

14 Area Models for Multiplication & Division, Part I

You Will Need

- Chapter 6, Multiplication and Division
- Volume 3, Appendix A, Area Models for Multiplication and Division
- overhead base ten area pieces
- a copy of Blackline 7 (Base Ten Area Pieces) for each child (optional)
for each group of four children
- base ten area and linear pieces
- Blackline 8 (Base Ten Grid Paper)
- chart paper and markers

Your Lesson

In this lesson, children explore several activities that focus on area models for multiplication and division. These activities extend similar ones found in Volume 2, Insight Lessons 79, 81, 87, 99 and 100; you may wish to revisit some parts of those lessons before proceeding.

Activity 1

Distribute base ten area and linear pieces to each group of four children. Have each group set the following collection of base ten area pieces before themselves: 16 strips and 20 units. Ask each group to do the following exercises: build a rectangular array that uses all of these pieces, determine the area and dimensions of their array, create a multiplication or division story problem that can be modeled by their array.

When ready, invite the children to take a “field trip” to observe each other’s work. Several rectangles are possible, two of which are sketched here.

20

9

The area is 180 square units.

Twenty children each made 9 cookies. How many cookies did they make in all?

45

4

The area is 180 square units.

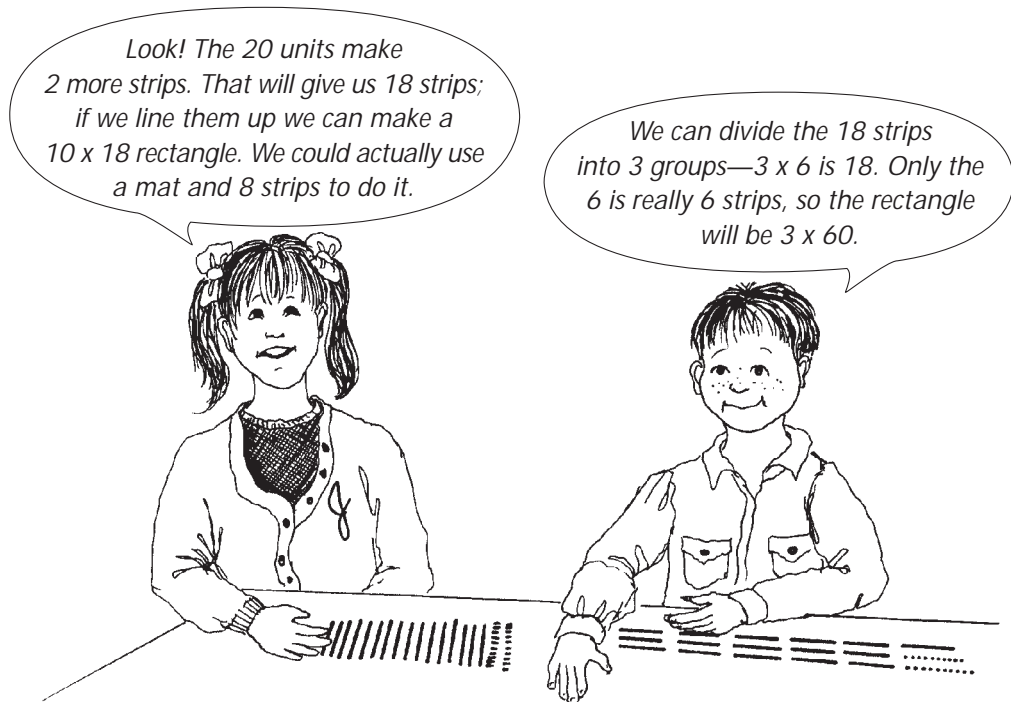
Mrs. Smith gave 45¢ to Sue and each of Sue's 3 friends. How much money did Mrs. Smith give to the 4 kids?

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Observe the children carefully as they work. They may need additional time to discuss their arrays and problems before proceeding with the next step of the activity.

Ask the groups to return to their places and have them form other arrays which use their entire collection of 16 strips and 20 units. Have them indicate the dimensions of these arrays with linear pieces and then make a sketch of their work on chart paper. How many arrays are possible? Encourage the teams to seek all the possibilities.

Observe the children as they work and try to gain some insight about their thinking. Some may use trial-and-error completely. Others may apply related knowledge of multiplication or number relationships. Some may also want to use a calculator for the purpose of testing possible divisors.

