Grade 7 Area of triangle

7.SS.2	
Develop and apply a formula for determining the area of • triangles • parallelograms • circles	1. Illustrate and explain how the area of a rectangle can be used to determine the area of a triangle. [DEVELOPED] 2. Generalize a rule to create a formula for determining the area of triangles. [DEVELOPED] 3. Illustrate and explain how the area of a rectangle can be used to determine the area of a parallelogram. [NOT DEVELOPED] 4. Generalize a rule to create a formula for determining the area of parallelograms. [NOT DEVELOPED] 5. Illustrate and explain how to estimate the area of a circle without the use of a formula. [NOT DEVELOPED] 6. Apply a formula for determining the area of a circle. [NOT DEVELOPED] 7. Solve a problem involving the area of triangles, parallelograms, and/or circles. [DEVELOPED ONLY FOR TRIANGLES]

Clarification of the outcome:

- The outcome is unpacked into three parts: (1) area of triangles, (2) area of parallelograms, and (3) area of circles. The reasons are: (a) each shape has a distinct area formula that is not sufficiently related to the other formulas and (b) each formula requires separate time to develop and apply to problems.
- The area of a triangle can be viewed as half of the area of a rectangle. For that reason, the area formula for a rectangle should be developed before the area formula for a triangle.
- In order to connect the area formula for a rectangle to the area formula for triangle, the rectangle formula MUST be understood as base x height. Why? A triangle does not have a length or width. It has a base and height.

Required close-to-at-hand prior knowledge:

- Understand area as a count of identical squares that cover a surface.
- Understand the area formula for a rectangle as base x height (not length x width).

SET SCENE stage

The problem task to present to students:

Organize students into pairs. Provide them with a diagram of sufficiently large scalene triangle (no equal sides) and 1 cm grid paper. Ask them to determine the area of the triangle in some way.

Comments:

The main purpose of the task is to refresh area as a count of squares and to engage students in thinking about a short cut (a formula) for determining the area of a triangle.

DEVELOP stage

Activity 1: Revisits SET SCENE, and addresses achievement indicator 7.

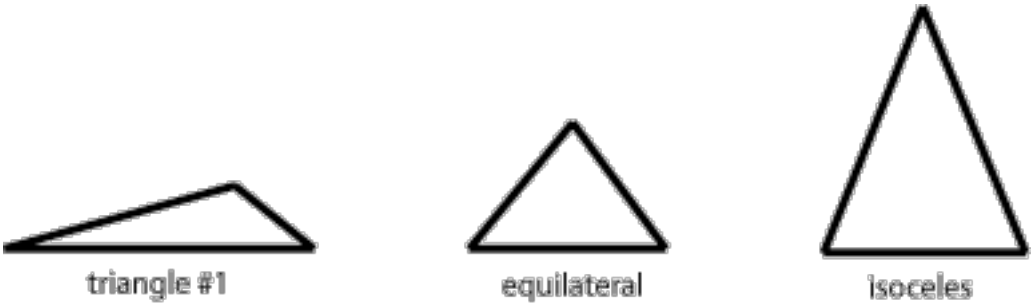
- ✦ Ask selected groups to describe how they found the area of the triangle. Discuss results.

Activity 2: Addresses achievement indicators 1, 2, and 7, and practice.

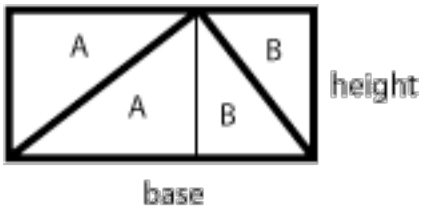
- ✦ Show students a floor plan of a room that is a right triangle where the side length and height of the triangle are given (e.g. 5 metres and 8 metres). Discuss why someone might want to know the area the floor (e.g. how much carpet to buy).
- ✦ Organize students into groups. Ask them to draw the right triangle on 1 cm grid paper, thereby representing an area of one square metre by an area of one square centimetre. Ask each group to determine the area of the triangle by counting whole and part squares. Discuss their estimates. Discuss whether a builder would want to draw a triangle on grid paper and count squares to determine its area. Suggest that there may be a short cut (a formula) for determining the area of a triangle.
- ✦ Ask students to fold a sheet of paper in half along a diagonal, thus forming a right triangle. Ask them how the area of a triangle is related to the area of a rectangle. ENSURE they realize that two right triangles form the area of a rectangle. Ask students how to calculate the area of the right rectangle in words. Expect BASE x HEIGHT. Ask students to express a formula for the area of a triangle in words (e.g.: base x width divided by 2) and symbolically (e.g.: 1/2 x B x H or (B x H)/2).
- ✦ Provide drawings of about three right triangles with no dimensions given and 30 cm rulers. Ask students to determine the area of each triangle. [They will first have to measure base and height.] Discuss solutions.

