Exploring Area

Grade 4

Note to teachers:
This unit provides students with a reintroduction to the concept of area using arrays as a primary focus of this work. Area will be also revisited later in the year with larger numbers.

Overview of the Lessons

Day 1- Ordering Rectangles

Day 2- Working with Rectangles

Day 3- Missing Dimensions

Day 4- Rectilinear Figures

Day 5- Recttiinear Figures

Ten Minute Math

Each lesson starts with a ten minute math activity that addresses other mathematics Standards. The Ten Minute Math activity can be done anytime that day and does not need to come immediately before the lesson. In this 5 lesson unit, the Ten Minute Math activities are:

Target Number (4.NBT.2, 4.NBT.4). Students work on subtraction skills.

Round Off (4.NBT.3, 4.NBT.4). Students work on rounding and number sense skills.

What's the value? (4.NBT.1, 4.NBT.2). Students work on place value skills.

Distance traveled (4.NBT.2, 4.NBT.4). Students work on subtraction skills

Target Number (4.NBT.2, 4.NBT.4). Students work on subtraction skills.

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Lesson 1: Which rectangle is the largest?

Cluster: Solve problems involving measurement and conversion of measurements. **Standard:** 4.MD.3	**Emphasized Standards for Mathematical Practice:** MP 3: Constructing a viable argument MP 6: Attend to precision
Mathematical Goal: The student will explore the idea of area by tiling a rectangle.	**Words you should hear students using during a mathematical conversation:** Dimensions, area, tile or cover, bigger, smaller
Materials: Copy of rectangles (see attached) Color tiles- 20 per pair or group	

Ten Minute Math: Target Number (4.NBT.2, 4.NBT.4)
We want to reach the target number 99. Your final equation can only use subtraction and cannot use a 0, 1, 2, or 5. Encourage students to find more than one solution.

Before :
Distribute the rectangles to students. It is best if the rectangles are pre-cut or allow a few minutes for students to cut out the 7 rectangles.

Ask students, "I want you to order these rectangles from largest to smallest."
Let students order these without guidance and correction.

During the lesson:
Each group orders the rectangles and discusses how to put them in order. Once groups have put them in order have them discuss their strategies and results.

Questions you may ask:
Can someone describe how they put them in order? What do you mean by largest?
If these rectangles were brownies which one would we want? Why?
Introduce the word area as a *measurement of space inside of a shape*.

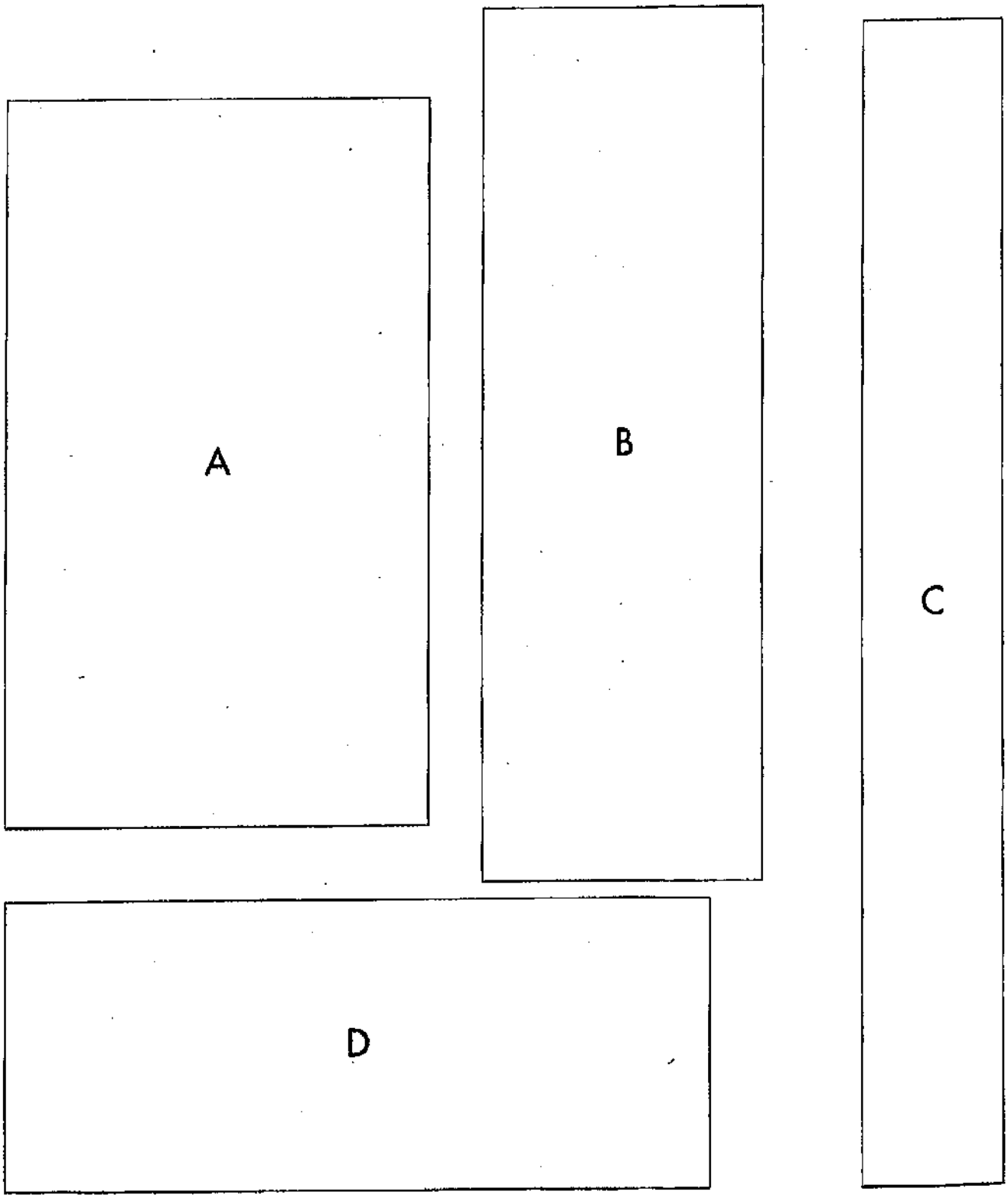
After:
Distribute color tiles to students. Have students cover each shape with tiles to determine the area of each shape. As students tile they should record their results for a discussion later.
*Options for this activity include:
1) students stay in their seat and tile each shape
2) the various shapes are at different stations around the room and students circulate and tile each shape.

