Grade 6 Rectangle area

6.SS.3	
Develop and apply a formula for determining the • perimeter of polygons • area of rectangles • volume of right rectangular prisms	1. Explain, using models, how the perimeter of any polygon can be determined. [NOT DEVELOPED] 2. Generalize a rule (formula) for determining the perimeter of polygons. [NOT DEVELOPED] 3. Explain, using models, how the area of any rectangle can be determined. [DEVELOPED] 4. Generalize a rule (formula) for determining the area of rectangles. [DEVELOPED] 5. Explain, using models, how the volume of any right rectangular prism can be determined. [NOT DEVELOPED] 6. Generalize a rule (formula) for determining the volume of right rectangular prisms. [NOT DEVELOPED] 7. Solve problem involving the perimeter of polygons, the area of rectangles, and/or the volume of right rectangular prisms. [ONLY AREA PROBLEMS]

Clarification of the outcome:

- ✦ The outcome concerns developing the formula for calculating the area of a rectangle. The formula should be 'area = base x height' (not length x width) because base and height thinking transfers to other shapes such as triangles and parallelograms. Length and width thinking does not transfer; it is specific to rectangles.
- ✦ The outcome is unpacked into three parts because perimeter, area, and volume are distinctly different concepts. Only the area part is developed here.

Required close-to-at-hand prior knowledge:

- ✤ Automaticity of multiplication facts.
- ✤ Understand area as a count of identical squares that cover a shape.
- ✤ Understand base and height as dimensions of a rectangle.

SET SCENE stage

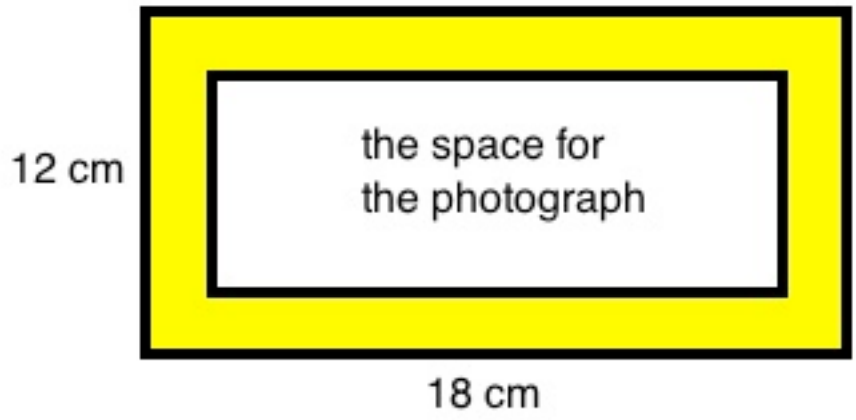
The problem task to present to students:

Ask students to solve the following problem in whatever way they want.

Provide 1 cm grid paper to use for solving the problem.

A border (the yellow area) is required inside a 12 cm by 18 cm rectangle. The border will go around a rectangular photograph. The border must have an area of 76 square cm. What are the dimensions of a rectangular photograph, when placed inside the 12 x 18 rectangle, results in a border area of 76 square cm?

[The dimensions must be whole numbers.]



Comments

The problem is somewhat complex but it allows for low-level solution strategies. It provides a believable situation for learning about a short cut (a formula) for calculating the area of a rectangle.

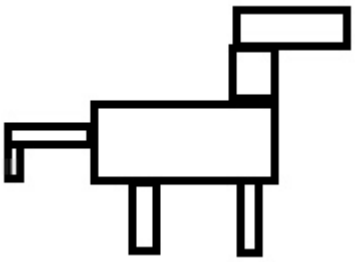
DEVELOP stage

Activity 1: Revisits SET SCENE

- Ask selected students to describe how they worked on the SET SCENE task. Discuss their thinking about area. Ensure students understand area as a count of counting squares that cover a shape.
- Discuss why it might be useful to determine the area of a rectangle (such as a wall to be painted) that is not conveniently marked off in identical squares.

Activity 2: Addresses achievement indicator 3.

- Have students use a drawing program (computer software), or geoboards, or grid paper to make/draw creatures from composite rectangular shapes (see example).
- Have students determine the areas of the creatures by counting squares. Discuss whether a shortcut (a rule/ formula) for determining the area of a rectangle might be useful for determining the areas of the animal shapes they drew.



Activity 3: Addresses achievement indicators 3 and 4.

- Ask students to figure out a shortcut for determining the area of a rectangle, expressing the shortcut in words.
- Using grids in a drawing program (computer software), or a geoboard, or grid paper, have students test their ideas by making rectangles, determining area by counting squares, and then determining area by using their shortcut. Have students express the verified shortcut in words (e. g. multiply the base times the height of a rectangle).

Comments

Steer students towards using base and height terminology rather than length and width. Base and height thinking has future payoff when developing other area formulas (e.g. a triangle).

Make sure that students use the side length of a square as the unit for measuring base and height.

Activity 4: Addresses achievement indicators indicators 4 and practice.

