

Represent Rational Numbers on the Number Line

Let's Build

Lesson 2-2

I can ... represent rational numbers using a number line.

Explore and Share

Seagull $\frac{3}{4}$ yard



Dolphin $-\frac{1}{4}$ yard



Sea Turtle -1 yard



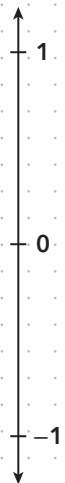
Shark -0.5 yard



The locations of four animals relative to sea level are shown.

A. What can you say about the animals and their positions relative to sea level?

B. How can you use a number line to represent the locations of the animals?



Generalize How is representing the locations of negative fractions and decimals like representing the locations of positive fractions and decimals? How is it different?

Essential Question

How can you plot, compare, and order rational numbers using a number line?

Animation



Visual Learning

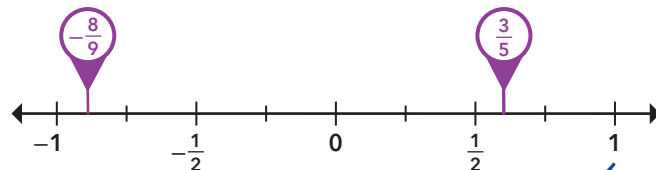
Example 1 Understand Rational Numbers



Any number that can be written as the quotient of two integers is called a **rational number**. A rational number can be written in the form $\frac{a}{b}$ or $-\frac{a}{b}$, where a and b are integers and $b \neq 0$. A rational number can be a whole number, fraction, or decimal.

How can you find and position $-\frac{4}{3}$ and -1.5 on a number line?

$-\frac{8}{9}$ and $\frac{3}{5}$ are rational numbers in the form $\frac{a}{b}$ or $-\frac{a}{b}$.



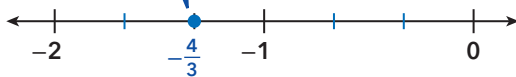
1 is a rational number because it can be written as $\frac{1}{1}$.

Generalize You can plot numbers on horizontal or vertical number lines.

ONE WAY Use a horizontal number line to plot $-\frac{4}{3}$. You can write $-\frac{4}{3}$ as a mixed number.

$$-\frac{4}{3} = -1\frac{1}{3}$$

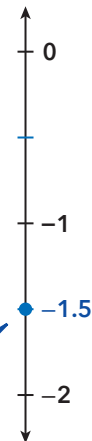
Divide the units on the number line into thirds and find one and one-third to the left of 0.



ANOTHER WAY Use a vertical number line to plot -1.5 . You can write -1.5 as a mixed number.

$$-1.5 = -1\frac{5}{10} \text{ or } -1\frac{1}{2}$$

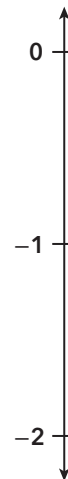
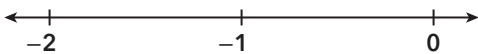
Divide the units on the number line into halves and find one and one-half below 0.



Try It! Find and position $-\frac{5}{4}$ and -1.75 on the number lines.

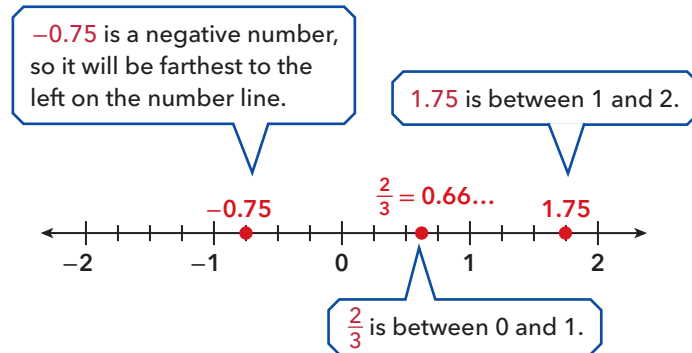
a. Write $-\frac{5}{4}$ and -1.75 as mixed numbers.

b. Plot the points on the number lines.



