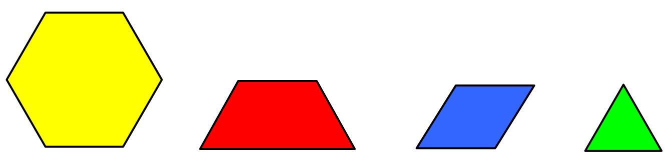
Using Pattern Blocks to Represent Fractions

Pattern blocks are a familiar manipulative in most elementary classrooms. Many students use them to create elaborate geometric patterns and designs, and teachers often use these manipulatives to help young students begin to think about area.

The features that make pattern blocks good for making geometric designs also make them a useful tool for teaching students about fractional relationships. Pattern blocks fit together so well because their sizes are all fractionally related to each other. Consequently, activities that encourage students to use these blocks to create geometric designs can also turn into interesting discussions about fractions.

What are pattern blocks?

A set of pattern blocks usually consists of 4 shapes: a hexagon, trapezoid, rhombus, and triangle. (Some sets also contain 2 more shapes, a square and a thin rhombus, but these are not used during explorations of fractions.) Each block is a different color. Pattern blocks are typically made out of plastic or wood, although online versions of them exist as well (see Resources section for a list of online pattern blocks).



Here is a set of pattern blocks that can be used to explore fractions.

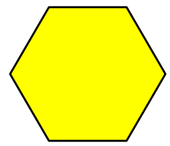
The collection of 4 blocks shown above is useful for exploring fractional relationships. The green triangle is half the size of the blue rhombus, and one-third the size of the red trapezoid. The yellow hexagon, which is the largest of the blocks, is twice the size of the red trapezoid, three times the size of the blue rhombus, and six times as large as the green triangle.

How do you use them?

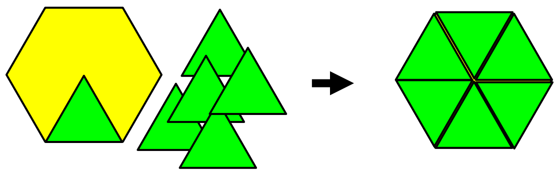
Pattern blocks are an example of an area model, and the area relationships between different blocks can be used to explore fractional relationships. When using pattern blocks, it is very important that one shape be designated as a "whole"—once this is done, then a wide variety of fractional relationships can be explored.

Here is a basic example that shows how pattern blocks can be used to think about fractions. This example is also shown in the video clips for this session.

Teacher: "If we say that one yellow hexagon is one whole, then how much of a whole is one green triangle?"



Student: "I'm going to place green triangles on top of the yellow hexagon to see how many fit. That might help me figure out this problem."



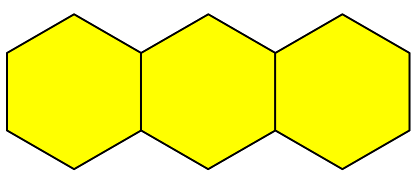
Student: "It looks like 6 green triangles can fit onto one yellow hexagon, so one green triangle must be one-sixth of a yellow hexagon."

In this example, one block has been designated as the "whole," and the student is figuring out what fractional part of the whole a smaller figure would be.

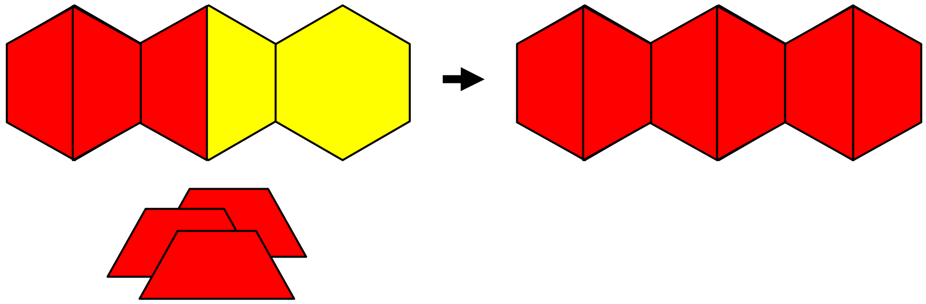
Even a basic problem like this one contains a number of important math concepts. First, in requiring students to explain one shape's size in terms of the size of another shape, the idea of part-whole relationships is introduced. Second, by using a number of same-sized blocks to tile over the whole, students are applying the idea that fractional partitions must be the same size as well (e.g., that each one-sixth section of the whole will be the same size).

