

## Sessions 4 and 5

# Writing About Area

### Materials

- Completed homework (Sessions 2 and 3)
  - Materials for finishing posters
  - Student Sheet 10, Make a Shape (1 per student)
- For the computer activity:
- Students' Game Records

### What Happens

During these sessions, students will be finishing up their posters. Some can continue to work at the computer on Tumbling Tetrominoes. All students work on an assessment activity in which they explain how they know the area of a shape is 5, 6, or 7 square units. Their work focuses on:

- making a shape with a given area
- explaining and justifying a solution in writing

### Ongoing Computer Activity

During Sessions 4 and 5, students may continue playing Tumbling Tetrominoes on the computer while others are working on the off-computer activities. Working with the My Rectangle option provides further practice in determining area.

## Activity

### Discussing Homework: Area at Home

Take some time to ask students about the homework they did on Student Sheet 8, Squares! Squares! Squares!

**Did you find areas in your homes or neighborhoods that were covered with squares? What were they? About how big was each square unit—bigger or smaller than the squares you are using for your posters? Bigger or smaller than the tiles on our classroom floor? How big was the total area (how many square units)?**

You may also want to choose one of the problems on Student Sheet 9, What's My Score? What's My Area?, to discuss with the class.

**What is the total area of the rectangle? How much of that area is covered? How did you figure that out?**

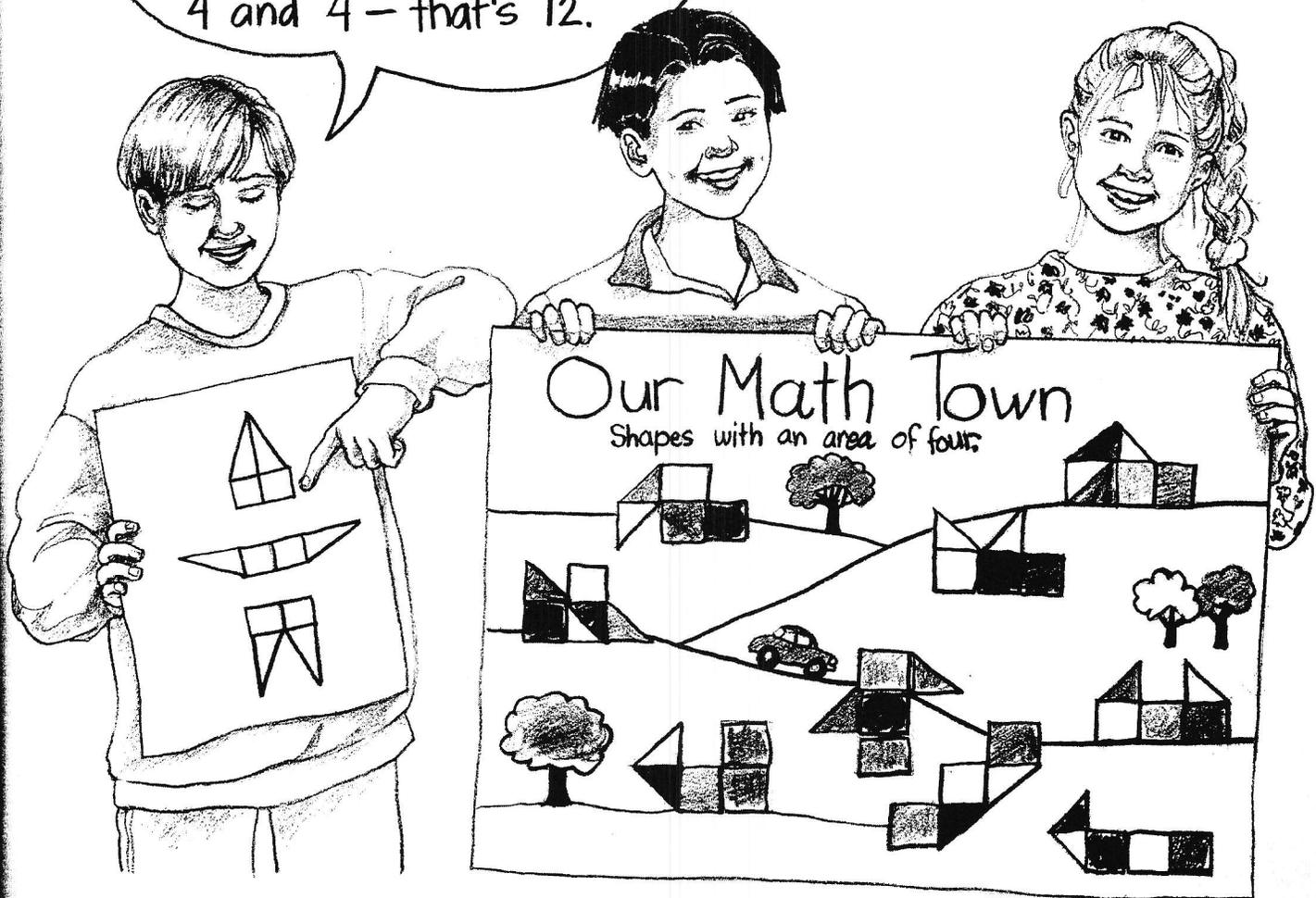
## Activity

Students work to complete their posters of shapes with an area of four square units. As they work, they keep checking new shapes they find for congruence with shapes they already have posted. As students finish, you can display the posters in the classroom.

Some students enjoy making pictures out of their four-square-unit shapes and coloring in details and backgrounds.

## Finishing the Posters

I made a person. These are the legs, the hands, and the head. It's 4 and 4 and 4 - that's 12.



## Activity

### Assessment

## Proving the Area of a Shape

Toward the end of Sessions 4 and 5, hand out Student Sheet 10, Make a Shape. Have each student draw a shape that is 5, 6, or 7 square units in area, using the dotted grid as a guide. Encourage students to use all three kinds of shapes they have worked with in this unit: the unit square, the half-unit triangle, and the unit triangle.

After drawing their shape, the students write an explanation of how they know what its area is. When you give students this assignment, explain that they may be doing several drafts, just as they do when they write, until they have a finished piece of work.

As students show you their written work, make sure that they have a complete explanation that could be understood by someone who had not been in class. Ask clarifying questions and have students add what they tell you to their written work. The **Dialogue Box**, *The Area of My Shape Is 5* (p. 64), shows how a teacher encouraged one student to clarify her explanation in successive drafts.