Example 2 Compare and Order Rational Numbers

Haru was asked to compare and order three rational numbers. Show how he can use $<$, $>$, or $=$ to compare $\frac{2}{3}$, 1.75, and -0.75 . Then order these numbers from least to greatest.



Look for Relationships

Remember, $\frac{a}{b} = a \div b$, so $\frac{2}{3}$ means $2 \div 3 = 0.66\ldots$. You can use this decimal form of $\frac{2}{3}$ to plot this number on a number line.

So, $-0.75 < \frac{2}{3} < 1.75$, and their order from least to greatest is $-0.75, \frac{2}{3}, 1.75$.

Try It! If $\frac{1}{4}$ is ordered within the list of numbers in the example, between which two numbers would it be placed?

Example 3 Interpret Rational Numbers in Real-World Contexts

Sam and Rashida are scuba diving. Their locations are shown relative to sea level. Use $<$, $>$, or $=$ to compare the two depths and explain their relationship.



$-40 < -25$. Rashida is at a greater depth than Sam.

Try It! At 10:00 P.M. one winter night, the temperature was -3°C . At midnight, the temperature was -7°C . Use $<$, $>$, or $=$ to compare the two temperatures and explain their relationship.

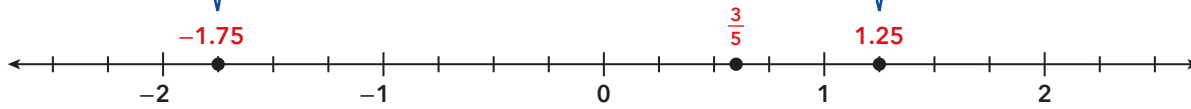
Key Concept



A **rational number** can be expressed as a fraction in the form $\frac{a}{b}$ or $-\frac{a}{b}$, where a and b are integers and b is not 0.

The number farthest to the left is the least number.

The number farthest to the right is the greatest number.



The numbers, in order from least to greatest, are: -1.75 , $\frac{3}{5}$, 1.25 .

Talk About Math Ideas

If n is a rational number, how do you represent the opposite of n ?

Do You Understand?

- Essential Question** How can you plot, compare, and order rational numbers using a number line?
- Generalize** Why are whole numbers rational numbers? Use 15 as an example.
- Vocabulary** Why are integers rational numbers? Give an example.
- Reasoning** Explain how the inequality $-4^\circ\text{C} > -9^\circ\text{C}$ describes how the temperatures are related.

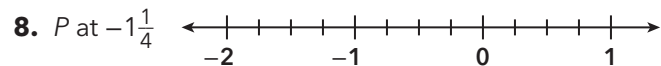
Do You Know How?

In 5-7, write the number positioned at each point.



5. A 6. B 7. C

In 8-11, plot the points on the number line.

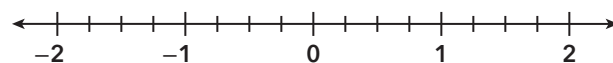


9. Q at 0.25

10. R at -0.75

11. S at $-\frac{1}{4}$

In 12 and 13, use the number line to help order the numbers from least to greatest.



12. 1.25 , $-\frac{3}{2}$, -1.25 , $1\frac{1}{2}$

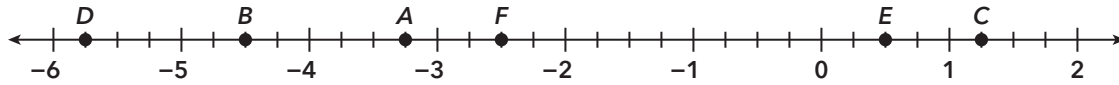
13. -1.5 , -0.75 , -1 , 2

14. If p is a negative number, order p , $-p$, and 0 from least to greatest.



Practice and Problem Solving

In 15–20, write the number positioned at each point.



