Teacher Guide: Fraction Garden

Learning Objectives

Students will…

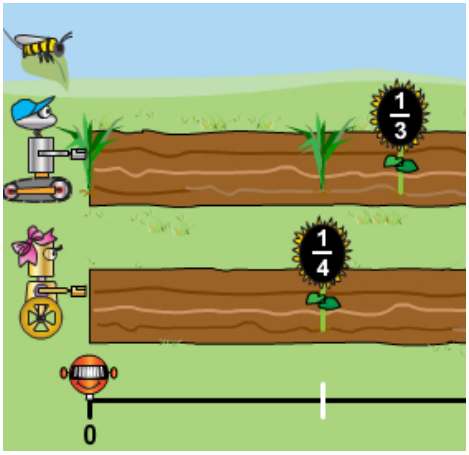
- Understand that the denominator of a fraction represents the number of equal parts the whole has been divided into.
- Understand that the numerator of a fraction is the number of parts being referred to.
- Compare the sizes of different fractions.
- Develop an understanding of equivalent fractions.
- Estimate the locations of fractions on a number line.

Vocabulary

denominator, equivalent, fraction, greater than, less than, numerator

Lesson Overview

The *Fraction Garden* Gizmo™ supports student understanding of fractions based on their positions on a number line.



In *Fraction Garden*, students explore fractions by planting flowers in a garden. The locations of the flowers are determined by the value of a fraction. Students compare fractions and estimate their values by using robots to plant and weed their garden.

The Student Exploration sheet contains three activities:

- Activity A – Students compare values of fractions based on their numerators, denominators, and locations on a number line.
- Activity B – Students explore equivalent fractions.
- Activity C – Students estimate the locations of fractions on a number line.

Suggested Lesson Sequence

1. **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. Specifically, ask students to share their strategies for dividing objects into equal sections (e.g. divide in half and divide each section in half, etc). After the discussion, if possible, use a projector to introduce the Gizmo and demonstrate its basic operations.

2. **Gizmo activity** (15 – 20 minutes per activity)
   Assign students to computers. Students can work individually or in small groups. If students work in groups it is important that each student have an opportunity to control the Gizmo. 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) and choosing 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.

3. **Extending the Gizmo** (15 – 20 minutes each)
Here are some suggestions for extending the activities in the Student Exploration sheet:

Activity A Extension – Have students work in pairs to compare fractions. One student plants two flowers in a garden and the other student needs to plant a flower between them. For each pair, have students explain how they found a fraction that was between the two given fractions.

Activity B Extension – Have students explore mathematically what makes two fractions equivalent. For example, start with $\frac{3}{4}$ and have students multiply the numerator and denominator by 2, to get $\frac{6}{8}$. Plant flowers in the garden at both of these fractions to prove that they are equivalent. Have students use this method to create more equivalent fraction pairs and see how many equivalent fractions they can find. Note that the Gizmo only supports numerator and denominator values up to 12.

Activity C Extension – The bee in the Gizmo can be used to support further estimation of fractions. The bee is moved along the length of the garden by dragging. If it stops over a flower (or a flower is planted underneath it) the bee will pollinate the flower. Have one student place the bee somewhere over the garden. The other student then tries to plant a flower directly under the bee. If the bee does not pollinate the flower, the student should try again until the planted flower is pollinated. Have students keep track of their guesses. Discuss how they found fractions just to the right or left of their initial guesses.

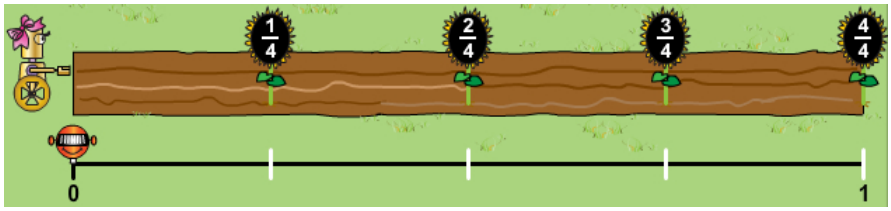
When you have finished the activities in the Student Exploration, wrap up the lesson with a class discussion. Ask students the following questions:

- How can you tell if two fractions are equivalent without graphing them?
- How can you change a fraction to move it left or right on a number line?
- What fraction in the Gizmo gets closest to zero without touching it? Can you think of any fractions that are even smaller, but still not equal to zero?
- What are some numbers that are between 0 and $\frac{1}{2}$? Between $\frac{1}{2}$ and 1?

