Area of Trapezoids

Summary

The students will be able to determine the area of a trapezoid by the composition and decomposition of rectangles, triangles, and parallelograms.

Main Core Tie

Mathematics Grade 6

Strand: GEOMETRY (6.G) Standard 6.G.1

Materials

- Shapes sheet *(Area of Trapezoids Attachment 1)* (pdf)
- Recording sheet *(Area of Trapezoids Attachment 2)* (pdf)

Scissors
Colored pencils
Paper
Graph Paper
Ruler or tape measure

Books:

- *Elementary and Middle School Mathematics*
, by John A Van De Walle; ISBN 1402918348

Background for Teachers

This lesson uses the principles from the lessons "Classifying Quadrilaterals" and "Decomposition and Area." Both lessons should have been taught prior to this one. Students will be given the opportunity to decompose shapes concretely, then represent them pictorially on paper, then will be transitioned to creating and using a formula for finding the area of a trapezoid.
This lesson assumes that students are competent in finding the area of rectangles and width of a side.
This lesson takes a problemsolving approach that is meant to allow students to develop their own meaning of area, and their own methods of finding it. Do not give the formula for a trapezoid until students have come up with their own methods and you've discussed accuracy and efficiency. Giving the formula too soon will cause students to simply "plug" in the numbers and solve. This is a lower level skill than being able to develop and understand a method for finding the area of a trapezoid. squares. A review of this knowledge may be helpful before beginning the lesson. It is also helpful if the students think of the formula for the area of a rectangle as b x h = A (base x height = Area) rather than or in addition to l x w = A. This allows for a smooth transition into the area formula of other shapes where the height is not the same as the length or

Intended Learning Outcomes

Develop a positive learning attitude toward mathematics.
Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems.
Reason logically, using inductive and deductive strategies and justify conclusions.
Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and notation of mathematics.
Connect mathematical ideas within mathematics, to other disciplines, and to everyday experiences.

Represent mathematical ideas in a variety of ways.

Instructional Procedures

Invitation to Learn:

Create a whole class KWL chart about area. Under the "K" column students should brainstorm everything they know about area, including how to find it and for which shapes they can find it. They should also include what area means. Under the "W" column students suggest what they want to know about area. If necessary, make some suggestions of your own to add to the list. The chart can include words and pictures. You may invite students to write their own contributions on the chart, or you can record it all.

At the end of the lesson the "L" column will be completed with everything the students have learned about area.

Instructional Procedures:

Students need one sheet of shapes to cut out "Area of Trapezoids Attachment 1" and one recording sheet "Area of Trapezoids Attachment 2."

Explain to students that it is important for mathematicians to record their work. We will be working with the shapes we've cut out, and we'll be recording our work as we go. Colored pencils work nicely to show what we're doing.

Note: Throughout the instructional procedures students are not actually finding the area, they are discovering methods and formulas to find the area. Students will actually compute the area during the attached activity.

"Set the parallelogram in the center of your desk and set the other shapes aside."

"Trace the parallelogram onto your paper to show what shape we're using."

"Our goal is to find the area of one parallelogram. We already know how to find the area of rectangles, but this is not a rectangle. What makes it different from a rectangle? Do you think these differences will affect how we find the area?"

"Go ahead and examine your parallelogram and discuss at your table any ideas for how we could find the area. You're welcome to draw on, fold, or cut your parallelograms if you think it will help." (If students are stuck, ask questions about how we could change the parallelogram to be like a rectangle so we can use what we already know about area.)

Have each table share their findings.

Hopefully, students discover that by decomposing a parallelogram into a trapezoid and a triangle, then moving the triangle to the other side, we can transform the parallelogram into a rectangle. Record this transformation on your paper using a different color.

Discuss that while making the new rectangle we didn't add any new paper to our parallelogram and we didn't take any away, we just rearranged it. The area of the original parallelogram will be the same as the area of the original rectangle. Thus, the formula we already know for rectangles ($b \times h = A$) works for parallelograms as well. (Emphasize that the diagonal side of the parallelogram is NOT the same as the height. This is a very common misconception among students.)

You can have students check that the area calculated using the $b \times h$ formula is actually correct by having them trace the parallelogram shape onto graph paper and having them using the square units on the graph paper to verify their answer. You can also print the shapes on graph paper.

Repeat steps 15 using the triangle instead. If they need hints guide them towards thinking about how we can make a triangle look like a rectangle or parallelogram. Recommend that they partner with someone at their table and combine their two triangles. Students record their work on their paper.

Discuss how two congruent triangles can always form a parallelogram with the same base and

height. However, we only want the area of one of the triangles, so have the students explain how we can find only half of the area of the new parallelogram (1/2 b x h = A). Record findings on the paper next to the triangle.

Once again, have students verify that the formula is correct by using graph paper.

Repeat steps 15 using the trapezoid. Remind students that they now know how to find the area of a rectangle, parallelogram and a triangle and should think of ways to decompose the trapezoid into those known shapes. Let them explore different ways to do that. Encourage them to cut, fold and move pieces to form the shapes they know. Students record what they've tried on their paper.

Once they've discovered how to find the area, they will probably need your help to express it as a formula. Students might have decomposed the Trapezoid in different ways. You can have students present the different ways they decomposed. Use the example where the trapezoid was decomposed into a rectangle and two triangles and then rearranged to form a rectangle to dicuss the formula. Talk to them about how each trapezoid has two bases, and that it is helpful to label them Base 1 and Base 2. Look at the base of the created rectangle. Is it like Base 1? Base 2? Would you say it's inbetween the size of base 1 and 2? The base of the created rectangle is the average of base 1 and 2.

Introducing the base as the average of the two bases might be the simplest way of getting students to understand the formula. If your students are Algebra ready, you can try showing how the formula can be derived algebraically. Once you've come up with the formula (1/2 x (base 1 + base 2) x h = A), they record it on their paper. Have them calculate the area using the formula and then verify using graph paper.

Lesson and Activity Time Schedule:

Invitation to Learn: 10 minutes
Instructional procedures: 35 minutes
Finish KWL (Assessment): 10 minutes
Attached activity: 35 minutes
Total lesson and activity time is 90 minutes.

Activity Connected to Lesson:

Students return to their recordings and find the actual measurements of each shape, then find the area using their new formulas. They record the area on the same sheet.

Depending on your students' number sense abilities, you decide how precise you'd like their measurements to be (i.e. rounding to the nearest cm, etc.).

Two "extra" shapes have been provided for students who may finish early and need additional challenges.

Students engage in smallgroup problem solving for Attachment 3 (pdf), which applies the content from this lesson as well as prior knowledge.

Extensions

Students find trapezoids in real life, measure them, and find the area. This is more authentic and meaningful than only finding area of trapezoids on worksheets.

Family Connections:

Using the studentmade tangrams from previous lesson, students can show their families how they can create various trapezoids and find the area using actual measurements.

Assessment Plan

Complete the KWL chart and assess what students offer as new knowledge they've learned about area.

In Instructional Procedures Step 3, carefully monitor students' abilities to recall the difference

between a rectangle and a parallelogram.
As students are working together at their tables, be sure to spend some time with each group asking guiding questions and assessing their ability to apply their knowledge to find new formulas. A clipboard makes documentation easy.
Student records provide an understanding of the students' methods and thinking.

Authors

Kellie Horton