15. A

16. B

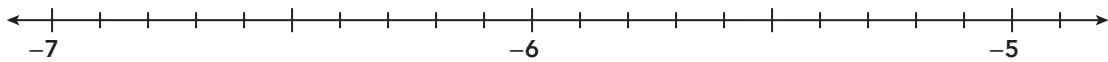
17. C

18. D

19. E

20. F

21. Plot the numbers on the number line.

A. $-5\frac{1}{2}$

B. -6.3

C. -5.8

D. $-6\frac{7}{10}$

E. -4.9

F. $-6\frac{9}{10}$

22. Use $<$, $>$, or $=$ to compare.

A. $\frac{1}{10} \bigcirc 0.09$ B. $-1.44 \bigcirc -1\frac{1}{4}$ C. $-\frac{2}{3} \bigcirc -0.8$ D. $0.5 \bigcirc \frac{2}{4}$ E. $-2\frac{3}{4} \bigcirc -2.25$ F. $-\frac{3}{5} \bigcirc -0.35$

23. Order the numbers from least to greatest.

A. -6, 8, -9, 13

B. $-\frac{4}{5}$, $-\frac{1}{2}$, 0.25, -0.2C. 4.75, $-2\frac{1}{2}$, $-\frac{8}{3}$, $\frac{9}{2}$

D. 4, -3, -8, -1

E. $-\frac{1}{4}$, 0.5, $\frac{3}{4}$, $-\frac{1}{2}$ F. $-\frac{4}{5}$, $-\frac{5}{4}$, $-\frac{3}{2}$, 1.5

24. **Make Sense and Persevere** What is the least number of points you must plot to have examples of all four sets of numbers, including at least one positive integer and one negative integer? Explain.

Rational Numbers

numbers that can be expressed as a quotient of two integers $\frac{a}{b}$ ($b \neq 0$)

Integers

whole numbers and their opposites

Whole Numbers

zero and natural numbers

Natural Numbers

the set of counting numbers
1, 2, 3, 4, 5, ...

- 25. Reasoning** Suppose you plot the locations of the animals on a number line. Which animal would be represented by the point farthest from 0 on the number line? Explain.

Animal	Locations Relative to Surface
Bloodbelly comb jelly	-0.8 km
Deep sea anglerfish	$-\frac{2}{3}$ km
Fanfin anglerfish	$-2\frac{1}{4}$ km
Gulper eel	-1.1 km
Pacific blackdragon	$-\frac{3}{10}$ km
Slender snipe eel	-0.6 km

- 26.** Which animal is closest to a depth of -0.7 km?

- 27.** Diya collected data on changes in sea levels. Her study concluded that as sea levels rise, the migration of coastal birds is impacted due to changes to their feeding areas. Describe in words what each sea level measurement represents.

Year	Sea Level
1	56.7 mm
2	34 mm
3	-22.8 mm
4	-54.5 mm

- 28. Construct Arguments** A classmate ordered these numbers from greatest to least. Is he correct? Construct an argument to justify your answer.

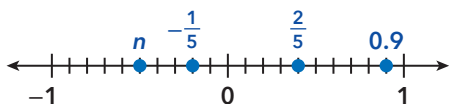
4.4, 4.2, -4.42 , -4.24

- 29. Make Sense and Persevere** Order -3.25 , $-3\frac{1}{8}$, $-3\frac{3}{4}$, and -3.1 from least to greatest. Explain.

- 30. Higher Order Thinking** Suppose $\frac{a}{b}$, $\frac{c}{d}$, and $\frac{e}{f}$ represent three rational numbers. If $\frac{a}{b}$ is less than $\frac{c}{d}$, and $\frac{c}{d}$ is less than $\frac{e}{f}$, compare $\frac{a}{b}$ and $\frac{e}{f}$. Explain.

Assessment Practice

- 31.** Which could be a value for n ?



- (A) $-\frac{1}{2}$ (B) $-\frac{1}{3}$ (C) $-\frac{1}{4}$ (D) $-\frac{1}{6}$

- 32.** Which inequality does **NOT** represent the correct position of two numbers on a number line?

- (A) $4\frac{1}{2} > \frac{25}{4}$ (C) $-6 < -5$
 (B) $-4\frac{1}{2} > -\frac{25}{5}$ (D) $-\frac{1}{2} < \frac{1}{2}$