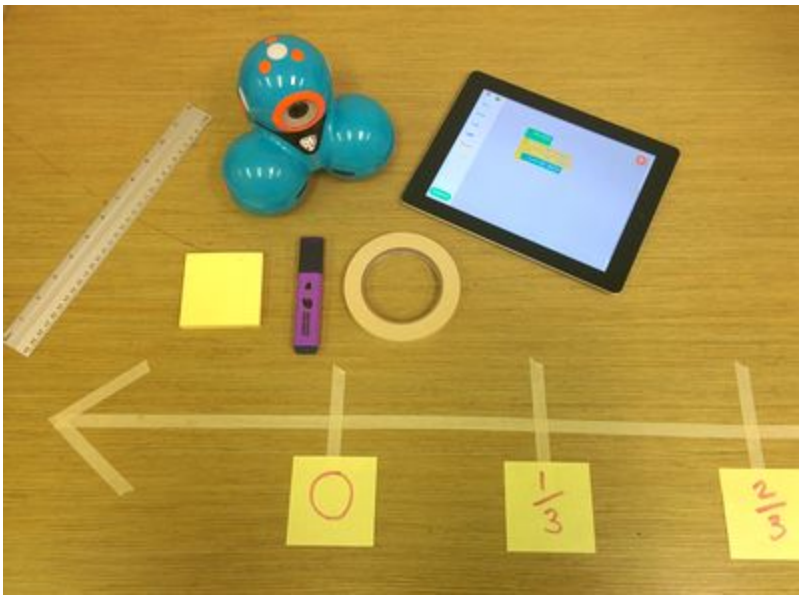
A Slice of Number Line Pie



Overview:

Already knowing fractions of pizza and pie, students will “roll out” those models to connect them to the number line. In this lesson, students will use Dash to model fractions on a number line.

Curriculum: Math, CS

Group Size: 2 - 4 per Dash	Target Grades: 3 - 4	Time Required: 1.5 - 2 hours

Content Standards:

Mathematics:

- 3.NF.A.2: Understand a fraction as a number on the number line; represent fractions on a number line diagram.
    - 3.NF.A.2.a: Represent a fraction 1/*b* on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into *b* equal parts. Recognize that each part has size 1/*b* and that the endpoint of the part based at 0 locates the number 1/*b* on the number line.
    - 3.NF.A.2.b: Represent a fraction *a*/*b* on a number line diagram by marking off *a* lengths 1/*b* from 0. Recognize that the resulting interval has size *a*/*b* and that its endpoint locates the number *a*/*b* on the number line.
- 4.NF.B.3: Understand a fraction *a*/*b* with *a* > 1 as a sum of fractions 1/*b*.
    - 4.NF.B.3.a: Understand addition and subtraction of fractions as joining and separating parts referring to the same whole.

- 4.NF.B.3.b: Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions, e.g., by using a visual fraction model. *Examples: 3/8 = 1/8 + 1/8 + 1/8 ; 3/8 = 1/8 + 2/8 ; 2 1/8 = 1 + 1 + 1/8 = 8/8 + 8/8 + 1/8*.

Materials Needed:

- 1 Dash per group of students
- 1 Blockly compatible tablet per group
- Fraction Review Worksheet printouts (1 per student)
- Sticky notes
- Markers
- Rolls of masking tape (1 per group) for students to create their own number line
- 1 yard stick or ruler per group

Lesson Objectives:

- Connect circular fraction models to the number line.
- Understand that a unit fraction 1/*b* represents 1 section of a number line [0, 1] broken into *b* sections.
- Model unit fractions on the number line.
- Model proper fractions on the number line.

Lesson Procedure:

This lesson can be broken into three classes or sections.

Class 1: From Fraction Circles to Number Lines (20 - 30 minutes)
Class 2: Unit Fractions on a Number Line (30 - 40 minutes)
Class 3: Proper Fractions on a Number Line (30 - 40 minutes)

Class 1: From Fraction Circles to Number Lines

Start the lesson by passing out copies of the Fraction Review Worksheet. Ask students to model the following fractions on the worksheet, one at a time.

