

LessonTitle: Picture Frames and Algebra**Alg 1.5****Utah State Core** Pre-Algebra Standards 2.1, 4 Algebra Standards 1-2 Process Standards 1-5**Summary**

In this lesson, students derive a method for finding the area of the frame for a picture. After they share their methods, the teacher helps the class to transfer the methods into algebraic representation. If appropriate, the students and teacher can simplify the expressions (methods) to discover they are all the same.

Enduring Understanding

Algebra is a language which developed to help us communicate about and solve problems efficiently and effectively. Using variables enables us to talk and learn about what we don't know.

Essential Questions

How does Algebra help us solve problems? Why do we use variables to help us solve problems?

Skill Focus

- Problem solving using trial and error
- Generalizing the problem solving process
- Using symbols to write equations
- Using the computer to examine the graphic representation of equations
- Comparing and generalizing different problem solving strategies

Vocabulary Focus**Materials** Calculators**Launch****Explore****Summarize****Apply****Assess**

Information

1) Students should work in groups in the initial part of the activities, arriving at solutions and preparing to show their way of thinking. The teacher should circulate asking questions and then lead group discussion and work on subsequent questions.

Discourse Suggestions:

- Count the squares in the frame. (students will try to do length times width)
- What did you do to figure out the answer? (document all answers)
- What symbols should we use to represent your numbers?
- How can we use these symbols to come up with a formula?
- What did we do in the picture frame problem to help you understand what Algebra is for?

2) After student groups have found the area of the frame and generated a method, record those methods, using numbers on the overhead or board. Students record on their papers. Some examples are:

$$10 + 10 + 8 + 8, \quad 9 + 9 + 9 + 9, \quad (2 \times 10) + (2 \times 8) \quad \text{etc.}$$

After students have recorded their numeric solutions to the problem, provide paper for them to represent their solution by drawing and coloring it.

3) Student groups should display and explain their solutions and drawings. As student groups present their solutions, students should individually fill in the various numeric solutions into the chart in problem #4.

4) Use a think aloud to help students see how you think when you translate the numeric solution into an algebraic expression. Model one or two of the solutions for the students. Then give them time to translate the remaining numeric solutions to algebraic expressions.

5) Model the process of condensing the formulas by combining like terms and using the distributive property. Depending on the level of the classes' experience, the teacher will choose whether students should work independently or as a class to complete this section.

Then direct a discussion in which you discuss the value of algebra, how formulas help us, and how it helps if everyone uses the same rules in the language of algebra. Students can then complete the remaining questions.

You may wish to include the idea of how Algebra is used to describe patterns and make predications about those patterns. Formulas and graphs help us to represent the patterns and figure out the growth without following the patterns step by step. The activity "More Picture Frames and Algebra" (below) develops this idea.

Additional information:

You may consider using a [Exploring Algebra with Geometer Sketchpad](#) activity, "The Border Problem" (pages 22-23), in addition to or instead of Picture Frames. Yet another duplicate activity, "Tiling Tubs", can be found in [Navigating through Algebra Grades 6-8](#), pages 63-64. Any of the above could be used as the learning activity and another as assessment.

Alg 1.5a

Picture Frames and Algebra

Name _____

1) On your graph paper, draw a 10 x 10 square in the upper left hand corner. We will pretend this is a picture. Color in a frame for the picture just inside the 10 x 10 square. Make the frame 1 unit wide. This will create an 8 x 8 picture. What is the area of the frame? _____

2) What is your method for finding the area of the picture frame? Write your method below using numbers. Then draw a picture of your way to find the picture frame area. Be prepared to explain your group's method.

3) Explain how to find the area of the picture frame for any size square grid using your method.

Write a formula that reflects your thinking. Area = _____

4) Record all the different methods for finding the area of the picture frame.

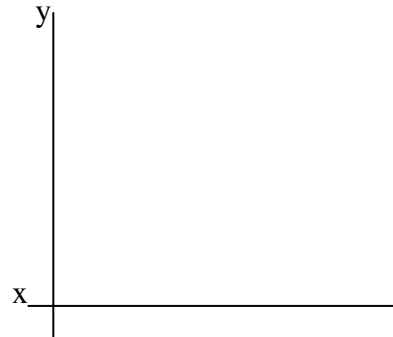
Group	Numeric formula	Algebraic formula
1		
2		
3		
4		
5		
6		
7		
8		
9		

Alg 1.5b

More Picture Frames and Algebra

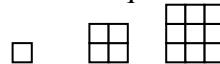
1. Make a table of increasingly large picture frames and their border areas. Use x to designate the edge size and y to designate the Border area. On the "T chart" below. Observe and describe the pattern of the numbers on the table. Graph the function.

Edge "x"	Area "y"
8	
9	
10	

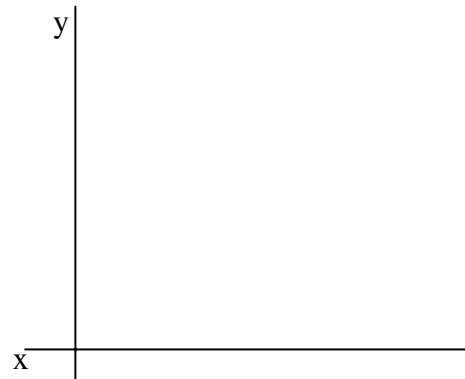


Formula: $y =$ _____

2. Figure out the number of 1×1 squares in the sequence of squares below. Record your findings on a table. Then graph the function.



Edge "x"	Squares "y"
1	
2	
3	



Formula: $y =$ _____

- 3) Describe the difference in the patterns found in #1 and #2 above. How does algebra relate to these patterns?

Extra for Experts: Find the total number of different sized squares found in the pattern in #2 above. Go to at least 4 or 5 stages until you can see the pattern.

edge "x"	squares "y"
1	
2	
3	

Equation: $y =$ _____