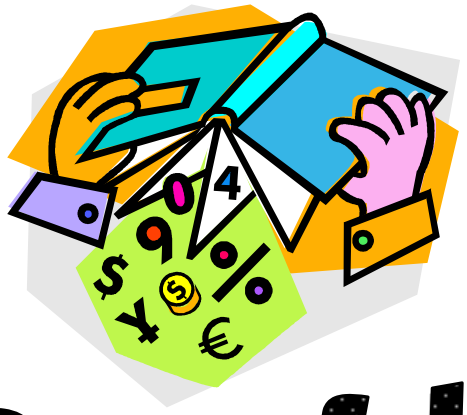
Mathematics:



A Story of Units

Parent Handbook

Grade 3

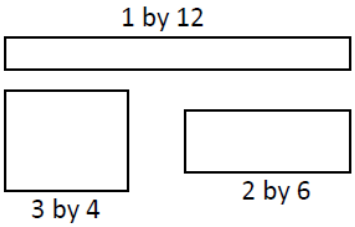
Module 4

Grade 3 • Module 4

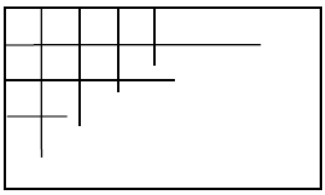
Multiplication and Area

OVERVIEW

In this 20-day module students explore area as an attribute of two-dimensional figures and relate it to their prior understandings of multiplication. In Grade 2, students partitioned a rectangle into rows and columns of same-sized squares and found the total number by both counting and adding equal addends represented by the rows or columns.

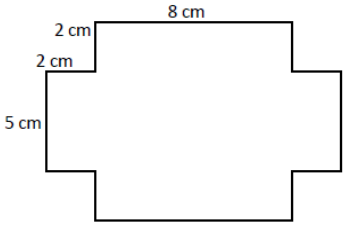


In Topic A, students begin to conceptualize area as the amount of two-dimensional surface that is contained within a plane figure. They come to understand that the space can be tiled with unit squares without gaps or overlaps. They make predictions and explore which rectangles cover the most area when the side lengths differ (but area is actually the same). Students may, for example, cut and fold rectangles to confirm predictions about whether a 1 by 12 rectangle covers more area than a 3 by 4 or a 2 by 6 rectangle. They reinforce their ideas by using inch and centimeter square manipulatives to tile the same rectangles and prove the areas are equal. Topic A provides students' first experience with tiling, from which they learn to distinguish between length and area by placing a ruler with the same size units (inches or centimeters) next to a tiled array to discover that the number of tiles along a side corresponds to the length of the side.



In Topic B, students progress from using square tile manipulatives to drawing their own area models. Anticipating the final structure of an array, they complete rows and columns in figures such as the example shown at the right. Students connect their extensive work with rectangular arrays and multiplication to eventually discover the area formula for a rectangle, which is formally introduced in Grade 4.

In Topic C, students manipulate rectangular arrays to concretely demonstrate the arithmetic properties in anticipation of the following lessons. They do this by cutting rectangular grids and rearranging the parts into new wholes using the properties to validate that area stays the same, despite the new dimensions. They apply tiling and multiplication skills to determine all whole number possibilities for the side lengths of rectangles given their areas .

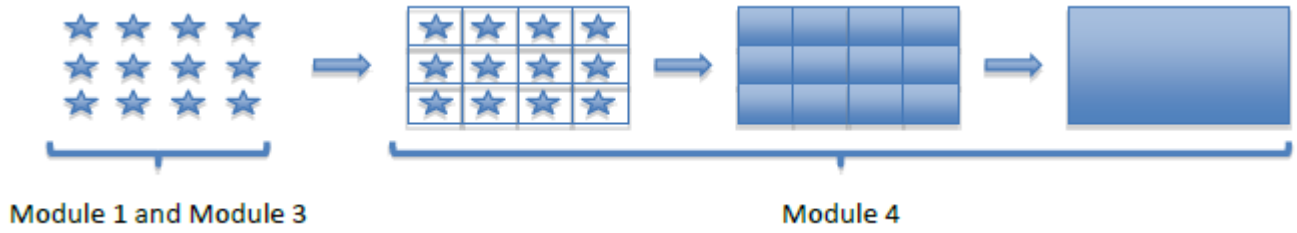


Topic D creates an opportunity for students to solve problems involving area. Students decompose and/or compose composite regions like the one shown at right into non-overlapping rectangles, find the area of each region, and add or subtract to determine the total area of the original shape. This leads students to design a simple floor plan that conforms to given area specifications.

