Grade 4

Number Lines

Purpose:

- To understand relationships between numbers
- To understand the relative magnitude of numbers.

Description:

Students place numbers on a number line. Students use what they know about one number to determine where a second number should be placed. As the types of numbers change and as the scale changes, students must use reasoning skills and their understanding of amounts and quantities to place the numbers.

Materials:

- A large, blank number line easily visible to all students during the routine time
- Attached blackline master of number lines

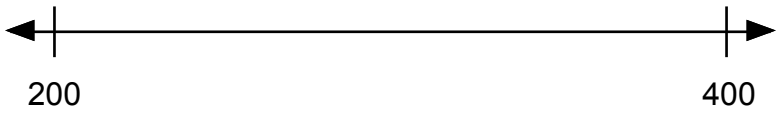
Time: 15 minutes maximum

Caution: Always include arrows on both ends of your number line representations so students realize the number line is infinite; we are only looking at a section of the number line.

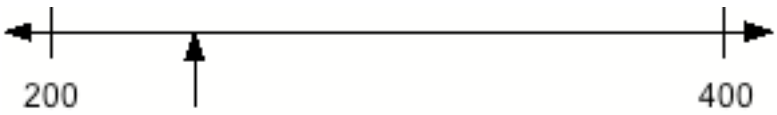
Directions:

VARIATION 1: ESTIMATION

1. Label 2 marks on the number line (e.g., 200 and 400).



2. Place an arrow somewhere between the 2 marks.



3. The class suggests reasonable values for the number at the arrow.
   The students should give reasons why the numbers they suggest are reasonable (e.g., "It looks like the arrow is about one fourth of the distance between 200 and 400. Since there are 200 numbers between 200 and 400, the arrow looks like it might be pointing to a number about 50 larger than 200, so I think it might be 250.").

Scaffold for Variation 1:

Give the students several numbers to choose from. Students select the number that makes the most sense to them and explain their reasoning. For example:

The arrow is pointing to which of the following numbers? Support your response with a mathematically convincing argument.

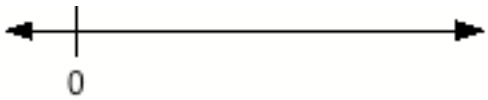
350, 250, 205, 380

Guiding questions for Variation 1:

- Support your placement with a mathematically convincing argument.
- Name a number that is greater than this number.
- How much greater? Prove it on the number line.
- Name a number that is less than this number.
- How much less? Prove it on the number line.

VARIATION 2: ESTIMATION

1. Label the mark on the left with a zero.

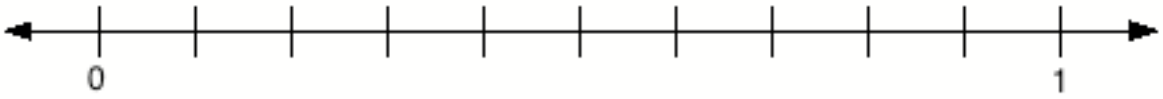


2. Tell the students the arrow is pointing to a particular number (e.g., The arrow is pointing to 375).

3. Ask where other numbers would be. This helps students look at the relative positions of values. For example:
   About where would 750 be?
   About where would 190 be?
   About where would 300 be?
   Justify your answers with mathematically convincing arguments.

VARIATION 3: DECIMALS

1. Draw a number line with 11 marks, evenly spaced (this will give you ten intervals). Label the extremes "0" and "1."



2. Write decimals on index cards (one decimal number per card). Use decimals such as 0.46, 0.52, 0.7, 0.44, 0.8, 0.48, 0.32, 0.6, 0.08, etc.

3. Choose only 2 or 3 decimals to work with each time you do this routine. Make multiple copies of the same numbers. Give a card to each pair of students. Give students time to discuss where their number would make sense on the number line.

4. Have one pair of students place their card where they think their number belongs on the number line. Students must give a mathematically convincing argument as to why they are placing the number at this location.

5. Students discuss with their partners whether they agree or disagree with the placement of the card and why.

6. Class asks clarifying questions to the pair in the front of the room.

7. Students share other strategies.

8. Lead a conversation about any numbers that students believe might be misplaced. Choose a few numbers whose placement warrants further discussion (e.g., should .25 be placed to the left or to the right of .3? How do you know?)

