Whole Number Algorithms and a Bit of Algebra!
Using Base Ten Blocks to "See" Algorithms

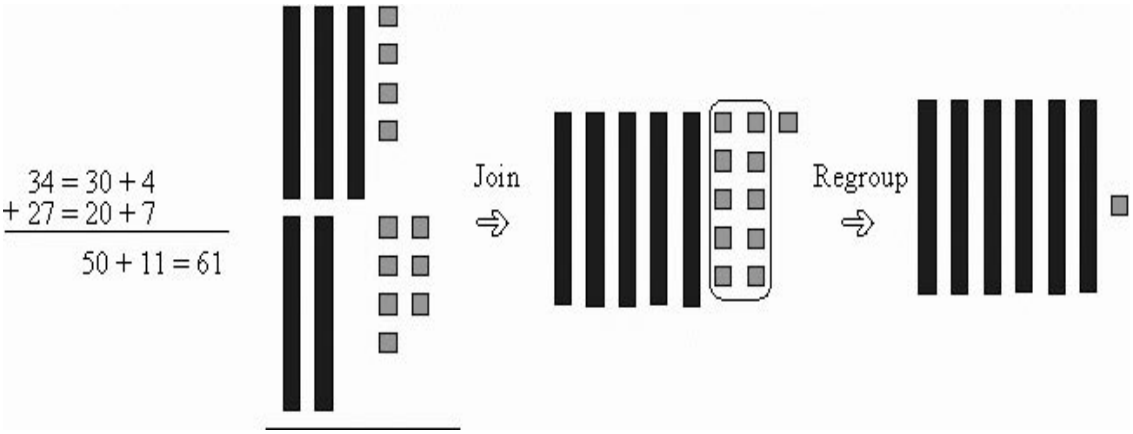
Objective: To look at addition, subtraction, multiplication and division of whole numbers from a geometric, "hands-on" perspective and an algorithmic perspective.

Audience: This activity is intended for teachers. The activity is designed to make connections between the use of manipulatives and the development of algorithms. Parents and students are welcomed!

Part 1: Addition - Focus on trading and regrouping.
Part 2: Subtraction - Focus on trading and regrouping.
Part 3: Multiplication - Focus on the distributive property and area models.
Part 4: Division - Focus on the scaffold method and area models.
Part 5: A Bit of Algebra - Focus on the distributive property and area models.

Part 1: Addition

1. **One Type of Addition Algorithm**

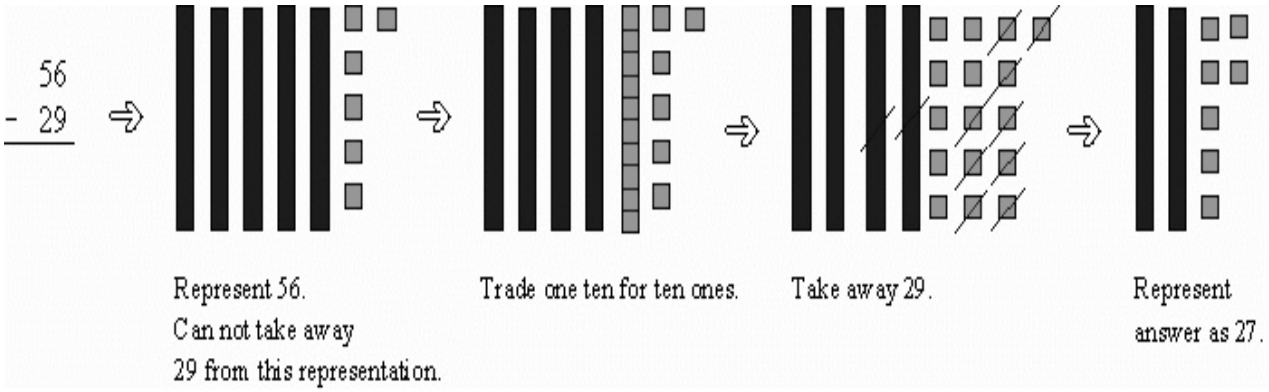


2. Try these problems using Base 10 Blocks and the algorithm. Write and draw your work.

38	126
+ 13	+ 45

Part 2: Subtraction

1. **One Type of Subtraction Algorithm**



$$\begin{array}{r} 56 \\ -\ 29 \end{array} \Rightarrow \begin{array}{r} (50+6) \\ -(20+9) \end{array} \Rightarrow \begin{array}{r} (40+16) \\ -(20+\ 9) \\ \hline (20+\ 7)=27 \end{array}$$

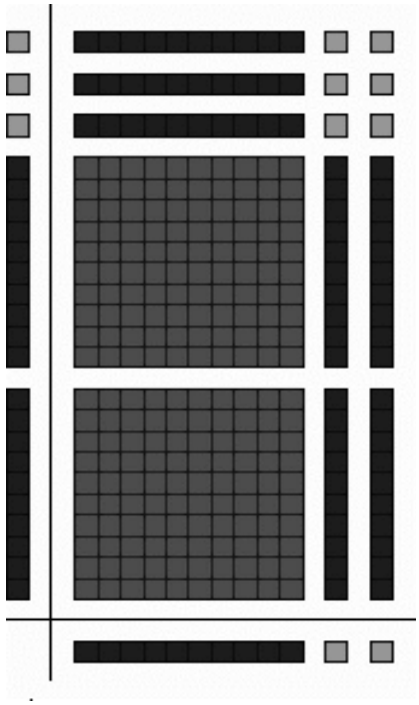
2. Try these problems using Base 10 Blocks and the algorithm. Write and draw your work.

$$\begin{array}{r} 63 \\ -\ 25 \end{array} \qquad \begin{array}{r} 50 \\ -\ 23 \end{array}$$

Part 3: Multiplication

1. **One Type of Multiplication Algorithm -** If you have 23 students in your class and they each need 12 straws for a craft project, how many straws do you need to supply? We write this as 23 groups of 12
or 23 × 12. Write out how you would solve the problem.

