

Notes for the Teacher

Students use algebraic variables to build area models of equivalent fractions. For example, to create fractions equivalent to $\frac{1}{2}$, students construct a model of $\frac{1}{2}$ as $\frac{n}{2n}$ and then vary the value of n . As they do, visual representations of $\frac{1}{2}$, $\frac{2}{4}$, $\frac{3}{6}$, etc., appear on screen. Students also make fractions equivalent to $\frac{1}{3}$, $\frac{1}{4}$, $\frac{2}{3}$, $\frac{3}{5}$, and ultimately, any fraction whatsoever. Through this process, students learn that multiplying the numerator and the denominator of a fraction by the same variable can be used to create equivalent fractions.

Objectives:

- Students will understand that multiplying the numerator and the denominator of a fraction by the same value creates an equivalent fraction.
- Students will use the concept of a variable to construct equivalent fractions.

Common Core Mathematical Practices: (1) Make sense of problems and persevere in solving them; (2) Reason abstractly and quantitatively; (3) Construct viable arguments and critique the reasoning of others; (5) Use appropriate tools strategically; (7) Look for and make use of structure.

Common Core State Content Standards: 3.NF3; 4.NF1; 6.EE2

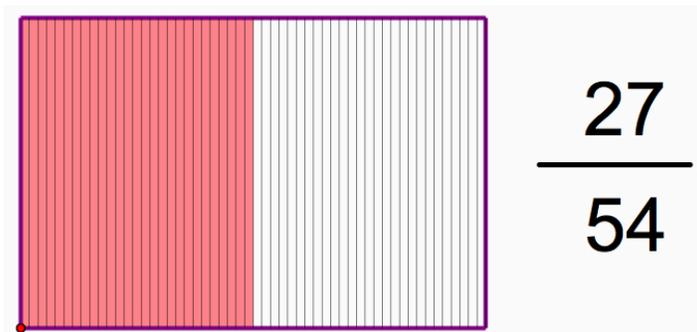
Grade Range: Grades 3–4

Introduce:

Use a projector to show sketch page “Example” and distribute the worksheet. Use the **Arrow** tool to select the numerator. Use the + key on your keyboard to increase the numerator several times. (Note: The – key will decrease the numerator.) Ask, “What do you notice about this fraction?” Students should state that the fraction is equal to $\frac{1}{2}$.

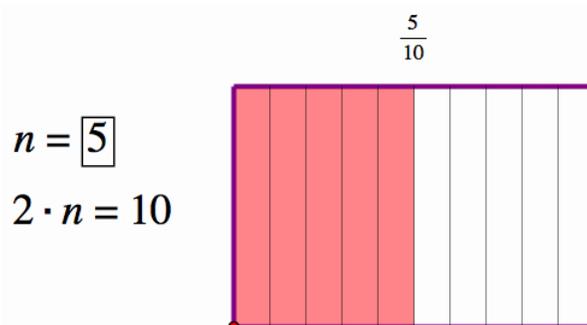
Then have students predict what the next denominator will be before you increase the numerator. Ask, “What is the relationship between the numerator and the denominator of all of these fractions?” Students will likely notice that the denominator is always 2 times the numerator. Students may enjoy seeing big numbers for the numerator and the denominator, such as $\frac{50}{100}$. To do so, double-click the numerator, enter a new value in

the dialog box that appears, and click **OK**. Tell students they will have the opportunity to build this model themselves and make a fraction that will always equal $\frac{1}{2}$.



Now go to page “Equal to $1/2$.” Use the **Arrow** tool to select n . Use the + key to show that the value of n can be any integer. Explain that n is the numerator of the fraction you’re about to make. Ask, “If n is the numerator, what should the denominator be so that the fraction is equal to $\frac{1}{2}$?” Ask students to state this value in terms of n : The denominator is 2 times the numerator, so the denominator should be $2 \times n$.

Follow the procedure in worksheet step 1 to demonstrate how to construct a fraction that is equivalent to $\frac{1}{2}$. Some students may not be familiar with the symbol * used as a multiplication sign. If needed, review the different ways to express multiplication: \times , \bullet , and $*$.