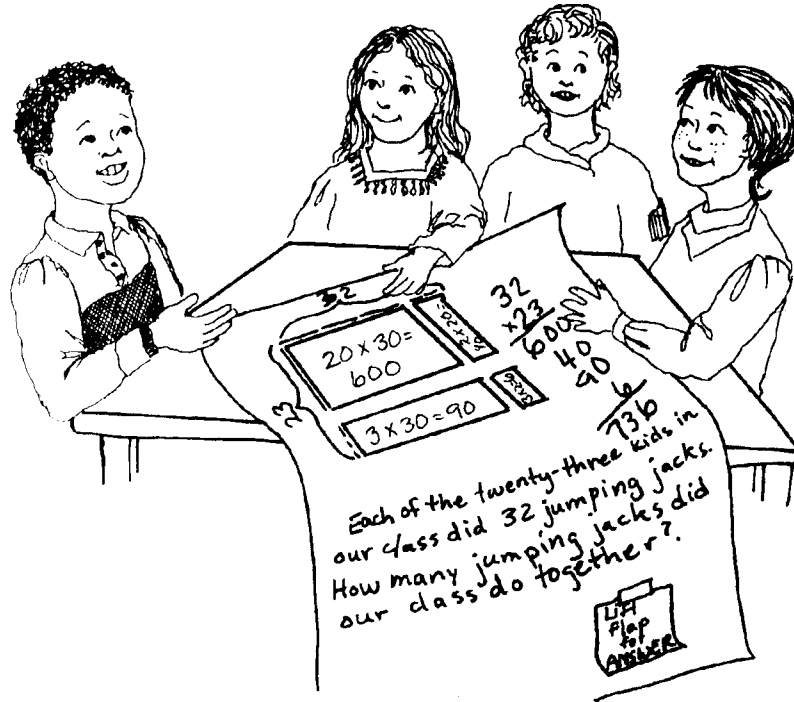


Ask the groups to also describe any similarities or differences they observe among their rectangles. Post the charts and discuss the results. Invite some of the groups to describe their work and explain their thinking. How can one be sure all the possibilities have been found? (Please see Teacher Tips.)

Activity 2

Ask the groups to do this problem: Form a rectangle with dimensions 23 and 32. Make a sketch (or grid paper diagram) of this rectangle and its dimensions. Write a multiplication problem that can be modeled by your rectangle. Describe how you would answer the question posed in your problem.

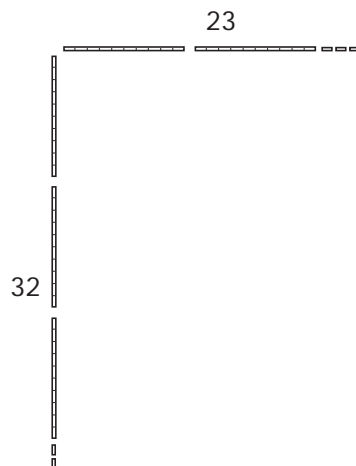
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Note how the groups form this rectangle. Do they begin with area pieces and attempt to form the rectangle first? Do any first use linear pieces to show the required dimensions, thereby forming the outline of the rectangle? Or are other ways emerging?

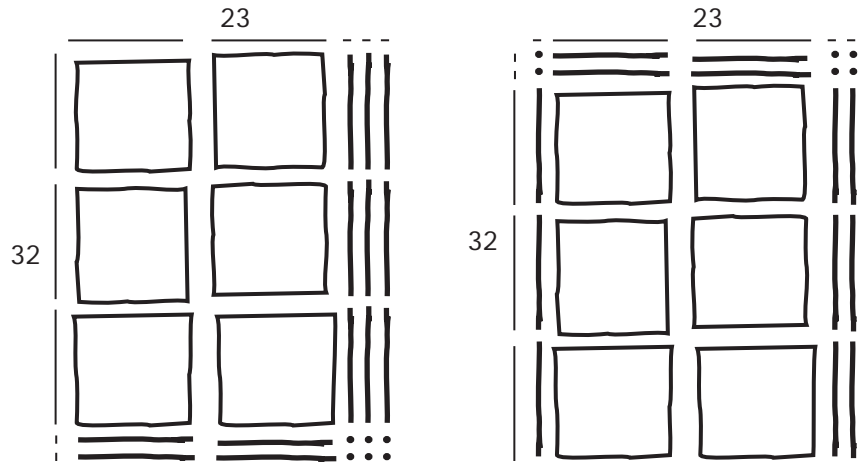
Conduct a sharing time where groups discuss their work with neighboring groups or with the entire class.