- Organize students into pairs. One student in each pair selects three whole number values for the area of a rectangle (e. g. 36 sq cm, 24 sq cm, 25 sq cm). The other student determines, by using the shortcut of base x height, all possible rectangles for each area (only for whole number lengths and widths). The student selecting the area values assesses the correctness of the solutions. Then the two students switch roles.

Activity 5: Addresses achievement indicators 4 and practice.

- Have students find rectangles in the room and measure the dimensions (length and width). Ensure that students find rectangles that are best measured in millimetres (e. g. a postage stamp), in centimetres (e. g. a sheet of paper), and in metres (e. g. the floor of the room).

Activity 6: Addresses achievement indicators 4 and 5.

- Have students measure the dimensions of a sheet of paper in millimetres and in centimetres. Have them calculate the area (using a calculator) for each unit of measurement. Discuss the effect of a unit of length on the calculated area (a smaller unit of length results in a larger number for the area).
- Discuss where a square kilometre is used as a unit of area for a rectangle. Have students visualize a rectangular region in their neighborhood (e. g. five blocks by six blocks) and estimate the area of the region in square kilometres.

Activity 7: Addresses achievement indicators 4, 5, and revisit SET SCENE.

- Ask students to solve the SET SCENE task again by using the base x height formula. Ensure they realize that '12 x 18 - 76' (140 sq. cm) is the area of the rectangular photograph. Ensure they realize that the only rectangle that has an area of 140 that can fit inside the 12 by 18 rectangle is a 10 by 14 rectangle.

Activity 8: Addresses achievement indicators 4 and 5.

- Provide students with at least three problems that involve finding the area of a rectangle such as: *A rectangular garden has an area of 200 square metres. Find the base and height of a rectangle that would have that area. Find a different base and height of a rectangle that would also have that area.*

Activity 10: Assessment of teaching.

- Ask students to solve a problem similar to the sample problem provided in activity #9. Ask them to show their thinking.

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.

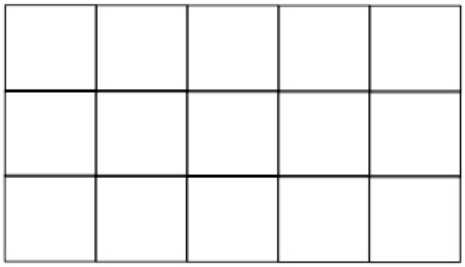
The MAINTAIN stage follows the sample worksheet.

Question 1.

Use the 'count squares' method to determine the area of the rectangle. _____

Use the 'formula' method to determine the area of the rectangle. Show your work. _____

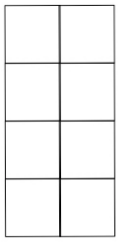
Should the two answers be the same? _____



Question 2.

What is the base of the rectangle? _____

What is the height of the rectangle? _____



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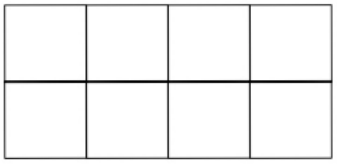
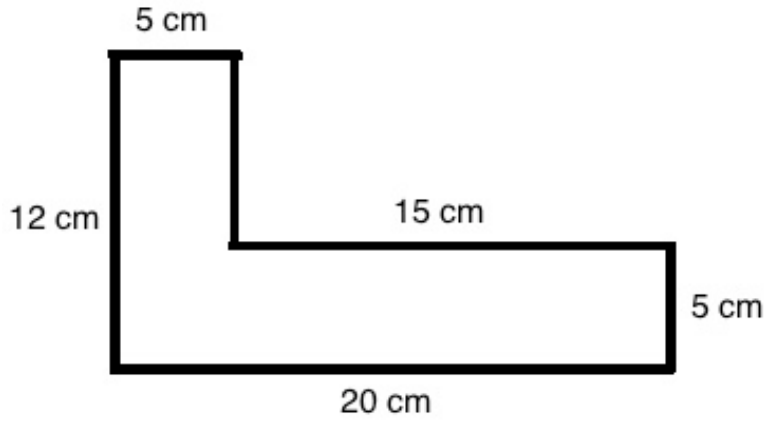


Question 3.

A rectangle is 12 cm by 8 cm. What is its area? Show your work. _____

Question 4.

What is the area of the composite shape? Show your work. _____



MAINTAIN stage

Mini-task example

Every so often:

- Provide students with a rectangle diagram, and ask them to determine its area using the formula.

Rich-task example #1

Using a drawing program (computer software) or square grid paper, have students design a business card in the shape of a rectangle and estimate and confirm the area, using the formula for determining the area of a rectangle. Have students figure out the number of cards that can be made from a 22 cm by 29 cm sheet of suitable paper.

Rich-task example #2

Give students the following information:

In each square centimetre of your skin there are about 2480 nerve endings. Ask students to estimate the number of nerve endings in their palms by approximating fingers etc. as rectangles and by using the rectangle area formula.

Comments

Both sample tasks involve complex problem solving.