When the fraction is complete, ask a volunteer to come to the computer and check that it is equal to $\frac{1}{2}$ by using the **Arrow** tool to select $n = 1$ and then pressing the + key to change n 's value. Ask students to observe which qualities change and which stays the same as the value of n changes. (You will discuss this later at the end of the activity.)

Then have students name the fraction they made in terms of n : $\frac{n}{2n}$.

Explore:

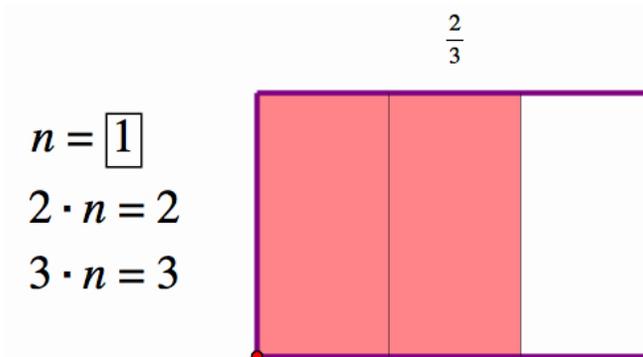
Assign students to partners and send them in pairs to the computers. Direct students to page “Equal to $\frac{1}{2}$.” Have students make their own fraction that is equivalent to $\frac{1}{2}$.

When they are done, make sure that students check their work by selecting n and pressing the + key multiple times.

Then have students go to the subsequent sketch pages and make fractions that are equivalent to $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{2}{3}$. As you circulate, ask students how they know the value of the denominator for the equivalent fraction.

While finding equivalent fractions for $\frac{1}{3}$ and $\frac{1}{4}$ follows the same basic procedure as for $\frac{1}{2}$, making a fraction equivalent to $\frac{2}{3}$ is a little more involved. For $\frac{2}{3}$, the numerator of the fraction will be $2n$, rather than just n , and the fraction is constructed as $\frac{2n}{3n}$. When students check that their fraction is equivalent to $\frac{2}{3}$ using the + key, be sure they use the **Arrow** tool to click on n , not $2 \times n$, as n is the value that can be adjusted.

Having made $\frac{2}{3}$, students can then apply what they learned to construct $\frac{3}{5}$ as $\frac{3n}{5n}$.

**Discuss:**

Call students together to discuss and summarize what they’ve learned. Have students explain how they knew what the numerator and the denominator should be for each fraction. Have students identify the changes that take place as the value of n changes. Be sure students understand that as the value of n changes, the values of the numerator and the denominator change, and these changes are reflected in the visual

representation. That is, the size and number of equal-sized parts changes, but the shaded area does not.

Go to page “Choose a Fraction.” Have volunteers select their own fractions, and then, as a class, make equivalent fraction. Ask students to explain their thinking as they are making the equivalent fractions.

Summarize by asking students to state how they can make an equivalent fraction for any given fraction. Students should state that they can create an equivalent fraction by multiplying both the numerator and the denominator by the same variable, such as n , x , y , etc. Ask students why multiplying a fraction by $\frac{n}{n}$ creates an equivalent fraction.

Discuss that $\frac{n}{n}$ is equal to 1, and multiplying by 1 does not change the value of the fraction.

Related Activities:

- *Make Your Own Fractions—Comparing Fractions to One*
- *Make Your Own Fractions—Ordering Fractions*
- *Make Your Own Fractions—Getting Close to One*
- *Make Your Own Fractions—Comparisons to One Half*
- *Make Your Own Fractions—Equivalent Fractions*
- *Make Your Own Fractions—An Early Algebra Approach to Equivalent Fractions*

License (CC-BY-NC-SA 3.0)

This work is licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc-sa/3.0/> or send a letter to Creative Commons, 444 Castro Street, Suite 900, Mountain View, California, 94041, USA.

If you adapt and/or share this work, you must attribute it to “KCP Technologies, Inc., a McGraw-Hill Education Company,” and you may distribute it only non-commercially under the same or similar license.

Portions of this material are based upon work supported by the National Science Foundation under award number DRL-0918733. Any opinions, findings, and conclusions or recommendations expressed in this work are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.