addresses achievement indicator 2.

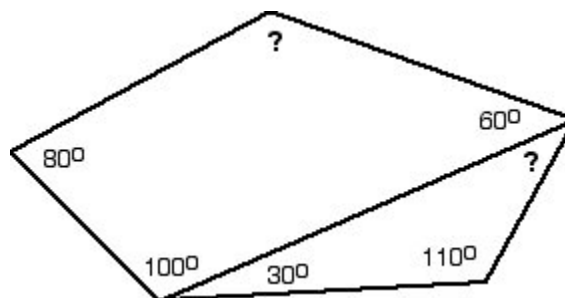
- ◆ Organize students into groups. Present the groups with an investigation: "You know that the three angles of a triangle add up to 180° . Investigate what the four angles of a quadrilateral (has 4 sides) should add up to. Begin your investigation for a rectangle and a parallelogram but also investigate other quadrilaterals."
- ◆ Have selected groups present their conclusion about the four angles of a quadrilateral. Discuss the results of the investigation.
- ◆ If no group thought about splitting the quadrilateral into two triangles and realizing that the sum of the four angles of a quadrilateral must be 2×180 , you present and discuss that thinking.

Activity 5: Revisits SET SCENE and addresses achievement indicator 1.

- ◆ Return to the SET SCENE tasks. Ask students to determine the missing angle using the knowledge they have learned about the sum of the angles of a triangle.
- ◆ Ask students to describe other situations where that knowledge might be useful.

Activity 6: Addresses achievement indicators 1 and 2, and practice.

- ◆ Provide students with a worksheet that has problems consisting of diagrams of single and composite triangles and quadrilaterals. Some angle sizes are given; some are not (see sample composite). Ask students to determine the size of the unknown angles without using a protractor.



Activity 7: Assessment of teaching.

- Provide a worksheet that has one triangle and one quadrilateral drawn on it. Each shape has all the measures of angles given EXCEPT that one angle measurement is NOT given for each shape. Ask students to determine the measure of that angle without using a protractor.

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.

Two angles of a triangle add up to 130 degrees. What is the size of the third angle?

Two angles of a triangle add up to 75 degrees. What is the size of the third angle?

Question 2.

Three angles of a quadrilateral add up to 310 degrees. What is the size of the fourth angle? _____

Three angles of a quadrilateral add up to 295 degrees. What is the size of the fourth angle? _____

Question 3.

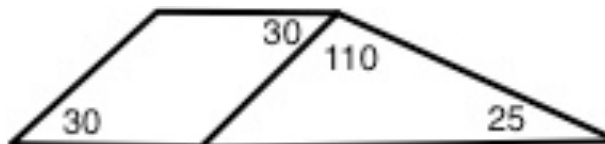
Johnny says that he can draw a triangle for which the size of the angles is 45 degrees, 80 degrees, and 90 degrees. Can Johnny do what he claims. Why or why not?

Question 4.

Johnny says that he can draw a quadrilateral for which the size of the angles is 45 degrees, 80 degrees, 90 degrees, and 90 degrees. Can Johnny do what he claims. Why or why not?

Question 5.

Determine the size of each unknown angle. Show your work.



MAINTAIN stage

Mini-task example

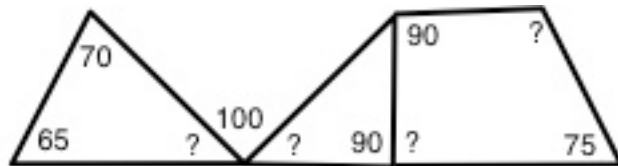
Every so often:

- Provide a diagram of a triangle and a quadrilateral where the size of one angle in each shape is not given. Ask students to determine the size of the missing angle.

Rich-task example

Present students with a complex problem consisting of composite triangles and quadrilaterals (see sample below).

Determine the size of each unknown angle. Show your work and explain your thinking.



Comments

The problem could be “dressed up” to simulate a surveying situation.