Facilitate a discussion of area by asking:
How did you determine which rectangle was the largest?
Help students to create a chart listing the rectangle dimensions and the area.
Ask students if they can write an equation to find the area of any rectangle on the chart.
Write 2 equations based on dimension that you see on the chart.

Evaluation:
Exit ticket- Explain what you did in math class today. How did you first decide to order your rectangle? Did using the tiles change the order of your rectangles? Why or why not?

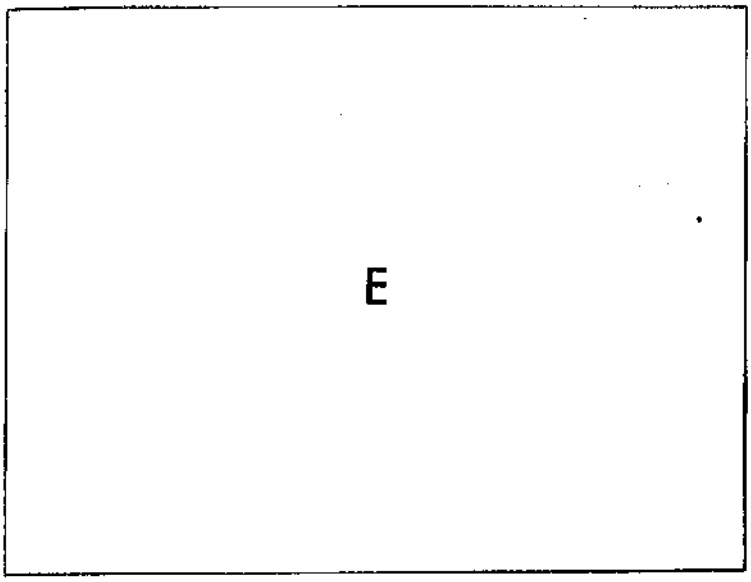
WHICH IS BIGGEST? (SHAPES A–D)

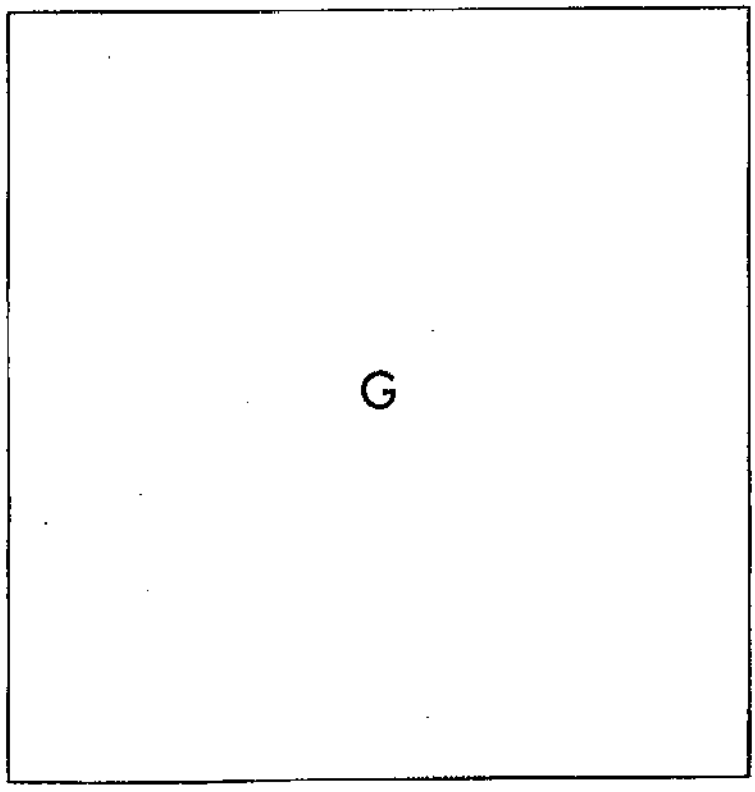
Cut out the rectangles. Which is the smallest? Which is the biggest? Put them in order.

