LessonTitle: **Algebraic Properties**	**Pre 5.0**
Utah State Core Content Standards 1-2 Process Standards 1-5	
Summary In this lesson, students will determine which property is true for the operations of addition, subtraction, multiplication and division. In addition students build, draw and explain area models for the distributive property.	
Enduring Understanding Just as in any language, Algebra involves basic properties which apply to operations (+, -, x, ÷) using numbers and variables.	**Essential Questions** Why do we have such a thing as "properties" in the language of algebra? Why do the properties work for some operations and not for others?
Skill Focus Using Algebraic Properties, especially the distributive property.	**Vocabulary Focus**
Materials TI-73 Calculators	
Launch ideas: "Some teachers worked Side B, Introduction to Properties, together as a class and then let the students work in groups to complete Side A. Other teachers worked a couple of examples on Side A as a class, then let the students finish Side A and B in groups. Working Side A as a class seemed to be more successful and led into a discussion about what it means to be a property."	
Explore "All teachers modeled with the overhead algeblocks extensively before passing out the student sets. Some teachers modeled the first page of the worksheet and others did sample problems. We decided it worked best to split the assignment into two days and not work on algeblocks the entire 95 minute block period. Students struggled the most with converting the model into an equation. C had his students draw the models without blocks."	
Summarize	
Apply	
Assess	

Information

I. To introduce the basic algebraic properties, use the Intro to Properties worksheets (see the chart link) and the following directions which follow. Be sure to do the Distributive Property worksheets before finishing the properties table.

Commutative Property. Explain that many fathers commute to work each day. They start from home and go to work. At the end of the day they start from work and go back home. This means they change places. Have students try 3+4, 3-4, 3x4, 3/4. Work through the first problem with them. Let students use calculators or use an overhead calculator or presenter. After they find which properties work and which do not, turn the paper over and fill in the Example and the Reminder for addition and multiplication.

Associative Property: Have three students come up to the front of the room. They are pretending they are in line to see a movie. They do not want to get out of line or they will lose their place. Have the #2 student face the #1 student and pretend to visit. Then have the #2 student turn and visit with the #3 student. (The two students talking represent inside the parenthesis) Did any of the students get out of line and lose their place? NO this is a very important part of the property. DO NOT CHANGE PLACES. See sample answer key and have students discover which operations work with this property. On side A fill in the Example and the Reminder for the ones that work.

Identity Property: If I asked to look at your student ID card, would I see a picture of your friend on it? NO, because your ID card is you. Your identity is who you are. Let's see what the identity does with the operations. Can you think of what you can ADD to something so that is does not change who it is? (meaning it's value) $4 + 0 = 4$ What about something you can multiply by that does not change the number's value? $5 \times 1 = 5$ Have students fill out worksheet and turn over to side A and fill in Examples and Reminder. Also fill in **Multiplicative Property of Zero**.

Substitution: A substitute teacher has the same value as your regular teacher. A substitute teacher is in your class to replace your missing teacher. In the example $5 + 3 = 8$, the $5 + 3$ has the same value as the 8. That means that the 8 can take the place of the $5 + 3$. Fill in side A as shown on sample worksheet.

The Multiplicative Inverse: When you multiply 2 numbers together, you get 1. The Multiplicative Inverse of 5 is 1/5 because when you multiply these to factors together, your answer is 1. The Multiplicative Inverse of 2/3 is 3/2. Have students write down the 3 examples from the key. Include the method of cross cancel. Fill out side A.

The Distributive Property: Leave this section until after completing distributive property activities below.

II. Do the Distributive Property worksheets included below. Then return to the properties table to finish the part about the distributive property.

III. Use the practice included below as starters or student practice.

Pre 5.0 Area models for the Distributive Property

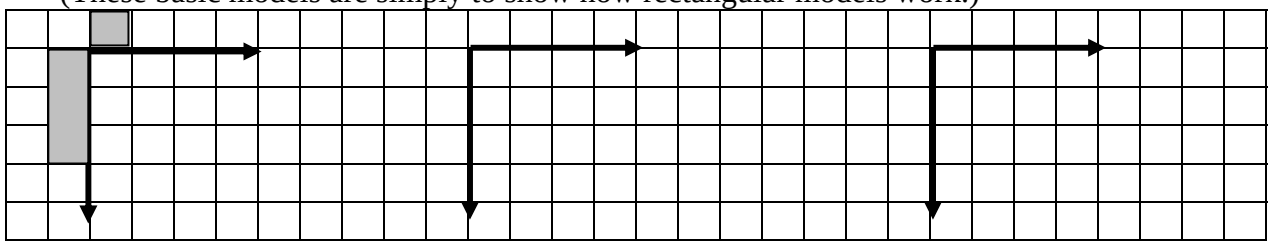
Use Algeblocks for the following problems.

1. In this problem you will learn how to use algeblocks or algebra tiles. Change the colors according to which tiles you are using. What are the pieces shown? Label the dimensions and area. (Demonstrate how the size of the block changes as the value of x changes.)

