

Teacher Guide: Modeling Fractions



Learning Objectives

Students will...

- Understand the meaning of the numerator and denominator of a fraction.
- Determine the effect on the value of a fraction when you:
 - Increase or decrease the numerator.
 - Increase or decrease the denominator.
- Create fractions that are equivalent to a given fraction.
- Find the least common denominator (LCD) of a pair of fractions.
- Compare fractions, both visually and numerically, using the LCD.
- Find the difference between two fractions.



Vocabulary

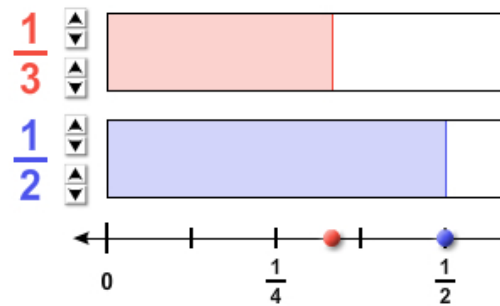
denominator, difference, equivalent, fraction, least common denominator, numerator



Lesson Overview

The *Modeling Fractions Gizmo™* uses area models to introduce students to fractions. Students can set the denominator of the fractions to any value from 1 to 8. They can shade the models to change the numerators.

Students can compare fractions visually or with the aid of a number line. The Gizmo also allows students to compare fractions numerically and find their difference using the LCD.



The Student Exploration sheet contains three activities:

- Activity A – Students see how changing the numerator and denominator affect the value of a fraction.
- Activity B – Students create equivalent fractions.
- Activity C – Students compare fractions by finding the LCD.



Suggested Lesson Sequence

1. **Pre-Gizmo activity** (🕒 10 – 20 minutes)

Pass out 4 or 5 rectangular strips of paper (all the same length), markers, and scissors to each student. Ask students to imagine that each strip represents a candy bar that must be divided among several students. Challenge students to divide the strips equally among 2, 3, 4, 5, and more students. In each case, ask students to describe what the portion size is, such as one out of six pieces. Finally, ask students which they would rather have, one out of five pieces of a candy bar, or one out of six pieces. Check that students see that *more* pieces results in *less* candy per person. (This is designed to get them ready for the fact that making the denominator of a fraction *larger* will make the value of the fraction *smaller*.)

2. **Prior to using the Gizmo** (🕒 10 – 15 minutes)

Before students are at the computers, pass out the Student Exploration sheets and ask students to complete the Prior Knowledge Questions. Discuss student answers as a class. At this point, letting students share how they thought about the questions is more valuable than “going over” the correct answers. After the discussion, if possible, use a projector to introduce the Gizmo and demonstrate its basic operations.

3. **Gizmo activity** (🕒 15 – 20 minutes per activity)

Assign students to computers. Students can work individually or in small groups. Have students work part of the Student Exploration sheet using the Gizmo. Alternatively, you can use a projector and do the Exploration as a teacher-led activity.

It may be overwhelming for students to do all of the activities in the Student Exploration in one sitting. We recommend starting with the first page of the Student Exploration sheet (Prior Knowledge Questions and Gizmo Warm-up) plus one of the three activities. Extend the lesson if you want using the extensions below. Return to the Gizmo and the unused activities in future class periods to reinforce the concepts.

4. **Extending the Gizmo** (🕒 15 – 20 minutes)

Here are some suggestions for extending the activities in the Student Exploration sheet:

Activity A Extension – The *Modeling Fractions* Gizmo allows fractions with denominators as high as 8. Ask students to make area models of fractions with larger denominators, and to identify the fraction based on an area model that you draw on the board. Ask students to compare the magnitude of pairs of fractions with the same denominator (such as $\frac{3}{11}$ and $\frac{5}{11}$) or the same numerator ($\frac{4}{9}$ and $\frac{4}{15}$).

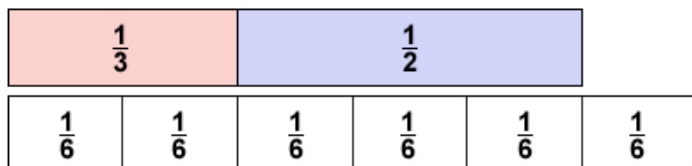
Activity B Extension – Continue to practice creating equivalent fractions to a given fraction. For example, ask students to create at least five fractions that are equivalent to $\frac{1}{3}$, $\frac{2}{5}$, etc. Based on the Gizmo, students should have noticed that you can create an equivalent fraction by multiplying the numerator and denominator by the same number. In some cases, you can also make equivalent fractions by *dividing* the numerator and denominator by the same number. This is called *simplifying* a fraction. Practice this technique with fractions such as $\frac{3}{9}$, $\frac{6}{12}$, $\frac{20}{25}$, and $\frac{18}{24}$.

Activity C Extension – Finding the least common denominator for a pair of fractions is a big step and one that will require much discussion and practice to understand. Using very simple examples, discuss why it is useful to find a common denominator when comparing fraction pairs such as $\frac{1}{3}$ and $\frac{2}{5}$. Practice finding common denominators, and apply this technique to adding and subtracting fractions.

5. **Follow-up activity: Fraction Tiles** (🕒 30 – 40 minutes)

Use strips of paper to create a set of fraction tiles. First create a set of “whole” pieces of equal length and marked in fourths, sixths, eighths, tenths, twelfths, etc. Next, create a variety of shorter pieces to represent fractions such as $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{2}{5}$, etc.

To model addition of fractions, students can place two of the shorter strips end to end. By laying the appropriate longer strip alongside, students can determine the sum. A similar process is used to model subtraction as the difference between two fractions.



**Modeling addition
using fraction tiles:**

$$\frac{1}{3} + \frac{1}{2} = \frac{5}{6}$$



Mathematical Background

The *Modeling Fractions* Gizmo was designed to introduce students to the basics of fractions. As you introduce this topic, be aware of several common fraction misconceptions:

- If an area model shows one shaded region and two unshaded regions, students may think the fraction represented is $\frac{1}{2}$ rather than $\frac{1}{3}$. Students need to understand that the denominator represents the *total* number of equal parts, not the number of “empty” parts.
- Increasing the numerator increases the value of a fraction, but increasing the denominator *decreases* the value of a fraction.
- When adding fractions with equal denominators such as $\frac{1}{3} + \frac{1}{3}$, students need to know that the numerators are added but the denominators are not. This may seem counter-intuitive at first. One way to combat this is to have students think about the problem in words. If you have one third and add to it one more third, what is the result? It’s two thirds. This can also be shown on the *Modeling Fractions* Gizmo: Model $\frac{1}{3}$ in each model, then ask students what they would have if they added the pieces together. It will be clear that the result is $\frac{2}{3}$ rather than $\frac{2}{6}$.



Selected Web Resources

Advice on teaching fractions: <http://www.beam.co.uk/pdfs/JED.pdf>

Fraction misconceptions: <http://www.standards.dfes.gov.uk/intervention/214.html>

Teaching fractions with chocolate: <http://k6educators.about.com/cs/math/a/teachfractions.htm>

Visual fractions: <http://www.visualfractions.com/>

Fractions and other simulations: http://www.mathplayground.com/math_manipulatives.html

Fraction tiles: http://www.abcya.com/fraction_tiles.htm

Least common denominator: <http://www.mathsisfun.com/numbers/common-denominator.html>