❖ **Tip for the Linguistically Diverse Classroom** Students who are not yet writing in English can share how they know their shape has a specific area by creating a visual math problem. For example:

$$\begin{array}{r} \triangle \triangle \triangle \triangle \triangle \triangle = 3 \square \\ \triangle = 1 \square \\ \square \square = 2 \square \\ \hline 6 \square \end{array}$$

For the revision, encourage students to add to their drawings to explain even further. For example:

$$\begin{array}{r} \triangle \triangle \triangle = \square \square \square = 3 \square \\ \triangle \triangle \triangle = 3 \square \\ \triangle = 1 \square \\ \square \square = 2 \square \\ \hline 6 \square \end{array}$$

You may want to assign this task for homework after Session 4, then give students time in class to revise it during Session 5. For discussion about how to evaluate this assessment, see the **Teacher Note**, *Assessment: Proving the Area of a Shape* (p. 62).

## Activity

### Choosing Student Work to Save

As the unit ends, you may want to use one of the following options for creating a record of students' work on this unit.

- Students look back through their folders or notebooks and write about what they learned in this unit, what they remember most, what was hard or easy for them. You might have students do this work during their writing time.
- Students select one or two pieces of their work as their best work, and you also choose one or two pieces of their work to be saved in a portfolio for the year. You might include the last assessment in the unit, Proving the Area of a Shape (Investigation 2, Session 5), and any other assessment tasks from this unit. Students can create a separate page with brief comments describing each piece of work.
- You may want to send a selection of work home for parents to see. Students write a cover letter, describing their work in this unit. This work should be returned if you are keeping a year-long portfolio of mathematics work for each student.

## Sessions 4 and 5 Follow-Up

**All Possible Shapes** As students complete their shape posters, some may become interested in how many possible shapes there are with four square units, and may want to try to find them all. Using only the unit squares and half-unit triangles, we have found 22 shapes (so far!).

You might compile a class poster showing all the different shapes that the class has discovered, with no duplicates. This compilation can remain displayed beyond the completion of this unit, and students can continue to try to find new shapes.

Remember, a shape that is a flip or rotation of another shape is considered the same. Students need to carefully compare any "new" shape to the shapes that have already been created.

### Extension

This assessment asks students to solve a problem, justify their solution, and then write about their work. Communicating about mathematical reasoning is difficult, especially if students have not had much experience doing so. However, it is a critical part of mathematical activity. Because writing is difficult for many students, we treat this task in the way that we treat any writing assignment—giving students time to write down their first thoughts, present these to an audience (you), get feedback on their work, and then use that feedback to revise it.