Terminology

New or Recently Introduced Terms

- Area (the amount of two-dimensional space in a bounded region)
- Area model (a model for multiplication that relates rectangular arrays to area)



- Square unit (a unit of area—specifically square centimeters, inches, feet, and meters)
- Tile (to cover a region without gaps or overlaps)
- Unit square (e.g., given a length unit, it is a 1 unit by 1 unit square)
- Whole number (an integer, a number without fractions)

Familiar Terms and Symbols

- Array (a set of numbers or objects that follow a specific pattern, a matrix)
- Commutative Property (e.g., rotate a rectangular array 90 degrees to demonstrate that factors in a multiplication sentence can switch places)
- Distribute (e.g., $2 \times (3 + 4) = 2 \times 3 + 2 \times 4$)
- Geometric shape (a two-dimensional object with a specific outline or form)
- Length (the straight-line distance between two points)
- Multiplication (e.g., $5 \times 3 = 15$)
- Rows and columns (e.g., in reference to rectangular arrays)

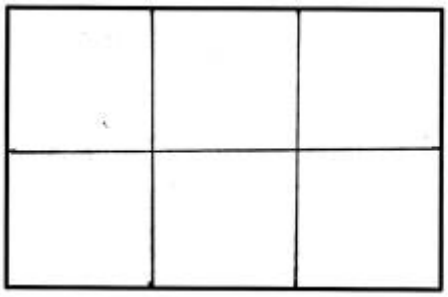
Suggested Tools and Representations

- Area model
- Array
- Grid paper (inch and centimeter)
- Rulers (both centimeter and inch measurements)
- Unit squares in both inch and centimeter lengths (e.g., square tiles used for measuring area)

Lesson 1

Objective: Understand area as an attribute of plane figures.

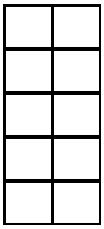
Shape A



6 squares

The area of Shape A is 6 square units. The units used to measure are squares, so they're square units!

Shape B



The area of Shape B is 10 square units.
The units used to measure are squares,
so they're square units!

Lesson 2

Objective: Decompose and recompose shapes to compare areas.

Maggie uses her square inch pieces to create these two rectangles. Do the two rectangles have the same area? How do you know?

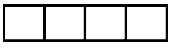
Shape A

Shape B

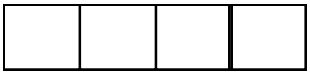
Yes, they have the same area because I counted 6 squares in both Shape A and Shape B.

Both shapes are measured using the same unit, square inches, so they have the same area.

Shape C = 4 square cm



Shape D = 4 square inches

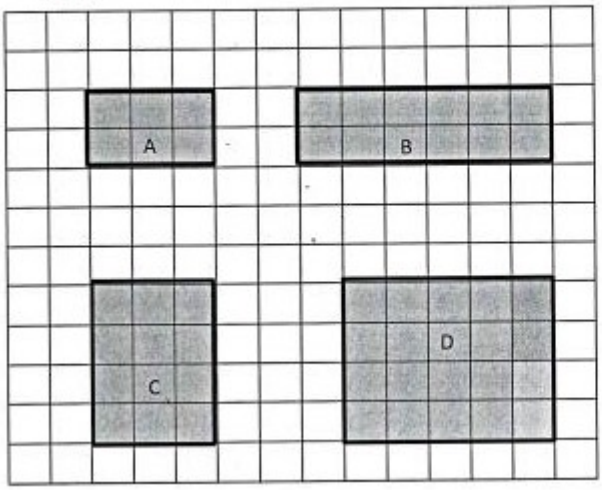


These shapes both have 4 squares but different areas. Shape C is measured with square cm and Shape D is measure with square inches.

Lesson 3

Objective: Model tiling with centimeter and inch unit squares as a strategy to measure area.

Each ▪ is 1 square unit. What is the area of each of the following shapes?