- one half (½)
- one fourth (¼)

- two thirds (⅔)
- five sixths (⅚)
- three eighths (⅜)

Ask students to describe their models. For example, one fourth is modeled by dividing the circle into four equal sections and shading one of the sections.

- What represents the whole?
    - Each circle represents one whole.
- What represents the fraction?
    - Each section of a circle represents the fraction. The students should shade one of these sections to model the unit fraction.

Unplugged activity - Unrolling a Circle into a Number Line

Ask students to divide into groups of different numbers (2 to 9). Instruct each group to hold hands in a circle. Remind them that the circle represents one whole.

- Ask one or two students from each group “What fraction of the whole do you represent?”
    - If there are 3 students in a group, each student represents one third; if there are 8 students in a group, each student represents one eighth; and so on.

Once all groups state the correct fraction that each student represents, go around the class and “unroll” each circle of students into a straight line.

- Tell students that now the line represents one whole.
- Ask the person on the left end of the line “What fraction of the line do you represent?”
- Ask a person in the middle of the line “What fraction of the line do you represent?”
    - If there are 3 students in a line, each student still represents one third of the line; if there are 8 students in a line, each student still represents one eighth; and so on.

Ask all students to go back to their seats except the group of 4. Have the group of 4 stand at the front of the class, holding hands in a line, arms outstretched as much as

possible.

- Remind the students that the line represents one whole.
- Write “0” on a sticky note and stick it to the hand of the student on the right end of the line (i.e. the hand that is not holding another student’s hand).
- Write “1” on a sticky note and stick it to the hand of the student on the left end of the line (i.e. the hand that is not holding another student’s hand).
- Tell students that the line represents the distance between the values 0 and 1.
- Write “¼” on a sticky note. Ask a student to place the label ¼ of the distance between 0 and 1.
    - The sticky note should be placed on the joined hands of the first and second students from the right.
    - If the student places the sticky note on the first person rather than between the first and second person, tell them that each student represents one fourth of the line. Ask them if the location they placed the note is one fourth of the distance between 0 and 1.
    - If students are still having trouble deciding where to place the label, tell them to assume that the arm span of each person in the line is equal.
- Write “¾” on a sticky note. Ask a student to place the label ¾ of the distance between 0 and 1.
    - The sticky note should be placed on the joined hands of the third and fourth students from the right.
    - If students are having trouble deciding where to place the label, ask them to think about how they would model ¾ on a circle. How many sections would be shaded? How many people make up ¾ of the line?
- Write “2/4” on a sticky note. Ask a student to place the label 2/4 of the distance between 0 and 1.
    - The sticky note should be placed on the joined hands of the second and third students from the right.
    - If students are having trouble deciding where to place the label, ask them to think about how they would model 2/4 on a circle. How many sections would be shaded? How many people make up 2/4 of the line?
    - Once students place this label correctly, ask them if there is another way that the fraction 2/4 can be represented. The answer is ½. If students

cannot figure this out, write “½” on a sticky note and ask them to place the label ½ of the distance between 0 and 1. Make sure they make the connection that 2/4 = 1/2 before moving on.

If you have time, repeat the line activity with a different number of students to model a different fraction.

Class 2: Unit Fractions on a Number Line

Divide students into groups of 2 to 4. Give each group 1 Dash, 1 Blockly compatible tablet, 1 yard stick or ruler, and 1 roll of masking tape.

Walk students through how to make a masking tape number line on the floor. Each group should make their own number line. Each number line will go from 0 to 1.

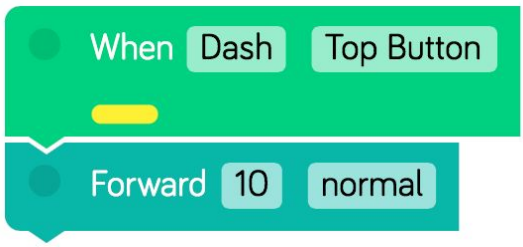
- Students should start by laying down a straight line of masking tape on the floor (about 2 yards long), and marking the location of 0, as shown.