This can be an opportunity for the children to begin visualizing the different parts of the array (this is explored further in Lesson 15). To do this, you might have a transparency of the array and its dimensions ready. Display this transparency, exposing only the dimensions. Ask the children if they can picture the area of the array.



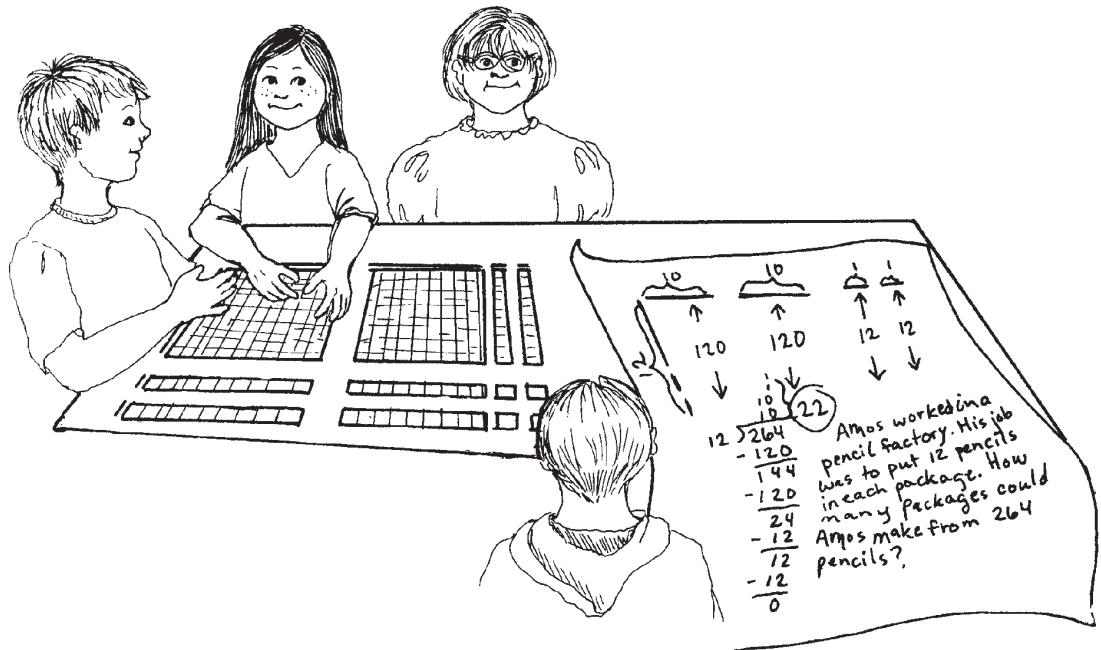
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Note that groups may validly form the same array yet have individual pieces in different locations.



Activity 3

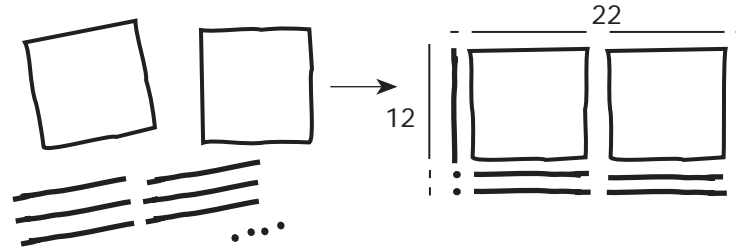
Repeat Activity 2, this time asking the groups to do the following problem. Form a rectangular array that has one dimension 12 and an area of 264 square units. Make a sketch or grid paper diagram of this array and its dimensions. Write a division problem that is modeled by this array. Describe how you see the answer to your problem.



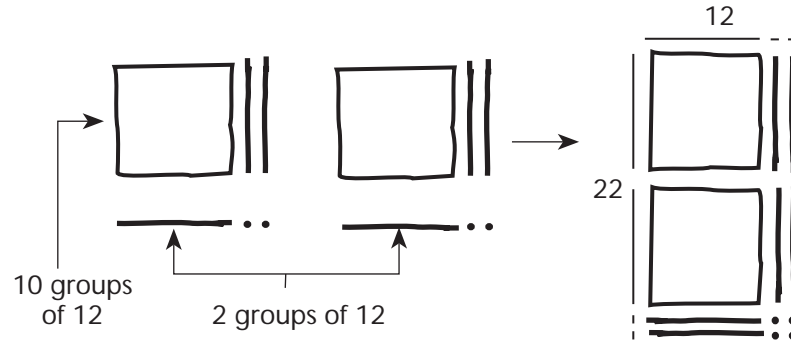
Once again, note the strategies used to form this rectangle.