Activity 3: Addresses achievement indicators 1, 2, and 7.

- Provide a drawing of an equilateral and isosceles triangle, and a triangle (neither equilateral or isosceles) whose top vertex is between the end points of its base (triangle #1 in the diagram). Ask students if the formula (base x height divided by 2) can be used to calculate the area of those triangles. The critical matter is to determine what is the base and what is the height. Discuss the matter.



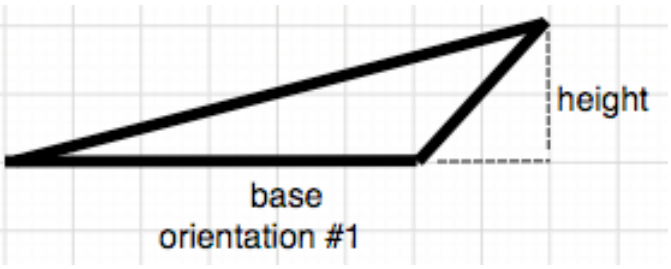
- Select the triangle #1 and ask the students to convince you that the formula, 'base x height divided by 2', can be used to determine its area. Expect someone to explain why triangle #1 is one-half of a rectangle whose base and height are the same as that of triangle #1. [Piece A of the rectangle is the same size as piece A of the triangle. Piece B of the rectangle is the same size as piece B of the triangle. Therefore the area of the triangle #1 is 1/2 of the area of the rectangle.] If no student is able to explain, draw the diagram shown below and discuss pieces A and B, etc.



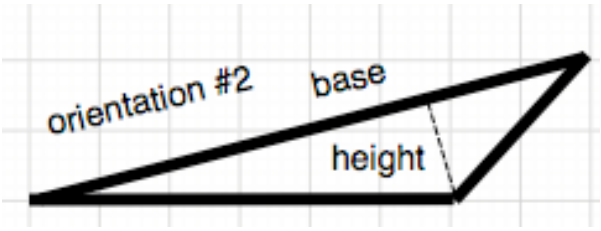
- Ask if an equilateral triangle is like triangle #1 (top vertex between end points of its base). Expect "yes". Ask if the area of an equilateral triangle is 'base x height divided by 2'. Expect "yes". Discuss and assist as needed.
- Ask if an isosceles triangle is like triangle #1. Expect "yes". Ask if the area of an isosceles triangle is 'base x height divided by 2'. Expect "yes". Discuss and assist as needed.

Activity 4: Addresses achievement indicators 1, 2, and 7.

- Ask students what triangle situation has not been considered yet. ENSURE they realize it is a triangle where the vertex extends past the base (see diagram).
- Ask students whether the formula 1/2 x base x height still works. Accept all responses.
- Ask students to measure the base and height for orientation #1 of the triangle (see diagram) and to calculate its area.



- Ask students to imagine the long side is the base and the height is the distance from there to the vertex (see diagram). Ask students to calculate the area of the triangle for orientation #2.



- Ask students to imagine the short side is the base and the height is the distance from there to the vertex (see diagram). Ask students to calculate the area of the triangle for orientation #3.

- Ask students to compare the three area calculations. Discuss the matter. ENSURE that they realize that the areas must be the same because no matter which orientation the triangle has, its area cannot change.

Activity 5: Addresses achievement indicator 7 and practice.