For Algeblocks **(**consider the top surface only)

	Dimensions	Area
Green	1 by 1	1
Yellow rod	1 by x	x
Orange rod	1 by y	_____
Yellow square	_____	_____
Orange square	_____	_____
Light orange rectangle	_____	_____

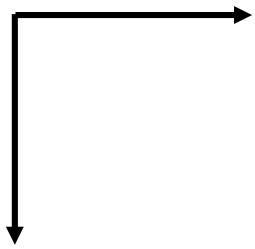
2. Build and draw rectangular models to show the following multiplication equations. (These basic models are simply to show how rectangular models work.)

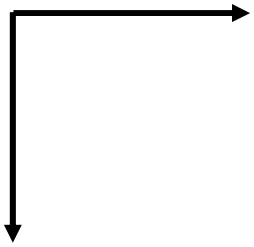


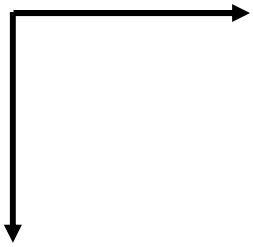
Equation: 3 * 1= _3_
Factors:__3, 1__
Product:___3_
Rectangle Dimensions: 3, 1
Area:_3 squares

Equation: 3* 2= ____
Factors:_____
Product: _____
RectangleDimensions:_____
Area: _____

Equation 3 * 3= _____
Factors:_____
Product:_____
RectangleDimensions: _____
Area: _____







Equation: 2 * 2 = ___
Factors:_____
Product:____
Rectangle Dimensions: ____
Area:_____

Equation: 4 * 4 = ____
Factors:_____
Product: _____
Rectangle Dimensions:_____
Area: _____

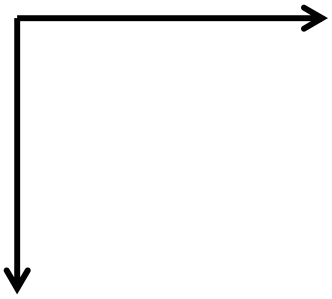
Equation x * x = _____
Factors:_____
Product:_____
Rectangle Dimensions: ____
Area: _____

3. Explain why we describe 2^2, 3^2, and 4^2 as "two squared," three squared," and "four squared."

FOR EACH OF THE FOLLOWING PROBLEMS, CHANGE THE VALUE OF X WHEN YOU DRAW THE MODEL! This will help you remember that x is a variable! For example draw x as 3 in the first drawing, 2 in the second etc.

4. Build the factors for 3(x + 2) on your desk. Then build the area model. Draw below.
   What are the dimensions of the model? _____
   What is the area? _____
   What are the factors of the multiplication problem? _____
   What is the product of the multiplication problem?_____
   Write equation modeled in this problem?
   _____

   Is this equation true for all values of x? _____



5. Build an area model for 4x + 4 on your desk. Then build the factors. Draw the factors and the area.
   What is the area or product? _____
   What are dimensions or factors? _____
   What is the equation modeled in this problem?
   _____

6. Build the factors for y(y + 3). Then build the area model. Draw.

   What is the area or product? _____
   What are dimensions or factors? _____
   What is the equation modeled in this problem?
   _____

7. Build the factors for 3(2x + 1). Build the areas. Draw

   What is the area or product? _____
   What are dimensions or factors? _____
   What is the equation modeled in this problem?
   _____

8. Build the factors for y(2y + 5)

   What is the area or product? _____
   What are dimensions or factors? _____
   What is the equation modeled in this problem?
   _____

9) In the examples on the previous page you built models to show the distributive property.
$a(b + c) = ab + ac$
Explain the distributive property. Use an example. Show how it works using numbers as well as an area model.

10) Sketch ALL possible rectangles for the areas below. It is possible to create more than one rectangle using the same blocks—it may also only be possible to create one rectangle. Label the dimensions (factors).

a) $4x + 2$

b) $3x + 2$

c) $6x + 6$

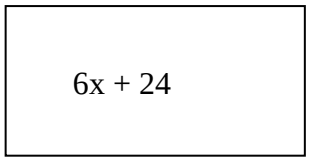
d) $4(2x + 1)$

e) $2(2x + 5)$

11) Can you distribute using division? $\frac{(a + b)}{c} =$ $\frac{(a - b)}{c} =$

Prove your ideas using numbers.

Extra for Experts. Label all the possible dimensions for the following rectangles. Pretend that the rectangles below could be shape shifted, that is made thinner, longer, shorter, or fatter.

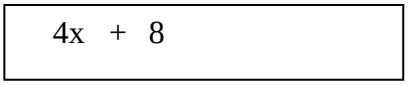


Factors

_____ _____

_____ _____

_____ _____



Factors

_____ _____

_____ _____

_____ _____

Simplify using the Distributive Property and Combine Like Terms

Simplify the following expressions if possible.

1) $6 + 3(3x + 4)$

2) $-8x(x - 4)$

3) $6x - (11x + 12)$

4) $10a + 6(3a + 3)$

5) $10 - (8x + 7) + 3(x + 4)$

6) $4 + 2(y + x) - 3(3 + 2x) - 8 + 3x - 5y$

7) Write an expression that describes the perimeter of the figure below. Then simplify it.