A: 6 square units

B: 12 square units

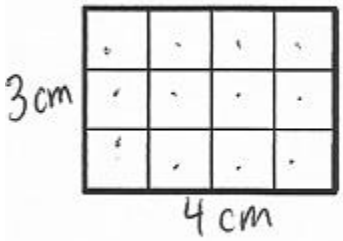
C: 12 square units

D: 20 square units

Lesson 4

Objective: Relate side lengths with the number of tiles on a side.

Mariana uses square centimeter tiles to find the side lengths of the rectangle below. Label each side length. Then count the tiles to find the total area.

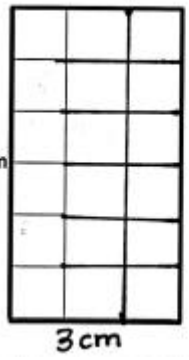


Total area: 12 square centimeters

Lesson 5

Objective: Form rectangles by tiling with unit squares to make arrays.

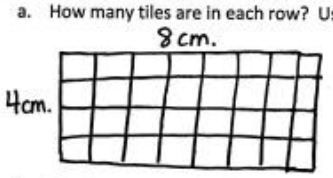
c. Area: 18 square centimeters.



6 × 3 = 18

4. Leon makes a rectangle with 32 square centimeter tiles. There are 4 equal rows of tiles.

a. How many tiles are in each row? Use words, pictures and numbers to support your answer.

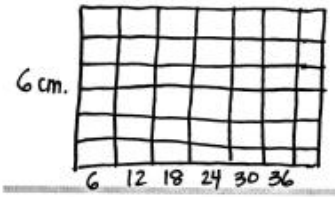


4 x 8 = 32 sq. cm

32 ÷ 4 = 8

There are 8 sq. cm tiles in each row.

b. Can Leon arrange all of his 32 square centimeter tiles into 6 equal rows? Explain your answer.

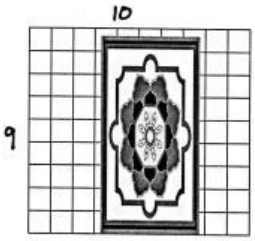


No, he can't. We don't know how to divide 32 by 6. If he had 36 square cm tiles, then he could divide it into 6 equal rows.

Lesson 6

Objective: Draw rows and columns to determine the area of a rectangle, given an incomplete array.

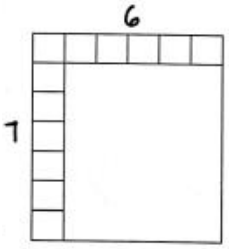
3. The tile floor in Brandon's living room has a rug on it as shown below. How many square tiles are on the floor, including the tiles under the rug?



9 x 10 = 90

There are 90 square tiles on the floor.

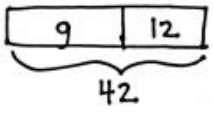
4. Abdul is creating a stained glass window with square-inch glass tiles as shown below. How many more square-inch glass tiles does Abdul need to finish his glass window? Explain your answer.



7 x 6 = 42

Abdul needs a total of 42 square inch glass tiles.

He already put down 12 tiles.



g = number of glass tiles needed

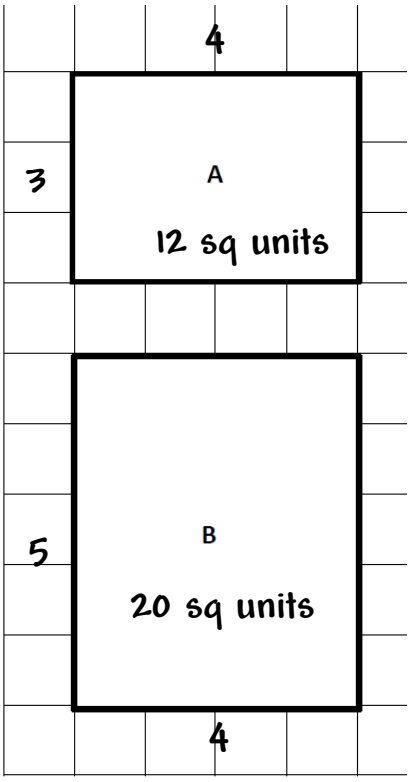
42 - 12 = g

g = 30

Abdul needs 30 more square inch glass tiles.

Lesson 7

Objective: Find the area of a rectangle through multiplication of the side lengths.