One advantage to using pattern blocks over other types of area models is that once a student understands the fractional relationships between the different base figures (the hexagon, trapezoid, rhombus, and triangle), she can apply these base relationships to solve much more complicated problems:

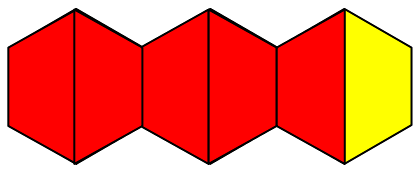
Teacher: "Let's say that the entire figure below represents one whole table. Can you show me how you could cover five-sixths of this table with a tablecloth?"



Student: "Ok. This whole is made up of three yellow hexagons, and I'm trying to find a way to make sixths. I know that the numbers 3, 2, and 6 are related, so let me put 2 trapezoids on each hexagon and see what happens."



Student: "If I use the trapezoids, I can cut the entire table into sixths. So covering five-sixths of the table would look like this:"



What are some basic activities?

Students can use pattern blocks to model a wide range of fractional relationships. This section will introduce you to some different types of activities that you can try with pattern blocks that promote ideas about equivalence and basic fractions operations.

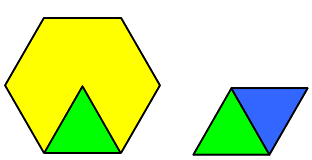
Identifying fractions, and thinking about equivalence.

Fraction identification activities can range from the basic to the complex. The merit of all pattern block activities, regardless of degree of difficulty, is that they help reinforce the idea that a fractional relationship can be modeled in terms of "parts" and "wholes." Further, the fact that pattern blocks can be tiled upon one another helps reinforce ideas of equivalence: using pattern blocks, a student might realize that 1, $^{2}/_{2}$, $^{3}/_{3}$, and $^{6}/_{6}$ are all equivalent representations of the same quantity.

Activity 1

Look at the two collections below. In the one on the left, the green triangle represents 1/6 of the yellow hexagon. In the one on the right, the green triangle represents 1/2 of the blue rhombus.

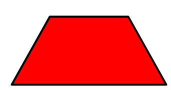
How is it possible for the green triangle to represent 2 different fractions?



Activity 2

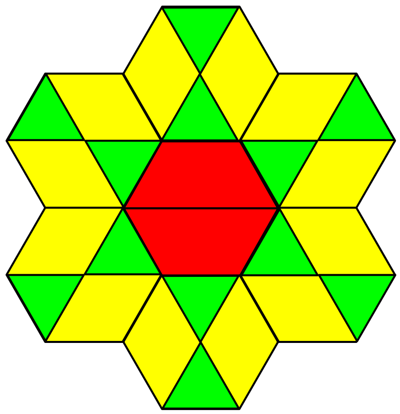
Using pattern blocks, show one-third of the whole figure below.

How could you prove that this is one-third?



Activity 3

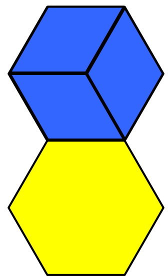
Look at the design below. What fraction of the design is red? What fraction of the design is green? How do you know?



Activity 4

Justin used blue rhombuses to figure out that 1/2 could also be written as 3/6.

Use pattern blocks to find another way you can write the fraction 1/2.



Activity 5

Using pattern blocks, make a design that is 1/3 red, 1/3 blue, and 1/3 green.

When students are doing these activities, they are coming to understand that fractions are used to represent relationships between quantities, and that as these relationships change, so too will the fractions. Once students understand this idea, they will be better able to make sense of fractions that cannot be easily modeled by pattern blocks (such as $^{8}/_{13}$), and will be better able to compare the relative sizes of two fractions.

Addition activities.

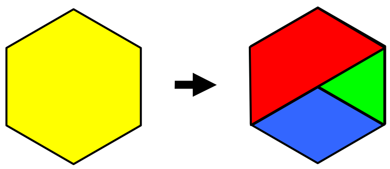
Once students understand how to use pattern blocks to show fractional relationships, they will be able to use these manipulatives to explore a wide range of topics, including the addition of fractions. Using pattern blocks to model fraction addition can help students understand addition algorithms, as well as help them understand the necessity of finding a common denominator when adding two fractions with different denominators.

A handful of addition activities are provided below. Some are designed to be introductory activities, while others push students to think about the necessity of common denominators when adding. In all of these activities, it is important that students identify what pattern block (or collection of pattern blocks) will be used to represent the whole, and what blocks will be used to represent the individual fractions being added.

Activity 1

John used three different pattern blocks to cover the yellow block below.

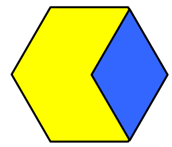
If the yellow block is 1, then what addition sentence can you use to express John's design?



Activity 2

Erin begin with the fraction 1/3, as shown below.

