

Facilitator Guide: Building Number Lines

Lesson Overview:

Big Idea: This lesson extends students' conceptual understanding of fractions on a number line by having them build number lines based on a unit fraction, the length defined by $1/n$, rather than by partitioning the distance between 0 and 1 based on fraction's unit (denominator). Iterating a unit fraction, making copies, to create a number line allows students to apply their counting schemas for whole numbers, 1 2 3..., to fractions, $1/2$ $2/2$ $3/2$

Lesson Flow: Project the warm up problems from the lesson's agenda page. Discuss missing numbers in the pattern as a class. Have students play the Build a Number Line puzzles from the link on the agenda page. Bring students together and project teacher puzzles from the agenda page to discuss as a class. Hand out Build Number Lines Problem Sheet to students and have them solve the problems independently. When most students are finished, project the last problem from the link on the agenda page to discuss as a class.

Warm Up: Number Patterns

Part 1: Teacher projects warm up while students find the missing numbers (5 min)

- Record missing numbers on the projected image or copy and fill in the sequence on the whiteboard
- Prompts:
 - $1/4$ $2/4$ $\underline{\quad}$ $5/4$ $\underline{\quad}$
 - $\underline{\quad}$ $\underline{\quad}$ 1 $\underline{\quad}$ $5/3$ $\underline{\quad}$
- Students can use individual whiteboards or paper and pencil

Part 2: Discuss warm up problem as a class (5 min)

- First prompt: Bring out the fact that we are counting by a unit fraction, fourths. Counting by fourths matches counting by whole numbers except we need to say the unit (fourth) we are counting by: 1-fourth, 2-fourths, 3-fourths....
- Second prompt: Focus on how to find the unit we are counting by. For example, students may see that 1 is the third count in the sequence and try counting by thirds.
 - Challenge students to make sense of the mixture of whole numbers and fractions in this sequence: what number could we use instead of 1 ($3/3$) or what numbers can come after $5/3$ (2 or $6/3$)?

Questions

- What numbers follow this pattern?
- How do you know this sequence makes sense?

Activity One: Build a Number Line

Part 1: Students solve Build a Number Line puzzles (5 min)

- Students use bar models to measure out distances from zero to create a number line with the numbers given in the puzzle. Some of the puzzles can be solved by first placing the whole numbers and then finding the fractions that go between them, a strategy used in Lesson 1.
- Other puzzles, however, need to be solved by choosing the unit fraction first, then making copies of it (iterating) to find the other numbers in the puzzle. All the puzzles can be solved using this strategy.
- Big idea: Choosing a length for a unit fraction, you can iterate that length to create a number line. That length is set arbitrarily. These puzzles can be solved using almost any of the bars given!

Part 2: Solve and discuss a Build a Number Line puzzle (5 min)

- Ask students to think on their own, discuss with a partner and then share as a class how to plot $9/6$, $2/6$, $4/6$, $5/6$ and $7/6$ on this number line.
 - Challenge students to think about which bar model makes sense to use as a length of $1/6$. Are there multiple solutions for this puzzle?
 - The larger bars will not work as $1/6$, but if you assign a value of $2/6$, they can be used to solve this puzzle.
 - This puzzle can be used to promote the Big Idea mentioned above. Replay this puzzle if the discussion lends itself to analyzing different solutions.

Activity Two: Build a Number Line with Unit Fractions

Part 1: Students work on **Build a Number Line with Unit Fractions** problem sheet (10 min)

- Students construct 4 number lines given a unit fraction for each one ($1/2$, $1/4$, $1/3$, $1/6$) and plot two fractions on the number line, one less than 1 and the other greater than 1.
- Students will need to iterate (making copies of) the given length of the unit fraction while attending to precision (keeping the length constant).

Part 2: Class discussion on problem 4 from the problem sheet (5 min)

- Project problem (build using $1/6$ and plot $7/6$ and $4/6$) from link in agenda.
- Ask students to think on their own, share with a partner and then discuss as a class, "What strategies can you use to find these fractions on the number line?"
- Focus the discussion that since the unit distance ($1/6$) is set, all other points on this number line are also set and many can be found by iterating, making copies of, $1/6$.
 - How can we use the information on the number line to find $7/6$, $4/6$?
 - Does it matter where we plot these fractions?
 - What is the distance between (any two consecutive sixths)? Students should recognize the the distance between any two consecutive sixths is always $1/6$.