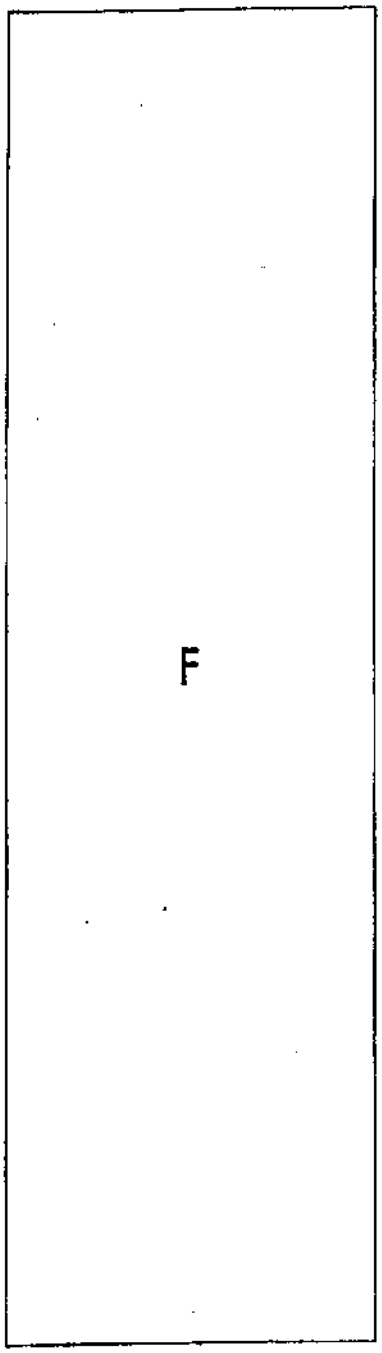


WHICH IS BIGGEST? (SHAPES E–G)

Cut out the rectangles. Which is the smallest? Which is the biggest? Put them in order.







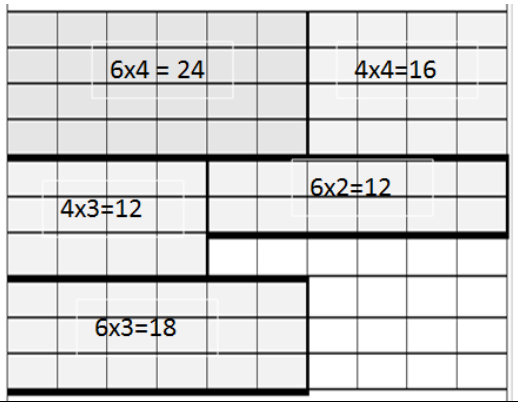
Day 2: Working with Rectangles

Cluster: Solve problems involving measurement and conversion of measurements. **Standard:** 4.MD.3	**Emphasized Standards for Mathematical Practice:** MP 3: Constructing a viable argument MP 5: Model with mathematics
Mathematical Goal: Students will explore the idea of area as a product of the length and the width.	**Words that you should hear students using in mathematical conversations:** Area, dimensions, length, width
Materials: Each group needs two number cubes. Each student needs a copy of the *Rolling a Rectangle* grid.	

Ten Minute Math: Round Off (4.NBT.3, 4.NBT.4)
There are 702 students in the cafeteria. 66 of them leave. About how many hundred students are still there? How close was your estimate to the actual answer?
If you rounded 66 to the nearest ten how close would that estimate be to the actual answer?

Follow-up task: There were 865 students in the cafeteria. 48 of them leave. About how many hundred students are still there? How close was your estimate to the actual answer? If you rounded 48 to the nearest ten how close would that estimate be to the actual answer?

Before:
Demonstrate how to play the *Rolling a Rectangle* game. Each group needs 2 number cubes and each student needs their own copy of the rolling a rectangle template (see the attached 10x10 grid). Roll the 2 number cubes to get the dimensions of the rectangle. Outline the rectangle on the grid writing an equation for the area inside of the rectangle. The game continues until you can no longer fit any more rectangles. Your score is the number of squares left. The lowest score wins. Students in this lesson can work through *Rolling a Rectangle* and Breaking Apart Arrays.