- Instruct students to write a Blockly algorithm to make Dash move 120 cm. There are many different ways this can be accomplished.

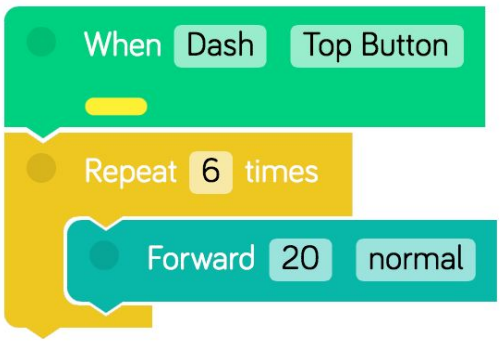
Instruct students to select “normal” speed for Dash in their algorithms. This will ensure that all groups have a number line of the same length.

    - The simplest of these algorithms is to make Dash move 100 cm and then 20 cm (or any combination of moves that adds up to 120 cm) with a single button press.

- You can also accomplish the same thing with multiple button presses. Here is a simple algorithm to make Dash move 10 cm with every top button press. Students would need to press Dash's top button 12 times for Dash to travel 120 cm.



- If students are familiar with loops, they can use one to make Dash move some fraction of 120 cm some number of times. Here is an algorithm that makes Dash move 20 cm six times, for a total of 120 cm.



- Any other algorithm that makes Dash move a total of 120 cm is also acceptable.

It is important that students use Dash to create the number line, rather than measure 120 cm with a yard stick. This is because Dash may not travel exactly 120 cm, but the other measurements at the same speed will be proportional.

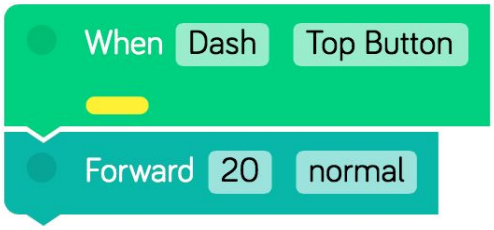
- Instruct students to mark the location where Dash stops. Label this location "1".
- Instruct students to write down their algorithm so it can be used later.

Give each group one of the following unit fractions to model on their number line: ½, ⅓, ¼, ⅙.

- Write these fractions on sticky notes and hand one to each group. Students will use the sticky notes to label the fraction on their number line.
- Ask students to mark their number lines with an estimate for the location of the unit fraction.

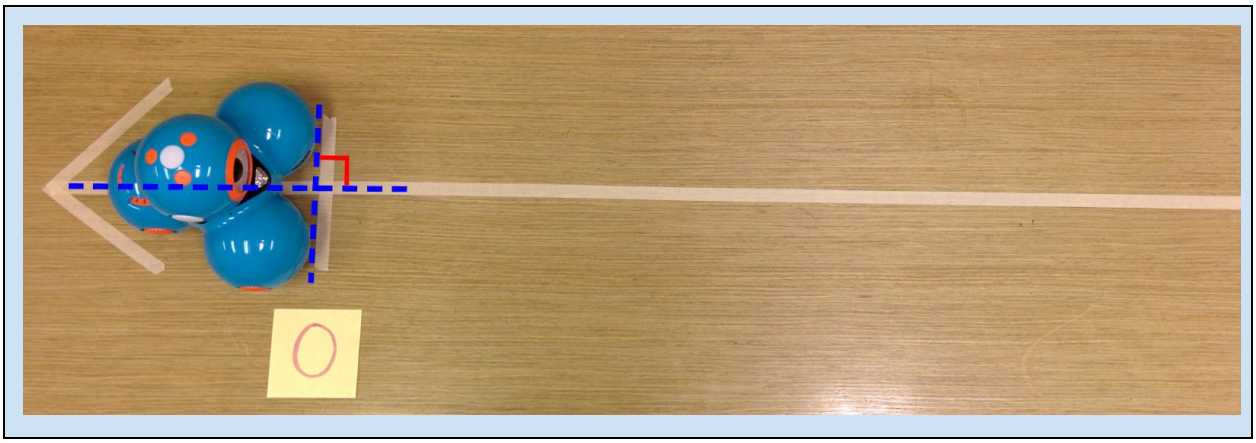
Challenge students to write a Blockly algorithm to make Dash move the given unit fraction distance on the number line.