It is important that students' performance not be judged only on their first attempts at solving a problem, but that they be given time to think, reflect, and revise.

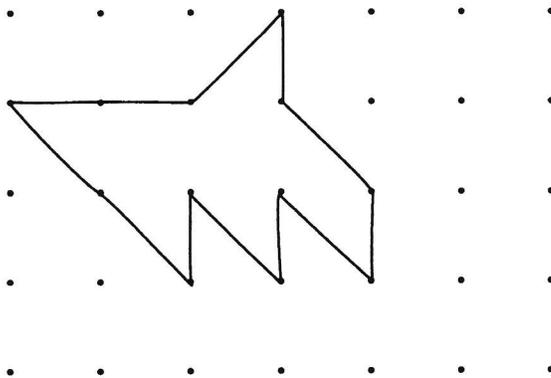
As you look at your own students' work, these questions can help guide your assessment:

- Was the student able to draw a shape and clearly show its area?
- Did the student understand how much area the half-unit and unit triangles covered?
- Was the student able to explain clearly how to calculate the area?

Following are several examples of student work. The first two explanations, Khanh's and Elena's, are quite clear and inclusive.

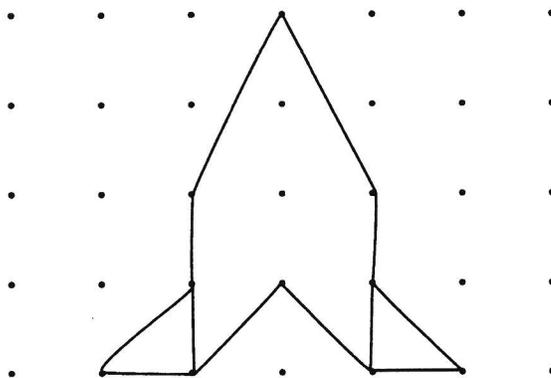
*Khanh's writing:*

I know that there are 5 because 2 triangles make 1 square exactly. And 1 square makes 1, and my design has 6 triangles, and 6 triangles make 3, and 2 squares make 2, and 3 plus 2 makes 5 square units.



*Elena's writing:*

There are 4 of the little triangles. That's 4 halves, so that makes 2. Then there's 2 of the big triangles. If you put them together like I did they cover two squares, so that's 2 more. That's 4 so far. Then there's 2 regular squares. So 2 more makes 6 squares.

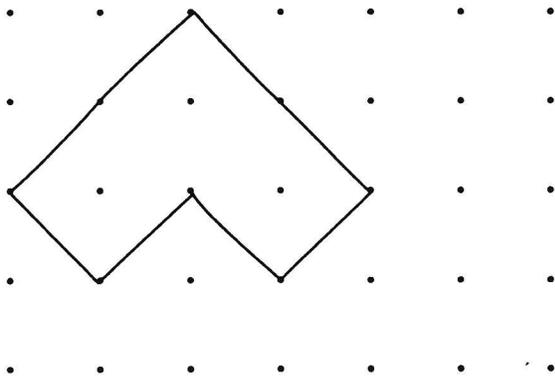


Both Khanh and Elena demonstrate their knowledge of the relationships between triangles and squares, and explain how to combine the pieces to find the area of their shapes. Elena has set herself a somewhat harder task, including the unit triangle in her shape.

Here are two examples of less complete explanations:

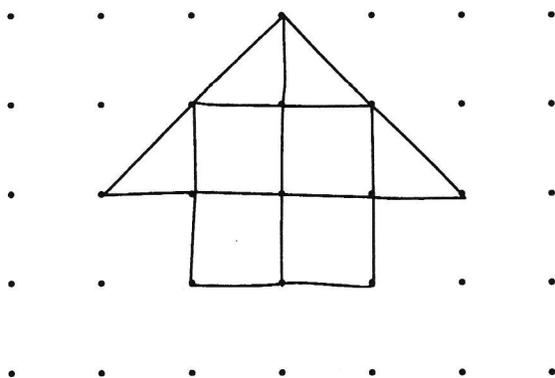
*Jeremy's writing:*

I know that my shape has 6 square units because it has 2 squares and 8 triangles and when you add them together you get 6 square units.