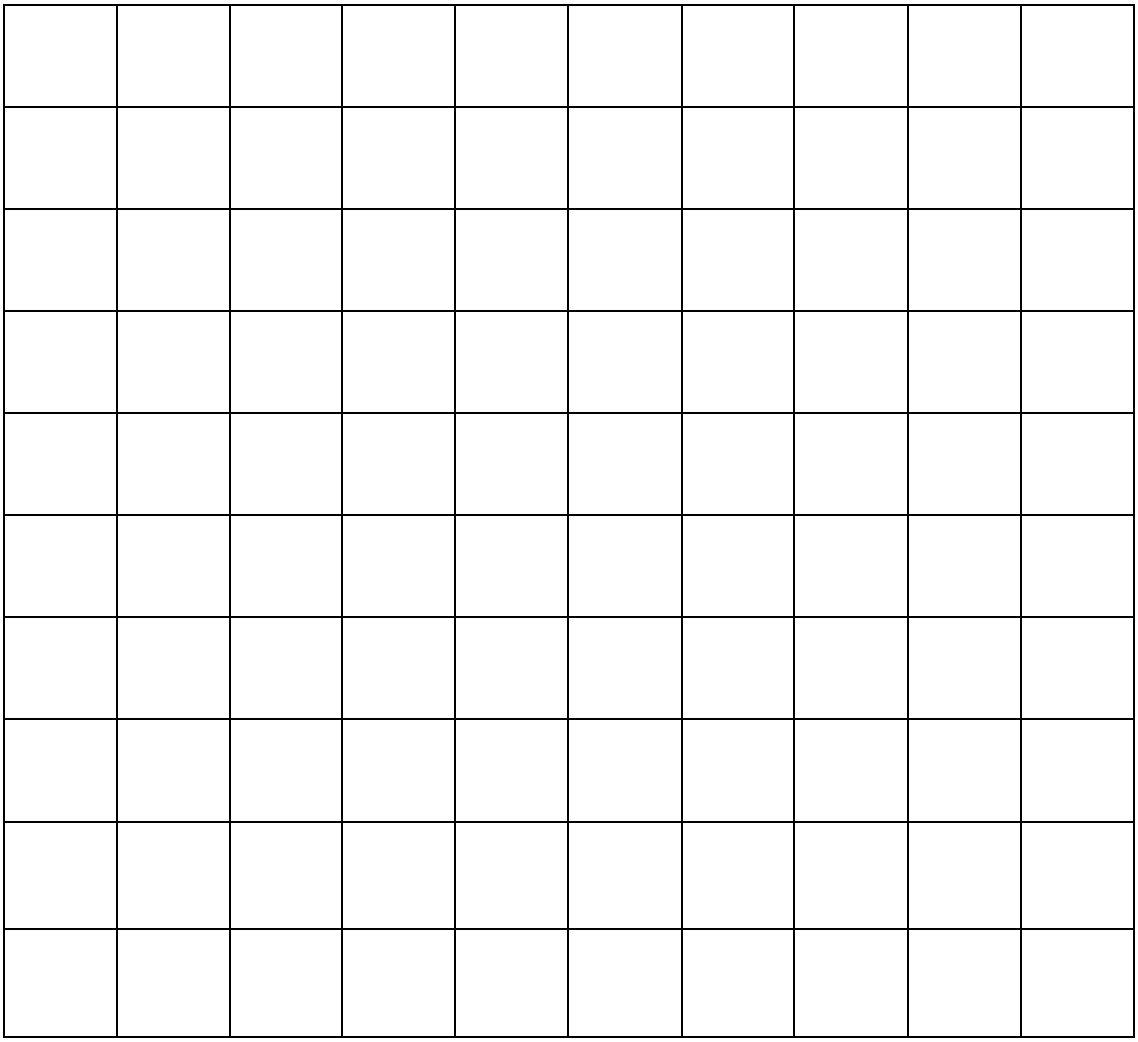


During:
Breaking Apart Arrays: see the attached activity sheet. Students decompose arrays into smaller multiplication problems. For example, 24 tiles can be made into an 8x3 rectangle. From there, students can determine how they will split the 8x3 rectangle into 2 smaller rectangles. Possibilities include: 6x3 and 2x3; 5x3 and 3x3; 7x3 and 1x3; 4x3 and 4x3; or 8x2 and 8x1.

After:
Pose this task to students, "what if we had a garden that was 6 ft by 4 ft long. What if we wanted to double the size of the rectangle?" Use grid paper or an interactive white board for a visual.

Evaluation: Evaluate student work on the various activities.

Roll a Rectangle Template



Name_____

Breaking Apart Arrays

Directions:

1. Choose the number of tiles you will use for this activity:

12 16 18 20 22 24 28 36

2. Count out the number of tiles you need. You will only use these tiles.

3. Complete the chart.

	Larger Array	Smaller Array
Break-Apart 1		
Break-Apart 2		
Break-Apart 3		
Break-Apart 4		
Break-Apart 5		
Break-Apart 6		
Break-Apart 7		
Break-Apart 8		
Break-Apart 9		
Break-Apart 10		
Break-Apart 11		
Break-Apart 12		

Lesson 3: Changing Dimensions

Cluster: Solve problems involving measurement and conversion of measurements. **Standard:** 4.MD.3	**Emphasized Standards for Mathematical Practice:** MP 3: Constructing a viable argument MP 5: Model with mathematics MP 6: Attend to precision
Mathematical Goal: The student will find the missing dimension of a rectangle	**Words that you should hear students using in mathematical conversations:** Area, dimensions, length, width
Materials: Graph paper, Square tiles	

Ten Minute Math: What's the value? (4.NBT.1, 4.NBT.2)
You have 18 objects in a jar.

a) If your objects were pennies what would be the value of your collection?
b) If your objects were dimes what would be the value of your collection?
c) If your objects were one dollar bills what would be the value of your collection?
d) If your objects were ten dollar bills what would be the value of your collection?

What do you notice about the value of your collections? What pattern do you notice about the value of your collections?

Before:
Show students a 9 unit by 6 unit rectangle and have them break it apart into different shaped rectangular arrays. Ask for multiple strategies and record the 2 arrays as an equation.
Examples: 9 x 3 + 9 x 3, 9 x 5 + 9 x 1, 5 x 6 + 4 x 6

During the lesson:
Pass out the task Designing a Storage Unit (see attached).
As students work, ask them: What do you know that is helping you start this task? How are you thinking about describing this shape to a friend?