- If students have trouble figuring out how far Dash must travel to model the given fraction, remind them that to model the fraction $\frac{1}{b}$, you must divide the whole into *b* equal parts. Each of these parts will have length $\frac{1}{b}$.
    - For ½, Dash must travel $\frac{120\ cm}{2} = 60$ cm along the number line.
    - For ⅓, Dash must travel $\frac{120\ cm}{3} = 40$ cm along the number line.
    - For ¼, Dash must travel $\frac{120\ cm}{4} = 30$ cm along the number line.
    - For ⅙, Dash must travel $\frac{120\ cm}{6} = 20$ cm along the number line. Below is sample code to make Dash move forward 20 cm.



Instruct students to run their Blockly algorithm to use Dash to mark the location of the given unit fraction on their number line.

Before running the Blockly algorithm, students should make sure that Dash is lined up properly at 0.



- Ask students if the location Dash stops at appears to represent the given unit fraction. If not, have the students explain why it may not be the correct location.
- Ask students to measure this distance on their number line to be sure that it correctly represents the unit fraction. If not, have students explain why this is not the correct location, and have them try again.
    - The location will not be correct if Dash did not move straight along the number line.
    - If students have the correct algorithm but Dash is not in the correct position after running the algorithm, have the student line Dash up at 0 on the number line and try again.

Check to make sure the students have correctly modeled the unit fraction on the number line.

- If this distance is correct, instruct students to write down their Blockly algorithm so it can be used later.
- Note that there are several different algorithms that can work for this activity. If Dash moves the correct distance along the number line, then the algorithm should be considered correct.
- Ask students to compare their initial estimate with the actual location of the unit fraction. Was their estimate close to the actual location?

Once all groups have modeled their unit fraction correctly, ask students to remove the unit fraction marking from their number lines.

If time allows, give each group a different unit fraction from the same set (½, ⅓, ¼, ⅛). Have students repeat the activity for this new unit fraction.

Class 3: Proper Fractions on a Number Line

Divide students into groups of 2 - 4. Give each group 1 Dash, 1 Blockly compatible device, 1 yard stick or ruler, and 1 roll of masking tape.

Instruct students to use the number line Blockly algorithm they developed in *Class 2: Unit Fractions on a Number Line* to make a 120 cm number line on the floor, using Dash. Each group should make their own number line. Each number line will go from 0 to 1.

It is important that students use Dash to create the number line, rather than measure 120 cm with a yard stick. This is because Dash may not travel exactly 120 cm, but the other measurements at the same speed will be proportional.