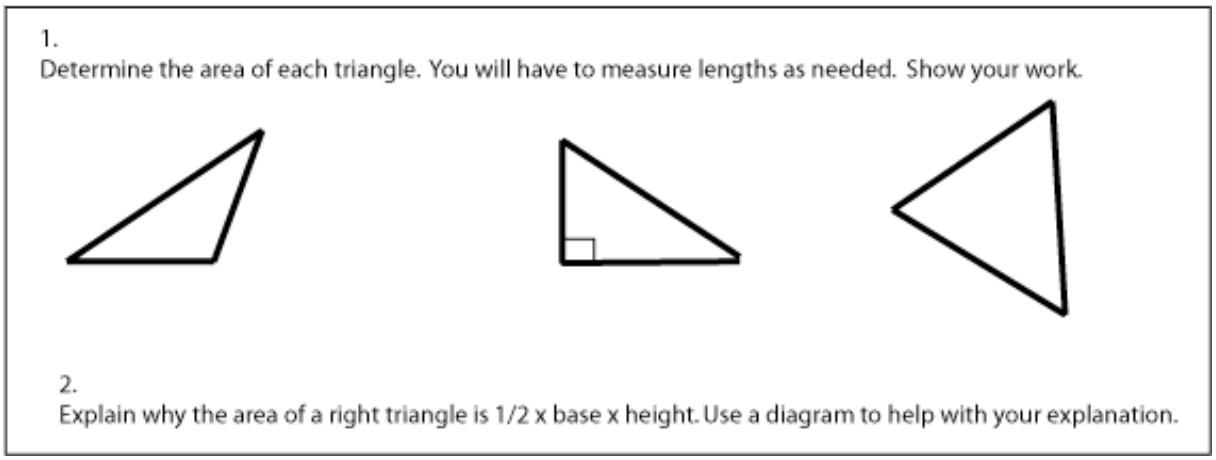
- Provide drawings of a variety of triangles in a variety of orientations (no more than six triangles in total) with no dimensions given. Ask students to determine the area of each triangle. [They will first have to measure base and width.] Discuss solutions.

Activity 6: Revisits SET SCENE and addresses achievement indicator 7 & practice.

- Revisit the SET SCENE task. Ask students to calculate the area of the triangle using the formula. Ask them to compare the answer obtained before to the calculated area. Discuss.
- Organize students into groups. Ask each group to create one word problem that involves finding the area of a triangle. Each group passes its problem to a different group. Each group solves the problem it was given. Assist as needed. Discuss the problems and the solutions.

Activity 7: Assessment of teaching.

- Provide a task sheet consisting of three different triangles and an explanation question. (see example below).



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

An example of a partially 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 worksheets.

Question 1.

Determine the area of each triangle.

a) Right triangle: base is 10 cm, height is 14 cm

b) Right triangle: base is 14 cm, height is 10 cm

c) Equilateral triangle: base is 20 cm, height is 17.6 cm

Question 2.

Determine the area of each triangle.

a)

b)

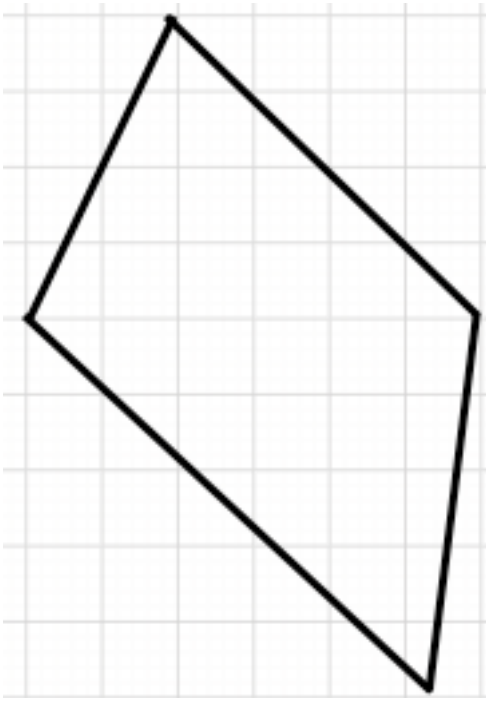
c)

Question 3.

An isosceles triangle has a base of 16 cm and the two equal sides each 12 cm long. What is the area of the triangle? Draw the triangle as part of showing your work.

Question 4.

What is the area of the kite shape? Hint: Look for triangles.



MAINTAIN stage

Mini-task example

Every so often:

- Present a diagram of a triangle without measurements included. Ask students to measure the pertinent matters and calculate the area of the triangle.

Rich-task example

Ask students to design a rocket using triangles, parallelograms, and rectangles and to label each type of shape in the rocket design. Ask them to determine the total area of the rocket design in square centimetres.

Comments

This is a rich-task because it is a complex problem that integrates area of a triangle with other area formulas.