After:
Facilitate a discussion by having each group share their strategies and the dimensions of their rectangles. Questions to ask:
What strategies did you use to find the dimensions of the rectangles?
How do you know you found all the rectangles with that area?

Evaluation:
Exit ticket- Tell them that you have a rectangular room that has 42 square feet of flooring on it. Ask them to determine the various combinations of side lengths for that room.

Designing a Storage Unit

Your class wants to build a non-rectangular storage unit to hold school supplies that has an area of 20 square feet all right angles. Using square tiles can you make a model of what some of these storage units may look like. Remember for your shape to have all right angles, each tile needs to be sharing at least one side with another tile.

Draw your examples on graph paper.

If you had to describe your shape to a friend what would you say?

How would you describe your shape to a friend in terms of dimensions? Are there smaller rectangles that make up your shape?

What would an equation look like?

If you get done early build another example of a storage unit and try to write a description and equation. Possible areas: 24, 32, 36, or 40 square feet.

Lesson 4: Composite Shapes

Cluster: Solve problems involving measurement and conversion of measurements. **Standard:** 4.MD.3	**Emphasized Standards for Mathematical Practice:** MP 3: Constructing a viable argument MP 5: Model with mathematics MP 6: Attend to precision
Mathematical Goal: The student will find the area of rectilinear figures.	**Words that you should hear students using in mathematical conversations:** Area, dimensions, length, partition, width
Materials: Graph paper, Plastic square tiles	

Ten Minute Math: Distance traveled (4.NBT.2, 4.NBT.4)
Your family drives 501 miles during a 2 day trip. They drove between 271 and 290 miles on Day 1. The number of miles that they drove on Day 1 was not an even number. How many miles could they have driven each day? Find as many possible answers as you can.

Follow-up: Your family drives 912 miles during a 2 day trip. They drove between 473 and 479 miles on Day 1. The number of miles that they drove on Day 1 was not an even number. How many miles could they have driven each day? Find as many possible answers as you can.

Before :
Today we are going to look at different shaped rooms and see how much carpet we will need for each room.
Put up the letter T on the overhead projector. "How can we find out how much carpet we will need for this room?" Have students brainstorm strategies. We do not want actual answers.

During the lesson:
Pass out copies of the letter T. Have students spend 10 minutes working to solve the problem. Monitor students as they work: Possible questions to ask:

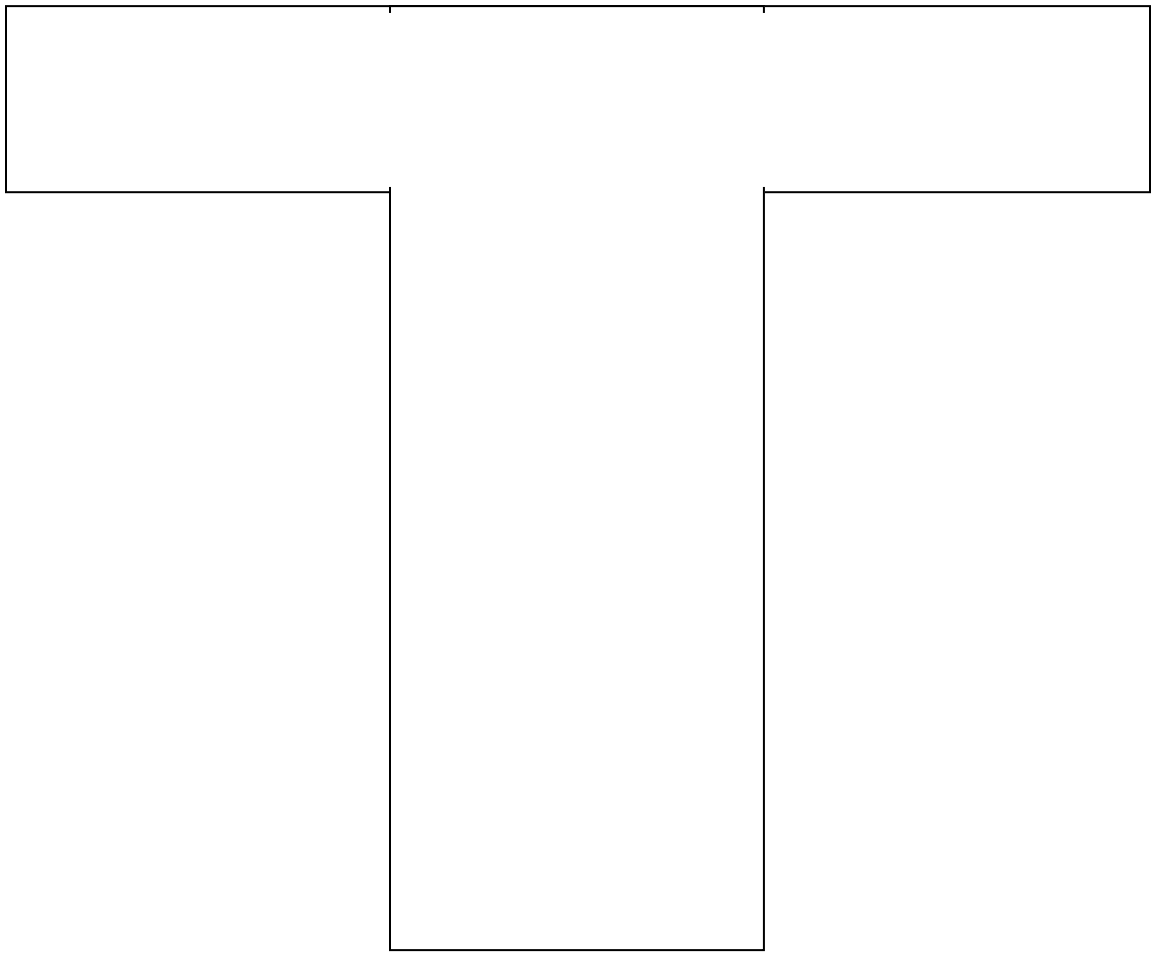
- "What strategies are you using to find the area of this room?"
- "How many rectangles did you decide to break your shape up into? Why?"