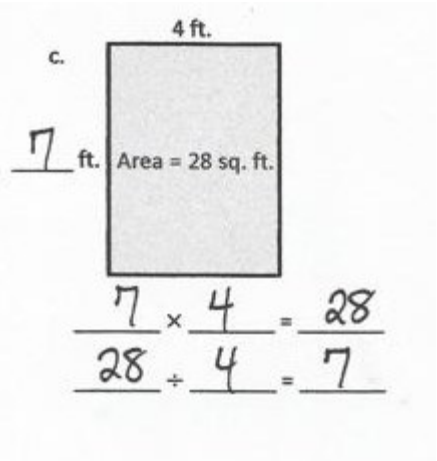
Area can be found by multiplying the length and width of a rectangle.

A. Area: 3 × 4 = 12 square units

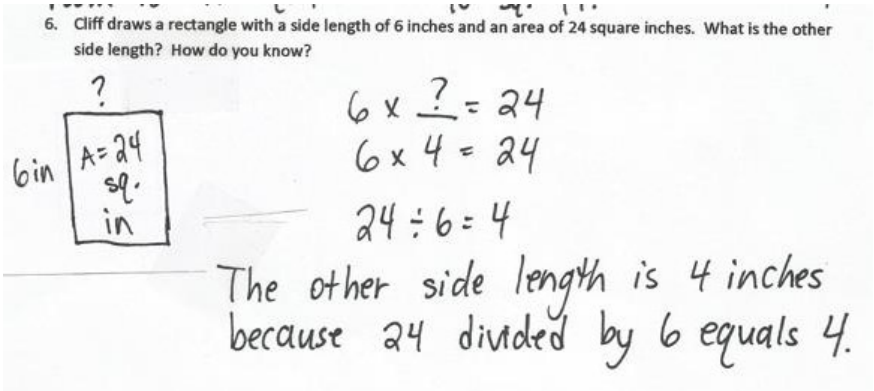
B. Area: 5 × 4 = 20 square units

Lesson 8

Objective: Interpret area models to form rectangular arrays.



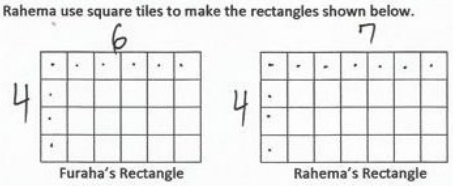
Related facts can help determine an unknown length of a rectangle's side when you know the area and the length of one side.



Lesson 9

Objective: Analyze different rectangles and reason about their area.

3. Furaha and Rahema use square tiles to make the rectangles shown below.

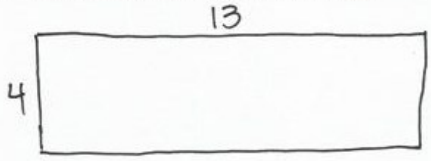


a. Label the side lengths on the rectangles above and find the area of each rectangle.

4 x 6 = 24
Furaha's rectangle has an area of 24 sq units.

4 x 7 = 28
Rahema's rectangle has an area of 28 sq units.

b. Furaha pushes his rectangle next to Rahema's rectangle to form a new, longer rectangle. Draw an area model to show the new rectangle. Label the side lengths.

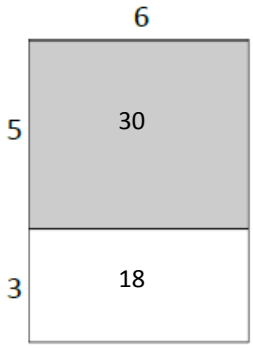


c. Rahema says the area of the new, longer rectangle is 52 square units. Is she right? Explain your answer.

Yes, she's right because the area of the new rectangle is equal to the sum of the areas of the smaller rectangles and 24 + 28 = 52 square units.

Lesson 10

Objective: Apply the distributive property as a strategy to find the total area of a large rectangle by adding two products.



5 × 6

3 × 6

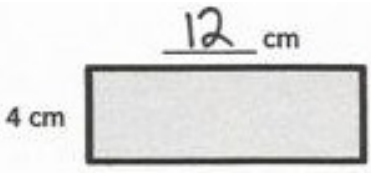
(5 × 6) + (3 × 6)
= 30 + 18
= 48 square units

There are 3 rectangles on the right: the large rectangle, the shaded rectangle, and the unshaded rectangle.

Adding the areas of the shaded and unshaded rectangles will produce the area of the large rectangle.