4. **Follow-up activity: Classroom number line challenge** (20 – 30 minutes)
Draw a large horizontal number line from 0 to 1 on your board. Give each student a sticky note with a fraction written on it. Select students randomly to come to the board and place their sticky note fraction at the appropriate place on the number line. Students may also choose to adjust the position of any existing fraction on the board. By the time the last student takes his/her turn the whole number line should be in order. You can adjust the difficulty of this activity by choosing which fractions you write on the sticky notes. You will also need to decide whether students are allowed to make marks (like Chalky in the Gizmo) on the board to help them place their fractions.

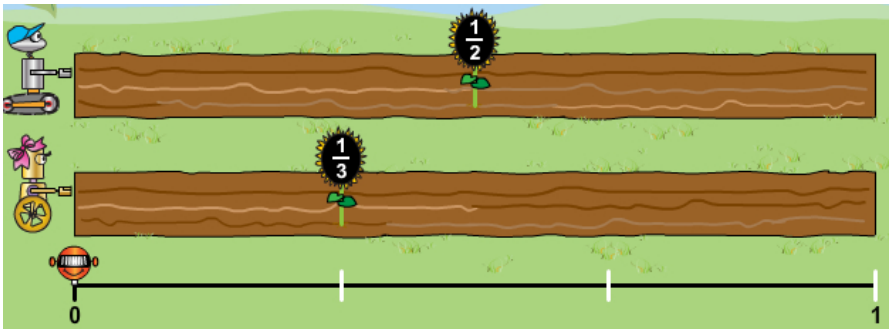
Mathematical Background

Students should understand that the denominator represents the number of equal sections that a whole (in this case the garden) is divided into. For example, in the diagram below, Chalky's marks show that the garden has been divided into four equal sections. So, all corresponding fractions have a denominator of 4. The numerator represents the part of the whole that is selected. For example, $\frac{3}{4}$ is located at the third of Chalky's four equally spaced marks.



When comparing fractions, increasing the numerator of a fraction without changing the denominator increases its size. For example, $\frac{3}{4}$ is greater than $\frac{2}{4}$ (see above).

However, increasing the denominator of a fraction without changing the numerator *decreases* its size. For example, $\frac{1}{3}$ is *less* than $\frac{1}{2}$. Students may believe that $\frac{1}{3}$ is greater than $\frac{1}{2}$ because 3 is greater than 2. You can use Chalky to show that divisions of 3 are smaller than divisions of 2.



The Gizmo presents equivalent fractions visually with fractions that line up with each other. It is important for students to see the mathematical rule behind this: if you multiply or divide the numerator and denominator of any fraction by the same number, the resulting fraction is equivalent. For example, $\frac{2}{3}$ is equivalent to $\frac{6}{9}$ (multiply numerator and denominator by 3) and $\frac{3}{12}$ is equivalent to $\frac{1}{4}$ (divide both by 3).

Selected Web Resources

Comparing fractions practice: http://www.visualfractions.com/Compare.html
Equivalent fractions: http://www.mathsisfun.com/equivalent_fractions.html
Fractions activity: http://www.bgfl.org/index.cfm?s=1&m=220&p=136,view_resource&id=178
Comparing fractions: http://www.nlvm.usu.edu/en/nav/frames_asid_159_g_2_t_1.html?from=category_g_2_t_1.html
Fraction king: http://www.shodor.org/interactivate/lessons/FractionKing/