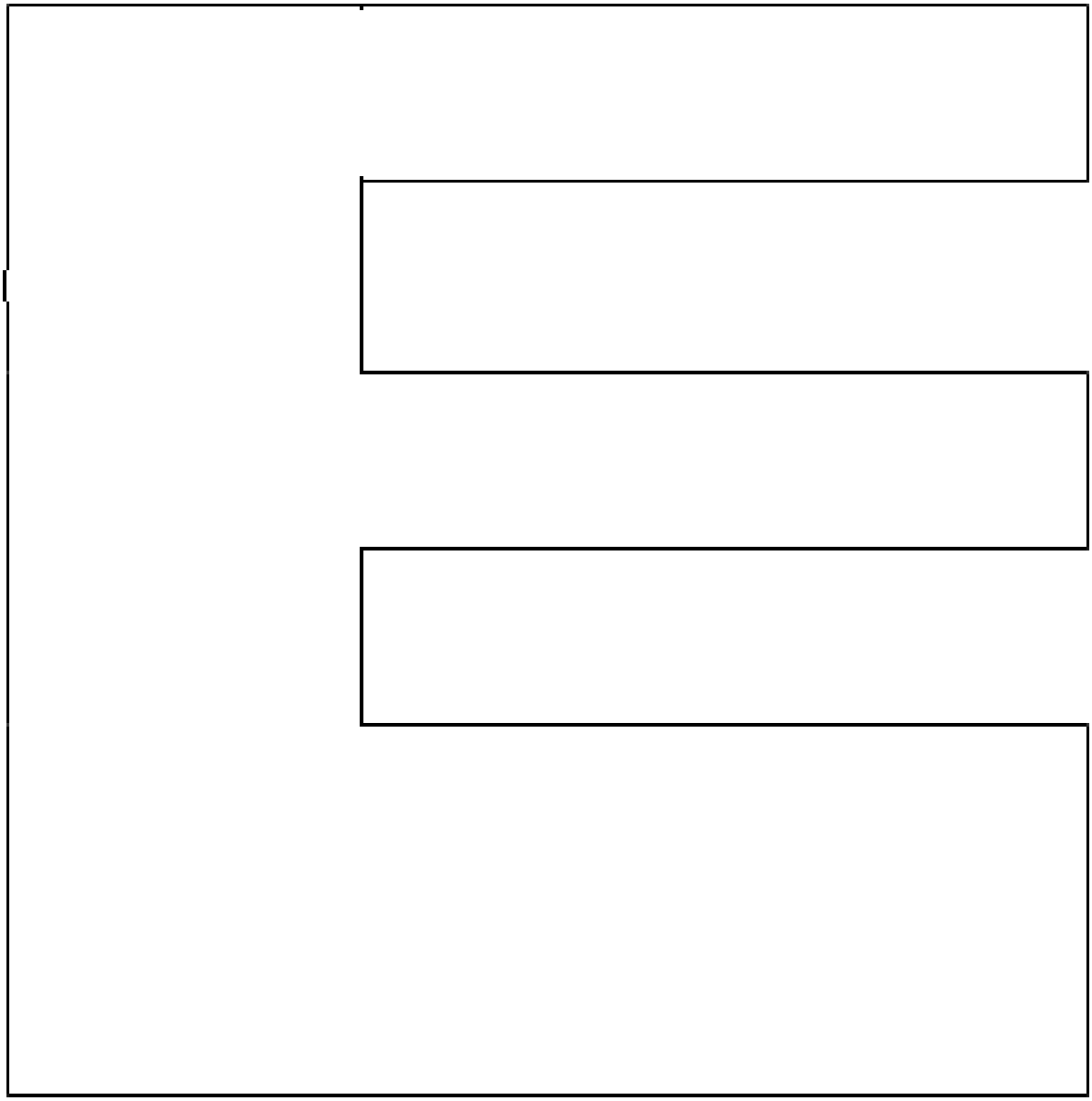
After:
Have students share their solutions and strategies they used. During the discussion, the strategy of dividing the irregular figure into two separate rectangles should emerge. (If it doesn't, introduce this strategy). For practice, have students work to find different ways to divide the rectilinear figure shaped like the letter E. After students solve the area ask them their strategies.