Lesson 11

Objective: Demonstrate possible whole number side lengths of rectangles with areas of 24, 36, 48, or 72 square units using the associative property.



d. Area: $8 \times 6 = (4 \times 2) \times 6$

$= 4 \times (2 \times 6)$

$= 4 \times 12$

$= 48$ sq cm

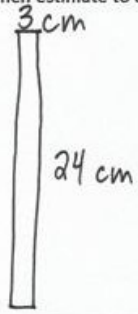
c. Use the expression 8×9 to find different side lengths for a rectangle that has the same area as the rectangle in Part (a). Show your equations using ( ). Then estimate to draw the rectangle and label the side lengths.

$8 \times 9 = 8 \times (3 \times 3)$

$= (8 \times 3) \times 3$

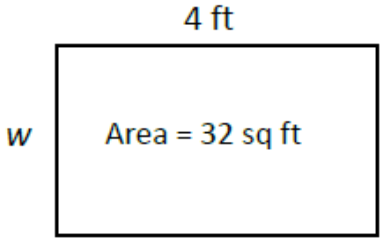
$= 24 \times 3$

$= 72$ sq cm



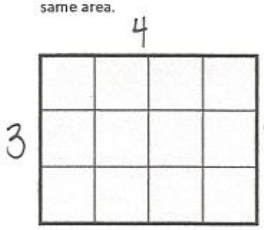
Lesson 12

Objective: Solve word problems involving area.

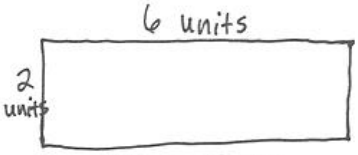


W = 32÷4

2. Stacy tiles the rectangle below using her square pattern blocks. Find the area of Stacy's rectangle in square units. Then draw and label a different rectangle with whole number side lengths and having the same area.



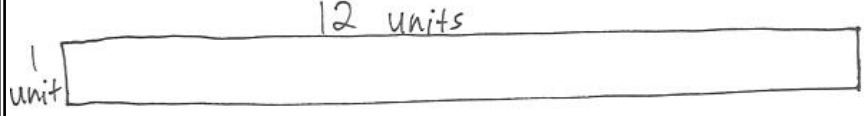
The area of Stacy's rectangle is 12 sq. units.



$2 \times 6 = 12$ sq. units

b. Can you draw another rectangle with different whole number side lengths and having the same area? Explain how you know.

Yes, I can draw a 12 units by 1 unit rectangle because I know $12 \times 1 = 12$.

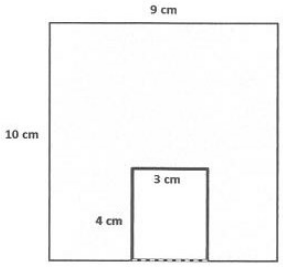


Lesson 13

Objective: Find areas by decomposing into rectangles or completing composite figures to form rectangles.

This figure shows a small rectangle cut out of a larger rectangle. We can find the area of the figure by subtracting the area of the smaller rectangle from the larger rectangle.

2. The figure shows a small rectangle cut out of a big rectangle. Find the area of the shaded region.

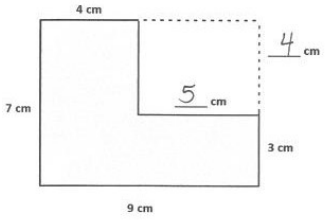


Big rectangle area: 10 x 9 = 90 sq cm
Small rectangle area: 4 x 3 = 12 sq cm

Area of the shaded region: 90 - 12 = 78 sq cm

This figure also shows a small rectangle cut out of a larger, rectangle. We can find the area of the figure by using the break apart strategy.

3. The figure shows a small rectangle cut out of a big rectangle.



a. Label the missing measurements.

b. Area of the big rectangle: 7 x 9 = 63 sq cm

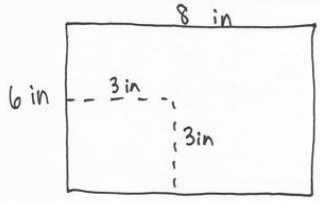
c. Area of the small rectangle: 4 x 5 = 20 sq cm

d. Find the area of the shaded region. 63 - 20 = 43 sq cm

Lesson 14

Objective: Find areas by decomposing into rectangles or completing composite figures to form rectangles.