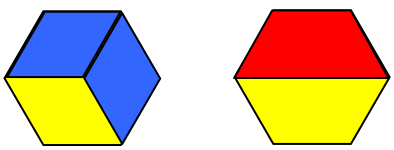
She added 1/3, and then she added 2/3, and then she added 3/3. How much did Erin have at the end?



Activity 3

Look at the two collections below. The collection on the left shows 2/3, and the collection on the right shows 1/2.

How much will you have if you add 2/3 and 1/2 together?



Activity 4

Use pattern blocks to solve the following addition problems:

$^{2}/_{6} + {}^{5}/_{6} = ?$

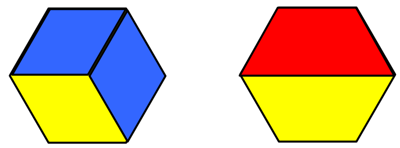
$^{1}/_{2} + {}^{3}/_{4} = ?$

$^{1}/_{3} + 1^{1}/_{2} = ?$

The example activities presented above bring up a number of different ideas about the addition of fractions. In Activity 1, students need to identify that the sum of the three fractions needs to be one whole, since the fractional pieces are all covering exactly one whole. Students learn how to add fractions with common denominators in Activity 2, and must also figure out how to express a sum that is more than one whole.

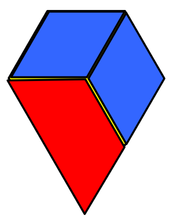
In Activity 3, students are confronted with two fractional parts that are not the same size. This question is much different from Activity 2, where students could add on similar-sized shapes and then figure out how that entire collection related to the original whole. Here, students must find some commonality between the fraction $^{2}/_{3}$ and the fraction $^{1}/_{2}$ in order to solve the problem. Some students may notice that they can put the pieces together and then think of the extra piece in terms of sixths; other students may figure out that both fractions can be written in terms of sixths, and then the process of adding is similar to what they did in Activity 2. The power of Activity 3 is that it poses a question that can be solved by finding a common denominator, but allows students to come to that conclusion themselves. Finally, Activity 4 presents three addition questions, and allows students the opportunity to set up and solve them using pattern blocks.

Solving the problem 2/3 + 1/2: Two methods

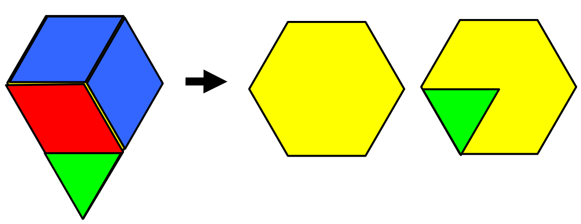


Method 1: Combining the fractions

Student: “I’m going to put these pieces together to see what happens. I also have to be careful not to add both hexagons together; if I did that, then the ‘whole’ would be changed.”



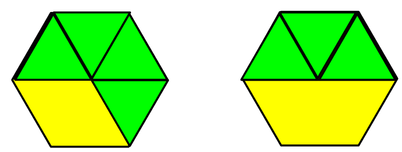
Student: “Here’s what I get when I put them together. But I have more than 1 whole, since I have that extra triangle hanging off. I need to figure out how much that amount is.”



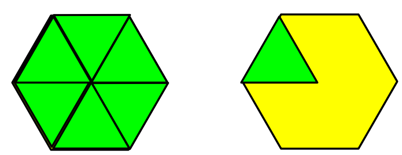
Student: “That extra part is one green triangle. So I know when I add 2/3 and 1/2, I get 1 whole and then 1 green triangle left over, which is 1/6 of a hexagon. So my answer is 1 and 1/6.”

Method 2: Converting to similar units

Student: “If I put these together, that won’t help me think about what the total is, because the two fractions are different sizes. So I need to make them the same sizes.”



Student: “I’ve put green tiles over the red and blue tiles, because I know that green tiles can fit onto all the other pattern blocks. Now I can put all the green tiles together and figure out how much I have.”



Student: “I can fill one entire whole with green triangles, and then I have one left over. So the total must be 1 and 1/6, since a green triangle is 1/6 of a yellow hexagon, and a yellow hexagon was our whole.”

Resources

The following resources have more information about how to use pattern blocks to teach fractions**.**

Web resources

Pattern Blocks Applet from National Library of Virtual Manipulatives:
http://nlvm.usu.edu/en/nav/frames_asid_170_g_2_t_3.htm

Cynthia Lanius' Lessons: Fraction Shapes Web site:
http://math.rice.edu/~lanius/Patterns/

Pattern Blocks Applet from Arcytech:
http://www.arcytech.org/java/patterns/patterns_j.shtml

Fun with Fractions lesson from NCTM:
http://illuminations.nctm.org/LessonDetail.aspx?ID=L345