RAUL *We got the minimal collection for 264 and moved the pieces around. The other dimension is 22.*

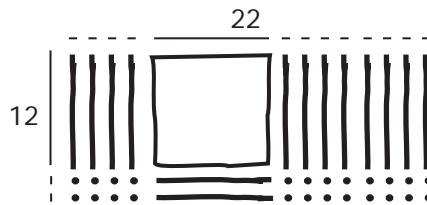
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LI We put the minimal collection for 264 into groups of 12. We made 22 groups and put them together.



RUTH We made a dimension of 12 with linear pieces first. Then we built the rectangle by filling it in with groups of 12 until we had 264 units. After a while we made it go faster by using a mat and 2 strips for 10 groups of 12.



Activity 4

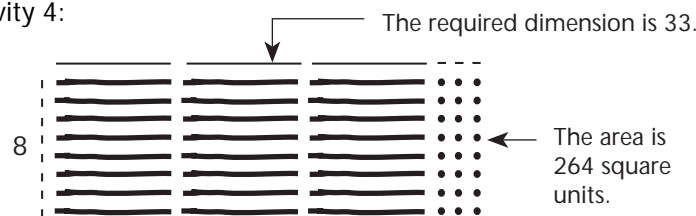
Continue working with an area of 264. Repeat Activity 2, only this time have the groups make a rectangle with area 264 and one dimension 8. What is the other dimension?

Activity 5

Repeat Activity 2 once more, only this time have the groups make a rectangle with area 264 and one dimension 16. What is the other dimension?

What strategies did groups use in Activities 4 and 5? How did the groups handle the remainder in Activity 5? Here are possible solutions for the problems in these activities.

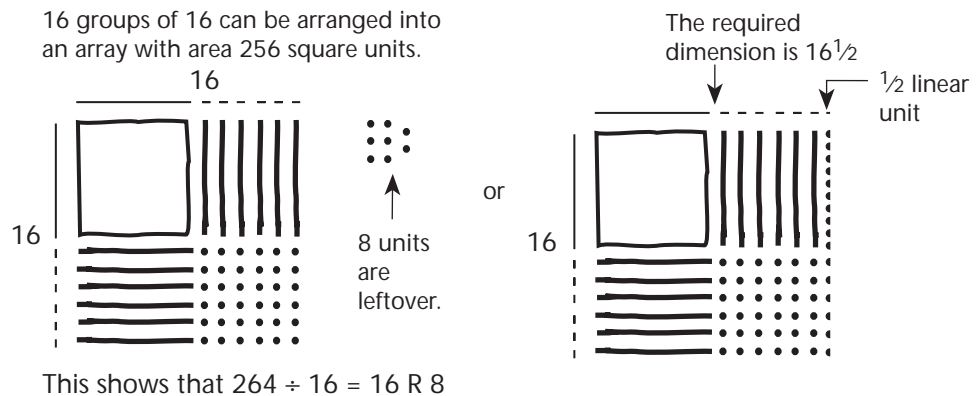
Activity 4:



This model shows that $264 \div 8 = 33$

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Activity 5:



Activity 6

As time permits, repeat Activity 2 by exploring other problems that focus on area models for multiplication or division. Be sure to offer problems that provide experiences with both operations.

Teacher Tips

Here are some notes about the activities of this lesson.

Activity 1: Assuming the units have area 1, then a collection of 16 strips and 20 units has a total area of 180 square units. Here are the dimensions of the rectangular arrays that can be formed from this collection:

1 by 180, 2 by 90, 3 by 60, 4 by 45, 6 by 30, 9 by 20, 10 by 18 and 12 by 15. (By trading some pieces, a 5 by 36 can also be made.)

Some teams may extend this list by distinguishing an array like 60 by 3 from 3 by 60. This can be their decision.

Activities 2–6: In these activities, children are asked to sketch arrays and their dimensions. Sometimes children with little or no experiences with sketching arrays may be more meticulous than necessary (e.g., drawing the units within a mat or a strip). Some modeling on your part may prevent these children from getting bogged down by unneeded details.

Journal Entry

If you were to ask a friend to build a rectangle, what dimensions would you use? What do you think their rectangle would look like after it was built? Make a sketch of the rectangle showing its dimensions and reporting its area.

(As a suggestion: Some of our children found it helpful to approach this task with the help of Blackline 7, Base Ten Area Pieces. This blackline offers a nice transition from pieces to sketches, since children can cut and paste the pieces on chart paper.)