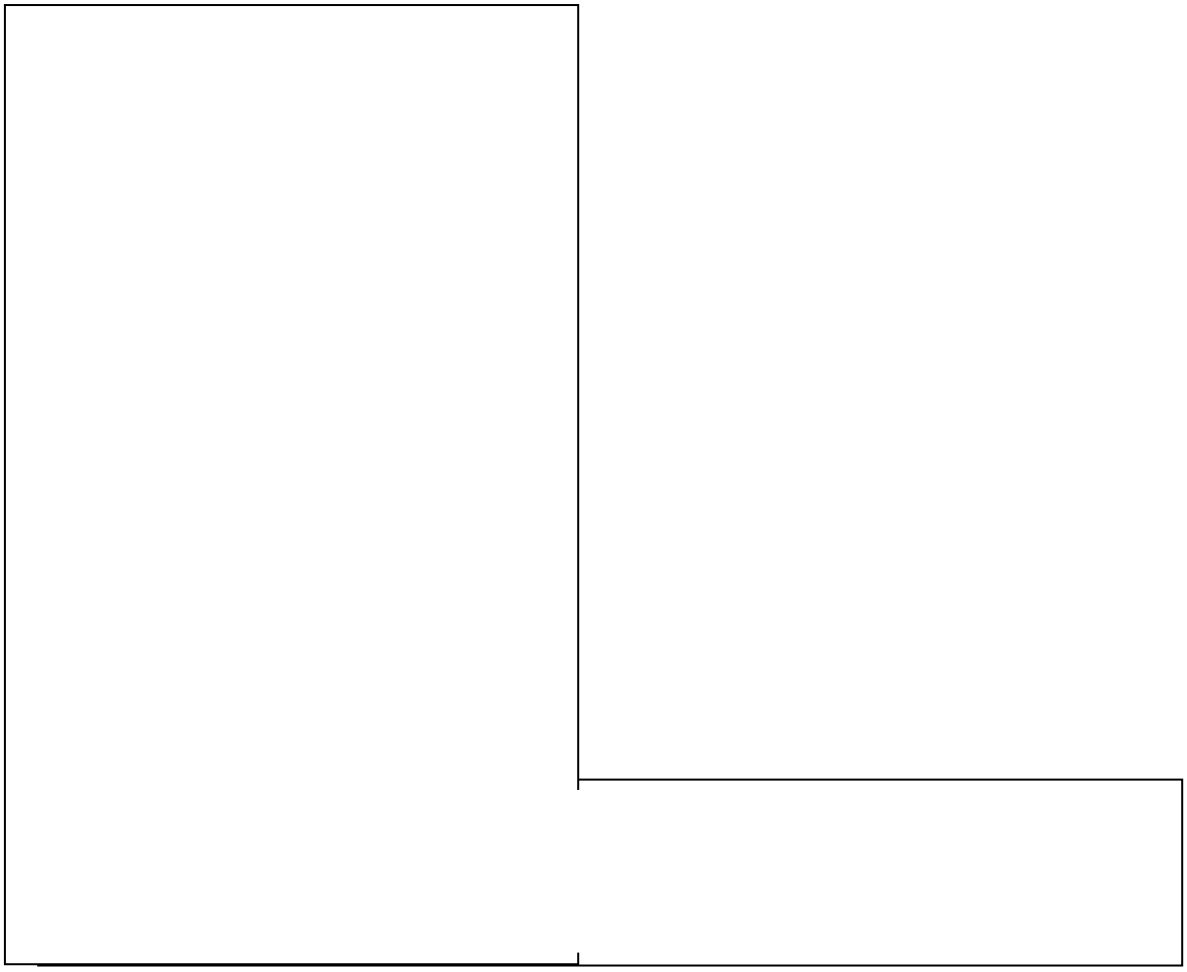
Students may talk about breaking the shape into four rectangles. Relate this idea to the order of operations. Students need to multiply each length and width for each rectangle, then add all the areas together to get a total area.

Pose a problem to students on the overhead of an "L" shaped object with only one missing side. Allow students to work for a few minutes. Discuss with students how you could find the missing side. Pose another problem to students with the same shape but with two missing sides. Discuss how you could find the missing measures.

Evaluation: Exit Ticket
Write a sentence explaining how you found the area of the letter E.