3. A paper rectangle has a length of 6 inches and a width of 8 inches. A square with a side length of 3 inches was cut out of it. What is the area of the remaining paper?

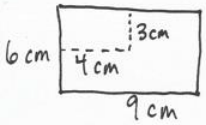


6 x 8 = 48 sq. in
3 x 3 = 9 sq. in
48 - 9 = 39 sq. in

The area of the remaining paper is 39 sq. inches.

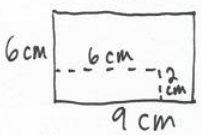
4. Tila and Evan both have paper rectangles measuring 6 cm by 9 cm. Tila cuts a 3 cm by 4 cm rectangle out of hers and Evan cuts a 2 cm by 6 cm rectangle out of his. Tila says she has more paper left over. Evan says they have the same amount. Who is correct? Show your work below.

Tila



6 x 9 = 54 sq. cm
3 x 4 = 12 sq. cm
54 - 12 = 42 sq. cm

Evan

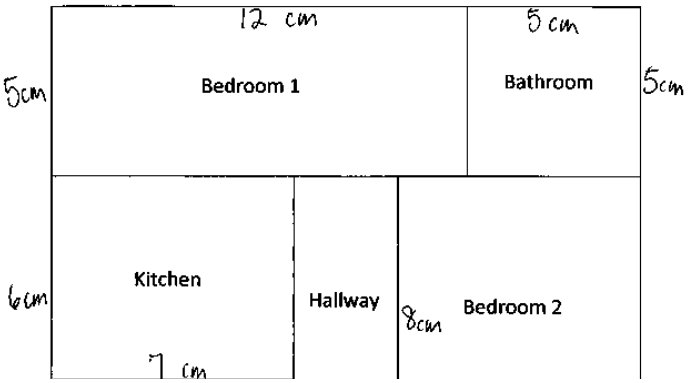


6 x 9 = 54 sq. cm
2 x 6 = 12 sq. cm
54 - 12 = 42 sq. cm

Evan is correct. They both have 42 sq. cm of paper left.

Lesson 15

Objective: Apply knowledge of area to determine areas of rooms in a given floor plan.

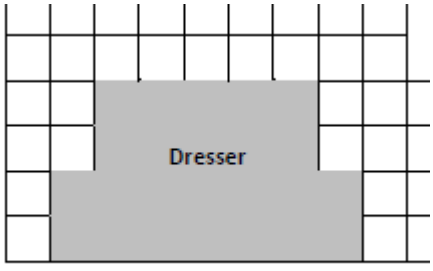


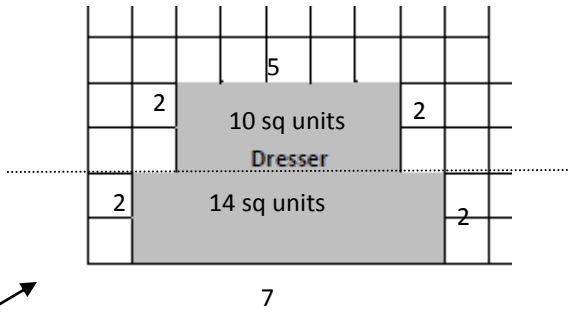
Room	Area	Strategy
Bedroom 1	60 sq. cm	5 x 12 = 5 x (10 + 2) = (5 x 10) + (5 x 2) = 50 + 10 = 60
Bedroom 2	56 sq. cm	8 x 7 = 56

Lesson 16

Objective: Apply knowledge of area to determine areas of rooms in a given floor plan.

- Count the squares to figure out the length of each side.
- Break the object apart and find the area of each section.
- Add together the area of each object to find the area for the whole shape.





Area = (2 x 5) + (2 x 7)

= 10+ 14

= 24 sq units

It' s important to become fluent with multiplication and division facts and to review addition and subtraction facts. Quick 5-10 minute activities are essential for memorization. Here are some ways to assist your child with memorizing basic facts:

- Flash Cards
  - ◊ both you and your child should say the fact aloud
  - ◊ begin learning them in order
- Skip counting up and down. Try beginning at different starting points.
  - ◊ ie: 3, 6, 9, 12– 9, 6 ,3 16, 20, 24, 28, 32-28, 24, 20, 16
- Have quick routine math talks in the car, store, and anywhere that seems appropriate.
- Computer Aides such as xtramath.org