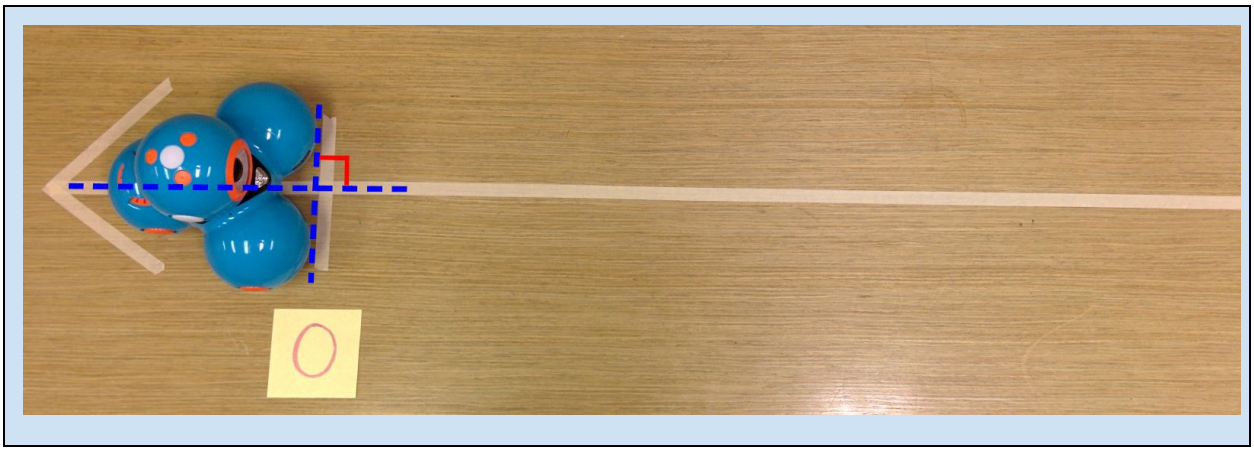
- See *Class 2: Unit Fractions on a Number Line* for details on how to make this number line.

Give each group a proper fraction to model on their number line. Make sure the proper fraction has the same denominator as one of the unit fractions the group modeled in *Class 2: Unit Fractions on a Number Line* and is from the following set: 2/3, 2/4, 3/4, 2/6, 3/6, 4/6, or 5/6.

- Write these fractions on sticky notes and hand one to each group. Students will use the sticky note to label the fraction on their number line.
- Tell students to mark their number lines with an estimate for the location of the proper fraction.

Challenge students to use the unit fraction Blockly algorithm they created in *Class 2: Unit Fractions on a Number Line* to make Dash move from 0 to 1 on their number line.

Before running the Blockly algorithm, students should make sure that Dash is lined up properly at 0.

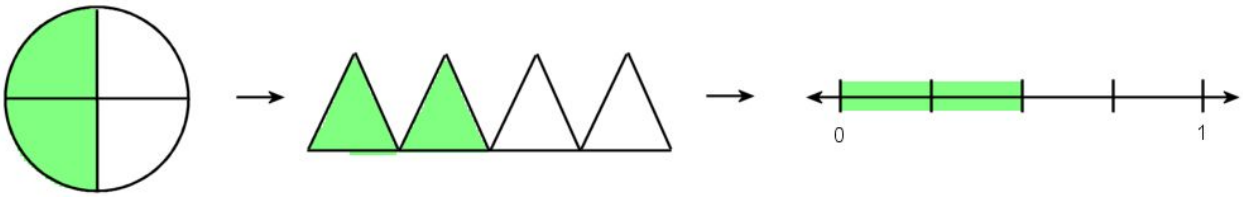


- Instruct students to mark the number line each time Dash stops. These marks will be the tick marks for the number line.
- Ask students “How many times did Dash stop by the time Dash got to 1?”
    - If the original unit fraction is 1/2, Dash’s second stop is at 1.
    - If the original unit fraction is 1/3, Dash’s third stop is at 1.
    - If the original unit fraction is 1/4, Dash’s fourth stop is at 1.
    - If the original unit fraction is 1/6, Dash’s sixth stop is at 1.
- Ask students “How many sections is the number line divided into?”
    - If the original unit fraction is 1/2, the number line is divided into two sections.
    - If the original unit fraction is 1/3, the number line is divided into three sections.
    - If the original unit fraction is 1/4, the number line is divided into four sections.
    - If the original unit fraction is 1/6, the number line is divided into six sections.

Instruct students to mark the location on the number line that they believe represents the given proper fraction.

- If students aren’t sure how to model the given proper fraction, ask them “If the first tick mark represents $\frac{1}{b}$, and the second tick mark is twice the distance from 0, what does the second tick mark represent?”
- If students still aren’t sure how to model the proper fraction, ask them how they modeled proper fractions in their circle models.
    - To model $\frac{a}{b}$, students should have divided the circle into *b* equal parts and shaded *a* parts of the circle.
    - Have students relate shading equal parts of a circle to moving equal intervals along the number line.