*Laurie Jo's writing:*

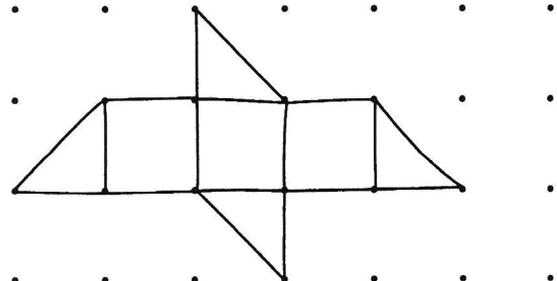
I counted them in halves and in wholes. The triangles are the halves and the wholes are the squares.



Jeremy and Laurie Jo may have a clear understanding of how to use the squares and triangles to measure the area of their shapes, but they have difficulty writing down their explanations. Further questioning might determine if these students are just repeating that triangles are halves because everyone is saying that, or if they are able to explain why this is true.

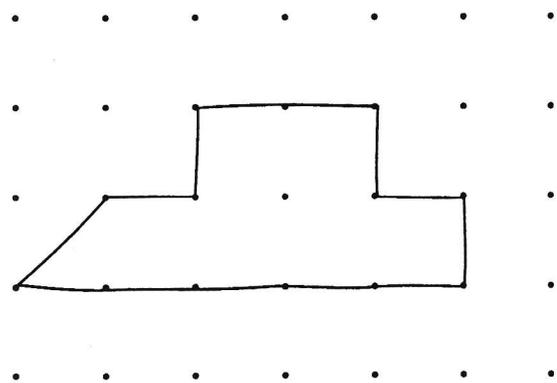
*Mark's writing:*

There are three squares and four triangles.



*Amanda's writing:*

Because it's different and I like it.

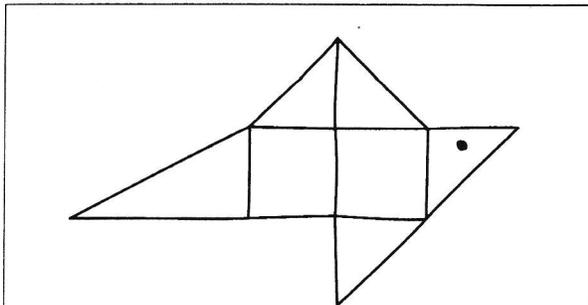


When students have a much less adequate explanation, this may indicate that they are not yet thinking about area as a covering of flat space. Mark and Amanda might need more guidance along those lines.

Amanda's writing could be a sign that she doesn't understand what you mean when you ask her to write about her mathematical thinking. She may be answering a question like "What did you think of this problem?" Further conversation is needed to determine what she understands about the problem itself.

## The Area of My Shape Is 5

Seung created a 5-unit shape for the assessment activity, Proving the Area of a Shape (p. 60). When Seung showed her work to her teacher, the following discussion helped the girl clarify her writing.



My fish. I know that the area of my fish is 5 because it has two squares and 4 triangles and 1 big triangle.

Why does 2 squares and 4 triangles and 1 big triangle make 5 square units? Maybe someone would count the pieces, [pointing to the pieces in succession] 1, 2, 3, 4, 5, 6, 7, and say that the area is 7.

**Seung:** No, because the squares are 1, 2, and then each triangle is half.

So how does that work to make 5?

**Seung:** Because, see, 1, 2 [touching each square], 3 [touching two small triangles], 4 [touching the other two small triangles], and 5 [touching the large triangle].

So you need to write more about how you counted the area.

Seung then added to her writing, so that it read:

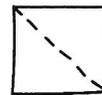
My fish. I know that the area of my fish is 5 because it has two squares and 4 triangles and 1 big triangle. The squares make two and then two triangles make one more and the other two triangles make one more, so that's 4. Then the one big triangle is a 1, so that makes 5!

That makes it much clearer to someone reading this how you counted the area to be 5 square units altogether. I only have one more question: How do you know that two small triangles make one square unit and the big triangle by itself is one square unit?

Seung protested that she knew "because we've been doing it all the time," but the teacher explained that her solution should make sense to someone who hadn't been "doing it all the time."

Seung's final writing looked like this:

My fish. I know that the area of my fish is 5 because it has two squares and 4 triangles and 1 big triangle. The squares make two and then two triangles make one more and the other two triangles make one more, so that's 4. Then the one big triangle is a 1, so that makes 5! Two small triangles make one square because if you put them together, they make one, like this:



The big triangle is the same as 1 square because if you chop off the top and attach it to the bottom, it's the same.