9. Leave the numbers on the number line from one day to the next so that students can look at the decimals relative to other decimals they have worked with.

Scaffold for Variation 3:

- Use decimal numbers that go to the same decimal place (e.g., all tenths or all hundredths).

Extensions for Variation 3:

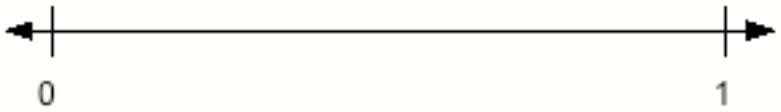
- Use labels other than 0 and 1 for the extremes (e.g., 3.1 and 4.1; 0.42 and 0.43).
- Include decimals that end in different places (e.g., 3, 0.3, 0.36).
- Use a number line with the intervals unmarked.

Guiding questions for Variation 3:

- Support your placement with a mathematically convincing argument.
- Name a decimal less/greater than yours.
- How do you know your decimal is less/greater than one half?
- Name another decimal equivalent to yours.

VARIATION 4: FRACTIONS

1. Label the extremes with "0" and "1."



2. Write different fractions on index cards (e.g., 1/8, 1/4, 3/8, 1/2, 5/8, 3/4, 7/8, 8/8 as well as their equivalent fraction names).

3. Choose only 2 or 3 fractions to work with each time you do this routine. Make multiple copies of the same numbers. Give a card to each pair of students. Give them time to discuss where their number would make sense on the number line.

4. Have one pair of students place their card where they think their number belongs on the number line. Students must give a mathematically convincing argument as to why they are placing the number at this location.

5. Students discuss with their partners whether they agree or disagree with the placement of the card and why.

6. Class asks clarifying questions to the pair in the front of the room.

7. Students share other strategies.

8. Lead a conversation about any numbers that students believe might be misplaced. Choose a few numbers whose placement warrants further discussion (e.g., should 1/4 be placed to the left or to the right of 3/8? How do you know?

9. Leave the numbers on the number line from one day to the next so that students can look at the decimals relative to other decimals they have worked with.

Scaffold for Variation 4:

- Use accessible fractions (e.g., fourths and eighths or thirds and sixths).

Extensions for Variation 4:

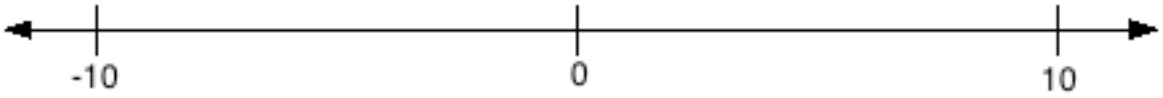
- Use a label other than 1 for the right-hand extreme (e.g., 2 or 3).
- Include mixed numbers and improper fractions in the numbers you place on the index cards.
- Integrate fractions that are not so "friendly" (e.g., fifths, sixths).

Guiding questions for Variation 4:

- Support your placement with a mathematically convincing argument.
- Name a fraction less/greater than yours. Prove it on the number line.
- How do you know your fraction is less/greater than one half?
- Name another fraction equivalent to yours.

VARIATION 5: INTEGERS

1. Label zero somewhere in the middle of the number line and label the extremes –10 and 10.



2. Write integers on index cards. Use numbers such as –1, -5, 3, 6, -8, 2, etc.

3. Choose only 2 or 3 integers to work with each time you do this routine. Make multiple copies of the same numbers. Give a card to each pair of students. Give students time to discuss where their number would make sense on the number line.

4. Have one pair of students place their card where they think their number belongs on the number line.

5. Students discuss with their partners whether they agree or disagree with the placement of the card and why.

6. Class asks clarifying questions to the pair in the front of the room.

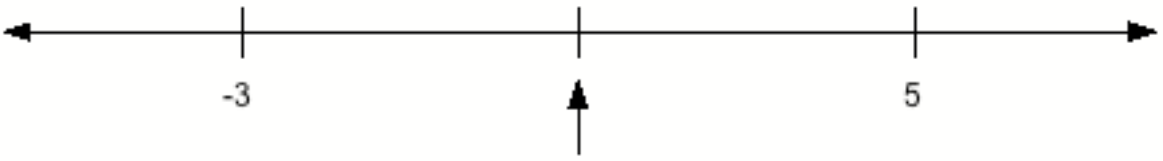
7. Students share other strategies.