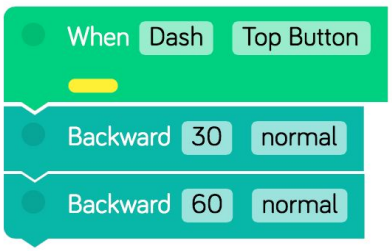
- If students are still having trouble, ask them to model the proper fraction with a circle. Then help them “roll out” the circle with a diagram. Make sure all shaded regions are adjacent, as shown.
    - Example: Model the proper fraction 2/4.



- If students think they have correctly labeled the proper fraction, ask them to measure this distance to be sure. If this distance is not correct, have students explain why not.
    - The location will not be correct if Dash did not move straight along the number line.
    - If students have the correct Blockly algorithm but Dash is not in the correct position after running the algorithm, have the student line Dash up at 0 on the number line and try again.

Check to make sure the students have correctly modeled the proper fraction on the number line.

Extension: For older students, while Dash is located at the proper fraction on the number line, have students make Dash get back to 0 using different sized moves. For example, if Dash is at ¾, students could make Dash move back ¼ (30 cm) and then 2/4 (60 cm) to end at 0.



Once all groups have modeled their proper fraction correctly, if time allows, ask students to remove the markings from their number lines. Then give each group a new proper fraction from the following set: 2/3, 2/4, 3/4, 2/6, 3/6, 4/6, or 5/6.

Have students repeat the activity for this new proper fraction.

