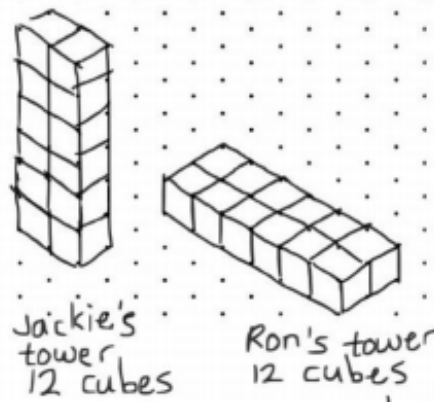


### Addition and Multiplication with Volume and Area

In Module 5, students will begin by reasoning about and working with three-dimensional shapes. They will explore cubic units and move toward calculations of volumes of rectangular prisms. Students also extend their two-dimensional work with area to figures with fractional side lengths. This Module bridges the Grade 4 work on area with Grade 6 work on volume and area to come.



Two orientations of 12 unit cubes

### New Terms in this Module:

**Base** - one face of a three-dimensional solid—often thought of as the surface upon which the solid rests

**Bisect** - divide into two equal parts

**Cubic units** - cubes of the same size used for measuring

**Height** - adjacent layers of the base that form a rectangular prism

**Hierarchy** - series of ordered groupings of shapes

**Unit cube** - cube whose sides all measure 1 unit

**Volume of a solid** - measurement of space or capacity



Unit Cubes

|                         |                           |                           |
|-------------------------|---------------------------|---------------------------|
|                         | $3\text{ in}$             | $\frac{1}{2}\text{ in}$   |
| $1\text{ in}$           | $3\text{ in}^2$           | $\frac{1}{2}\text{ in}^2$ |
| $\frac{1}{4}\text{ in}$ | $\frac{3}{4}\text{ in}^2$ | $\frac{1}{8}\text{ in}^2$ |

$$3 + \frac{1}{2} + \frac{3}{4} + \frac{1}{8} =$$

$$3 + \frac{4}{8} + \frac{6}{8} + \frac{1}{8} =$$

$$3 + \frac{11}{8} =$$

$$4\frac{3}{8}\text{ in}^2$$

An area calculation for  $3\frac{1}{2} \times 1\frac{1}{4}$

### What Came Before this Module:

Students learned to multiply fractions and decimal fractions, and began work on fraction division, working from concrete to abstract representations.

### What Comes After this Module:

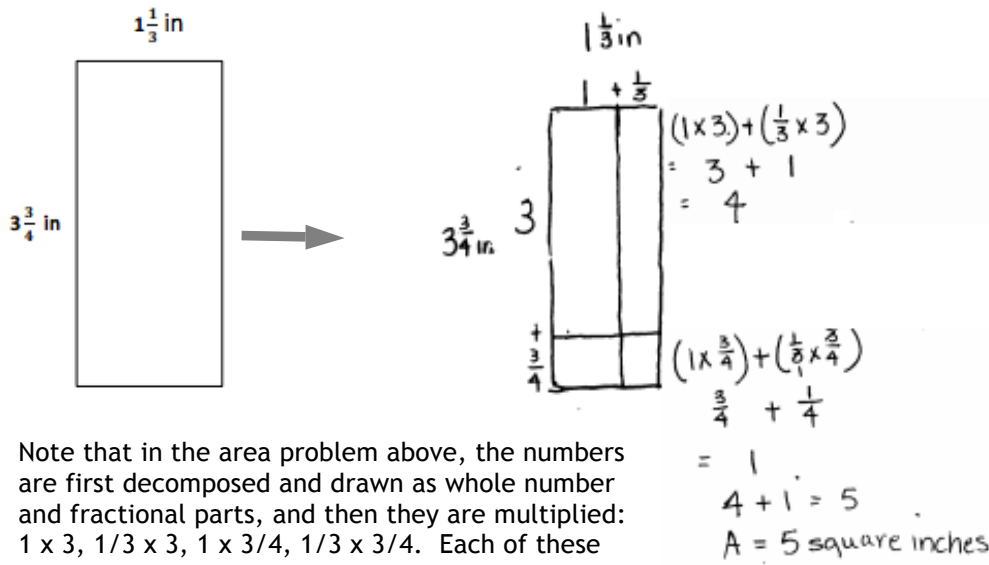
In Module 6, students will begin to explore the coordinate plane, working from the familiar number line toward plotting points and creating lines and patterns.

### + How you can help at home:

- Begin to discuss and notice the volume of various household containers - this is also a good opportunity to talk about what units are often used to measure volume.
- Keep practicing those multiplication and division facts, especially as problems become more complex.

## Key Common Core Standards:

- **Apply and extend previous understanding of multiplication and division to multiply and divide fractions.**
  - Multiply a fraction or whole number by a fraction
  - Solve real world problems involving multiplication of fractions and mixed numbers
- **Geometric measurement: understand concepts of volume and relate volume to multiplication and addition.**
  - Recognize volume as an attribute of solid figures and understand concepts of volume measurement
  - Measure volumes by counting unit cubes of various units
  - Relate volume to the operations of multiplication and addition
- **Classify two-dimensional figures into categories based on their properties.**
  - Understand that attributes belonging to a category of figures also belong to all subcategories of that category



Spotlight on Math Models:

Area Model with Fractional Parts

We will revisit this mathematical representation in Module 5 of *A Story of Units*.

*A Story of Units* has several key mathematical “models” that will be used throughout a student’s elementary years.

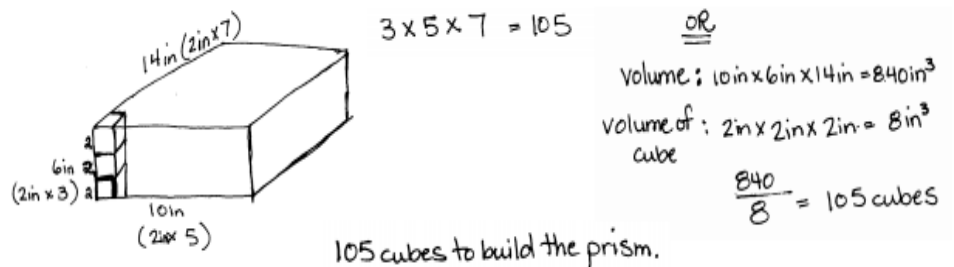
Earlier in 5<sup>th</sup> grade, we moved beyond using the area model for multiplication of whole numbers and begin to use this powerful model to illustrate mathematical operations on fractions. Now, we take a step further, and use the area model in various real-world problems, e.g. finding the area of a wall minus the space for two windows, or finding the area of a mat surrounding a picture in a frame.

The numbers we use in our area models now are often mixed whole numbers and fractions, giving students a chance to demonstrate their understanding in diagrams in which they show the multiplication of both the whole number and fractional parts of the problem.

Sample Volume Problem from Module 5:

How many 2-inch cubes are needed to build a rectangular prism that measures 10 inches by 6 inches by 14 inches?

(Example taken from Lesson 18)



Note that the student here shows two ways to solve the problem!