8. Lead a conversation about any numbers that students believe might be misplaced. Choose a few numbers whose placement warrants further discussion (e.g., should -4 be placed to the left or to the right of 3? How do you know?)

9. Leave the numbers on the number line from one day to the next so that students can look at the amounts relative to other numbers they have worked with.

Extensions for Variation 6:

- Write integers on the outlying marks such as –3 and 5.
  Have the class decide the value for the mark in the middle.
  In this example the arrow is pointing to 1.



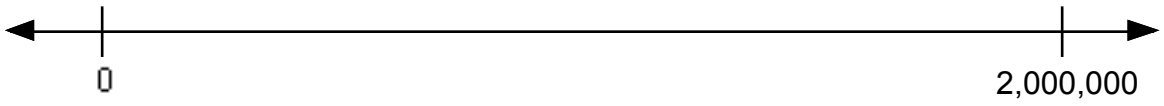
- Include numbers on the index cards that are less than the number marked on the left and are greater than the number marked on the right. For example, put –5 on a card. The students will place it an appropriate distance to the left of the –3 in the example. This will help students realize that each time we work with number lines, these number lines are just part of the infinite number line.
- Discuss relative distances between the numbers involved in the routine. (e.g., How far is it from –1 to 2?)

Guiding questions for Variation 6:

- Support your placement with a mathematically convincing argument.
- Name an integer that is greater than this number.
- How much greater? Prove it on the number line.
- Name an integer that is less than this number.
- How much less? Prove it on the number line.

VARIATION 7: VERY LARGE NUMBERS

1. Label the extreme to the left with a zero. Label the extreme to the right with1,000,000 or 2,000,000 or 3,000,000, etc. (a number in the millions).



2. Write large numbers (into the millions) on index cards.

3. Choose only 2 or 3 numbers to work with each time you do this routine. Make multiple copies of the same numbers. Give a card to each pair of students. Give students time to discuss where their number would make sense on the number line.

4. Have one pair of students place their card where they think their number belongs on the number line.

5. Students discuss with their partners whether they agree or disagree with the placement of the card and why.

6. Class asks clarifying questions to the pair in the front of the room.

7. Students share other strategies.

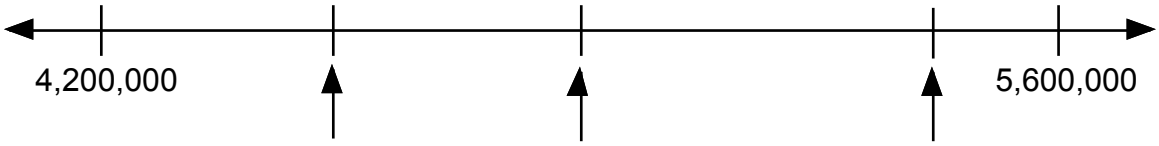
8. Lead a conversation about any numbers that students believe might be misplaced. Choose a few numbers whose placement warrants further discussion (e.g., should 1,234,567 be placed to the left or to the right of 1,199,999? How do you know?

9. Leave the numbers on the number line from one day to the next so that students can look at the amounts relative to other numbers they have worked with.

Extensions for Variation 7:

- Write zero on the mark to the left. Vary the million you write on the mark to the right. Have the class decide on a reasonable value for the mark in the middle.

Change zero to a different value. This increases the rigor of labeling the unknown marks.



- Students place numbers that are relatively close together so that they must be more discriminating in their examination of their number (e.g., 42,721,000; 42,271,000; 42,172,000).
- Occasionally give students numbers that **don't** belong between the labeled marks (e.g., if you have labeled the outside marks "0" and "40,000,000, give students the number 53,531,671 to place. This reminds students that they are working with only **part** of the number line.

Guiding questions for Variation 7:

- Support your placement with a mathematically convincing argument.
- Name a number that is greater/less than this number.
- How much greater/less? Prove it on the number line.

- What number is a hundred more/less than your number?
- What number is a thousand more/less than your number?
- What number is ten thousand more/less than your number?