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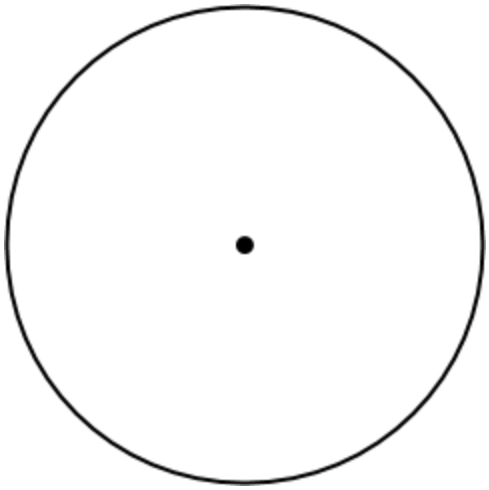
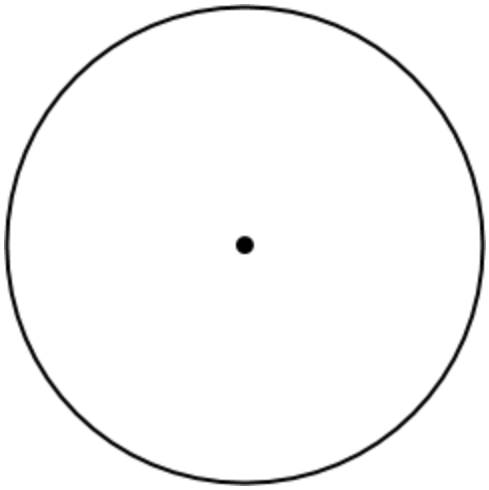
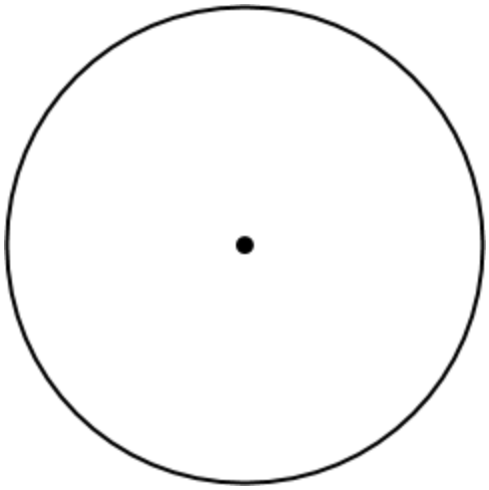
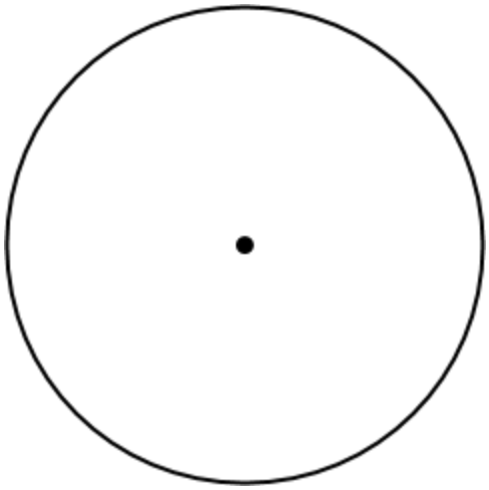
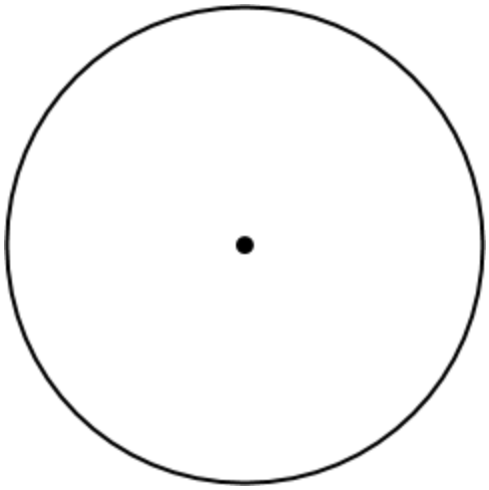
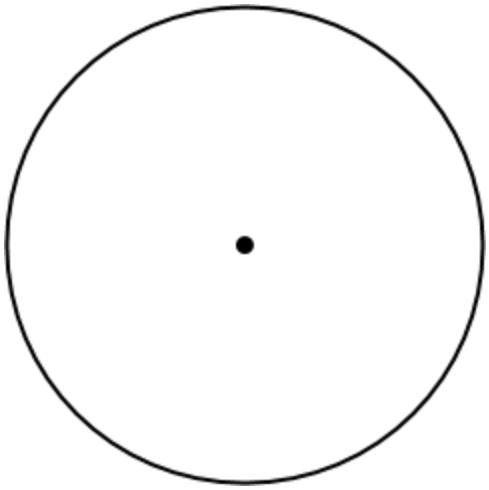
Fraction Review Worksheet

Evaluation Rubric

	Excellent	Competent	Needs work
Participation and Teamwork	The student actively participates in classroom discussions, answering questions and cooperating with group member(s) during the activity.	The student occasionally participates in classroom discussions and cooperates somewhat with group member(s).	The student does not participate in classroom discussion. The student does not cooperate with their group member(s) during the activity.
Mathematics	The student understands that 1/*b* can be found on a number line by dividing the interval [0, 1] into *b* equal parts and moving 1 part from 0.	The student understands that 1/*b* can be found on a number line by dividing the interval [0, 1] but cannot find the number of parts or the placement on the line.	The student does not understand that 1/*b* can be found on a number line by dividing the interval [0, 1] into *b* equal parts and moving 1 part from 0.
	The student can represent the proper fraction *a*/*b* on a number line.	The student understands that *a*/*b* is an extension of 1/*b*, but cannot connect that it's the *a*th part on the line.	The student cannot make the connection from *a*/*b* to 1/*b* and cannot map it to the number line.
Programming	The student is able to program Dash to show the locations of the fractions on a number line.	With some help from the teacher, the student is able to program Dash to show the locations of the fractions on a number line.	The student is unable to program Dash to show the locations of the fractions on a number line, even with help from the teacher.