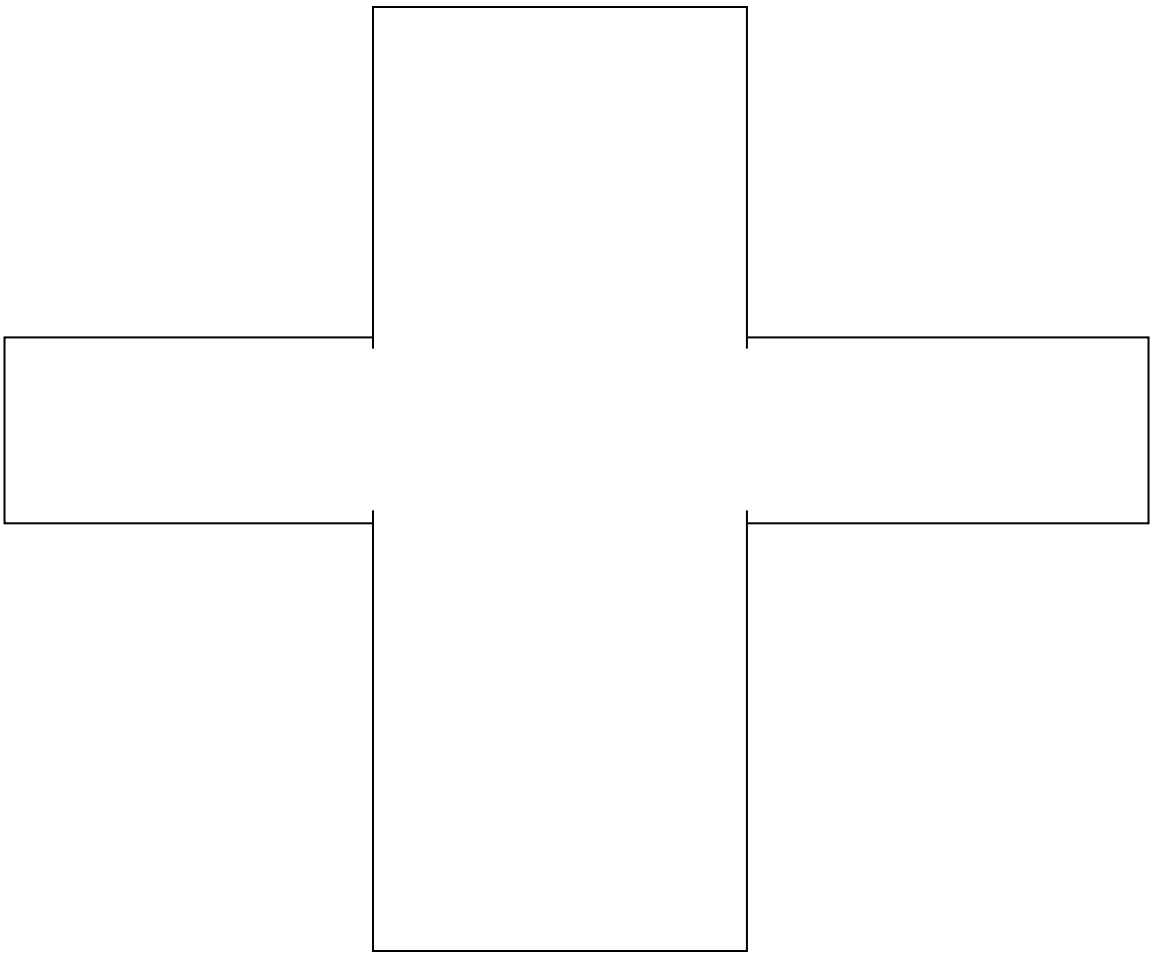


<table>
<tr><td colspan="2">Lesson 5: More Rectilinear Shapes</td></tr>
<tr><td>Cluster: Solve problems involving measurement and conversion of measurements.
Standard: 4.MD.3</td><td>Emphasized Standards for Mathematical Practice:
MP 3: Constructing a viable argument
MP 5: Model with mathematics
MP 6: Attend to precision</td></tr>
<tr><td>Mathematical Goal:
The student will find the area of a rectilinear figures.</td><td rowspan="2">Words that you should hear students using in mathematical conversations:
Area, dimensions, length, partition, width</td></tr>
<tr><td>Materials:
Graph paper, Handouts for centers</td></tr>
<tr><td colspan="2">Ten Minute Math: Target Number (4.NBT.2, 4.NBT.4)
We want to reach the target number 38. Your final equation can only use subtraction and cannot use a 0, 1, 2, or a 3. Encourage students to find more than one solution.</td></tr>
<tr><td colspan="2">Before :
Begin the lesson by talking about student’s exit ticket from the day before. Revisit the L-shaped figure and talk about it. Display a different-shaped L for students and ask them what they notice. Have them determine the area.</td></tr>
<tr><td colspan="2">During the lesson:
Pose the following task to students:
You want to build two rectangular rooms for your pets and need to put a rectangular hallway in between the rooms. You have up to 130 square yards of tile for the floor. Your hallway needs to be at least 3 yards wide. Each room needs to be at least 45 square yards. Design your rooms and your hallway using graph paper.

As students are working observe what strategies they are using. Students may use plastic square tiles to get started. Questions to ask include: what information are you using to help you get started? What numbers do we have to work within the problem?</td></tr>
<tr><td colspan="2">After:
Discuss students’ designs and have them share their strategies.

If more practice is needed, have students work on:
-Irregular shapes- Have students draw irregular shapes on grid paper then solve to find the area by breaking apart the shapes into rectangles.
-Other possible resources: www.commoncoresheets.com. Then search area and perimeter. Pick the worksheets that meet your students’ needs. Pick problems with 2 by 1 digit area problems and simple missing side problems.</td></tr>
<tr><td colspan="2">Evaluation:
Evaluate students based on the design of their rooms and hallway.</td></tr>
</table>

Extra Shapes if more practice is needed:



Need More Practice?

Real-world tasks

There is a 6 foot by 4 foot border around a garden. Sally says that she can double the area by only doubling one of the dimensions. She also says that if she doubles both the dimensions the area is more than double. When she doubles both dimensions how much larger is the new garden compared to the original garden? Is that true for other dimensions too? Why or why not?

A 20 foot by 7 foot room is connected to a hallway that is 6 feet by 8 feet. How much more carpet is needed in the room than in the hallway?

An 80 foot by 7 foot hallway in a conference center is connected to two rooms that are each 20 feet by 9 feet. How much more carpet is there total? How much more carpet is in the hallway than the conference rooms?