2. Notice two applications of the **Distributive Property** gives us the "standard" pieces. Here you see this in both vertical and horizontal formats. Find the pieces from the computations below on the area model. Notice that we are actually finding 12, 23's.



Vertical:

$$\begin{array}{rrrl} & 2 & 3 & \\ \times & 1 & 2 & \\ \hline & & 6 & = 2 \times 3 \\ & 4 & 0 & = 2 \times 20 \\ & 3 & 0 & = 10 \times 3 \\ 2 & 0 & 0 & = 10 \times 20 \\ \hline 2 & 7 & 6 & \end{array}$$

OR

Horizontal:

$$\begin{aligned} 12 \times 23 &= (10+2) \times (20+3) \\ &= (10 \times 20) + (10 \times 3) + (2 \times 20) + (2 \times 3) \\ &= 200 + 30 + 40 + 6 \\ &= 276 \end{aligned}$$

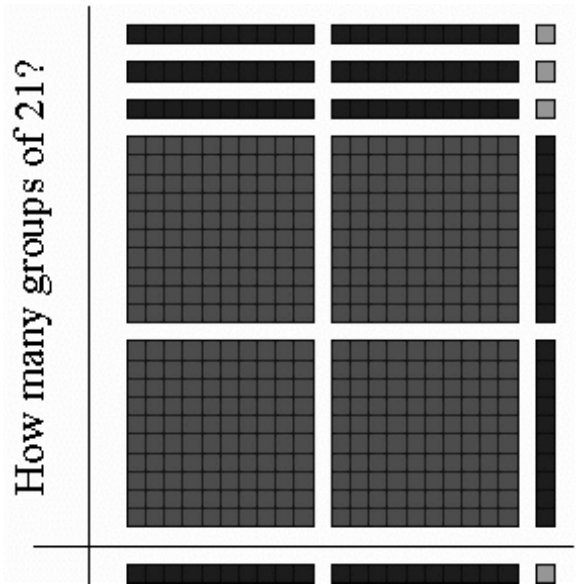
3. Try these problems using Base 10 Blocks. Draw or printout the area model you construct. Write out the details of the algorithm and find the products on your area model. Notice that the second problem is multi step. (Why?)

$$\begin{array}{r} 14 \\ \times \ 12 \\ \hline \end{array} \qquad \begin{array}{r} 24 \\ \times \ 13 \\ \hline \end{array}$$

Part 4: Division

1. **One Type of Division Algorithm** - You have 483 sea shells for a class art project. Each student needs 21 shells. How many students will be able to make the project? How many groups of 21 shells can you form out of 483 objects? We write 483 ÷ 21. Write out how you would solve this problem.

2. Find the number of groups of 21 on the Area Model. Draw in the left most column with the appropriate "Base 10 blocks."



3. Next, look at the scaffold method below. (Is there a correlation to the scaffold "good guess" method and the Area Model? Does there have to be a relationship?)

21) 483	
− 420	20 groups of 21
63	
− 63	+ 3 groups of 21
0	23 groups of 21

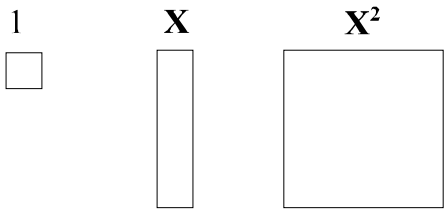
4. Now, you have 483 sea shells for a class art project. There are 21 students in your class. If you give each student the same number of shells, how many shells will each student have? Use the blocks to model this problem. Is it still written 483 ÷ 21? Discuss.

5. Caution: When you pick problems for illustration with Base 10 blocks, make sure you check them out first using the blocks! Sometimes a problem requires that you break up a FLAT in order to fill in the area model. This type of problem is not the best for a first use of the blocks.
Try these by drawing Base 10 Blocks. Solve also using the scaffold method.

$13\overline{)299}$ $14\overline{)308}$

Part 5: Moving to Algebra!

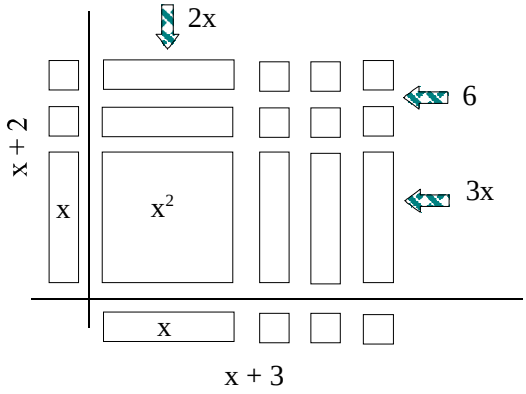
1. We can use the Base 10 blocks idea to create Base x blocks or Algebra Tiles. x is unknown!



2. Look at the figure to the right. This is an area representation of (x + 2)(x + 3). Compare this to 23 ×12. Do you see a similarity?

3. Expand:
(x + 2)(x + 3) = _____

Find the pieces on the picture to the right.



4. Try these! Draw them out and then expand. Can you see the pieces?

a. x(x+4)

b. (x+1)(2x+3)

c. **Extension:** Draw and expand (x + 2y + 3)(2x + y). Hint: You will need y and y^2 blocks.