Drill: Classify each number as ***natural, whole, integer, rational,*** or ***irrational***.
Write as many as apply.

---

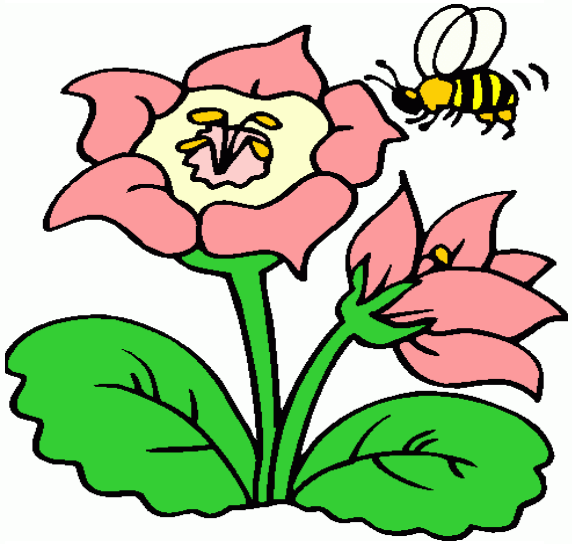
1. 7.4569594…
2. -5 ¾
3. -79
4. 3
5. 0
6. √16

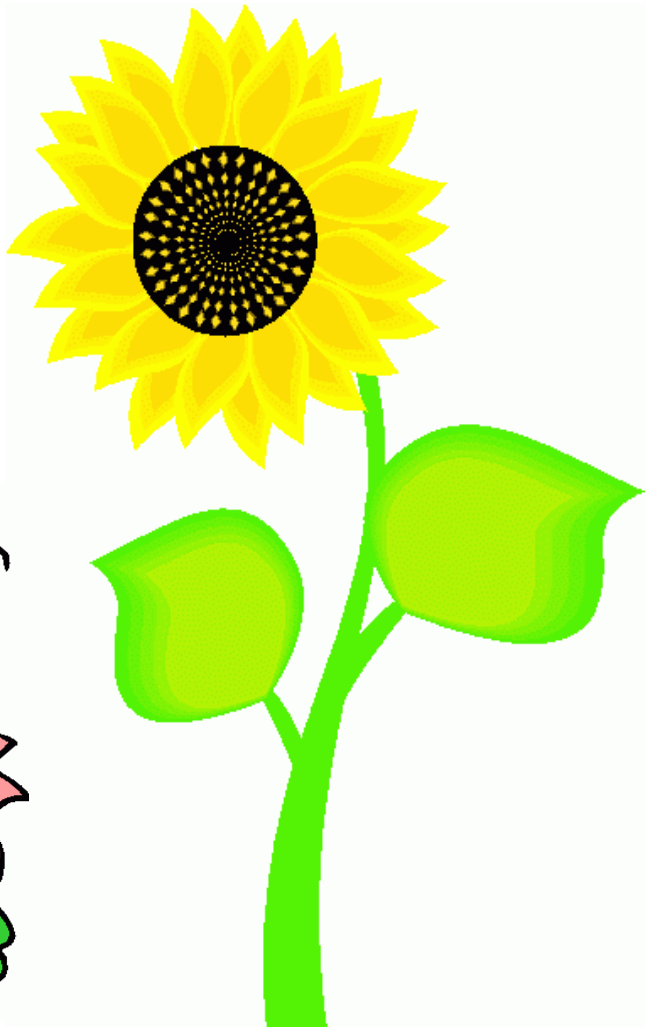
Categories of Numbers in the *REAL* Number System

- Natural Numbers
- Whole Numbers
- Integers
- Rational Numbers
- Irrational Numbers

Natural Numbers

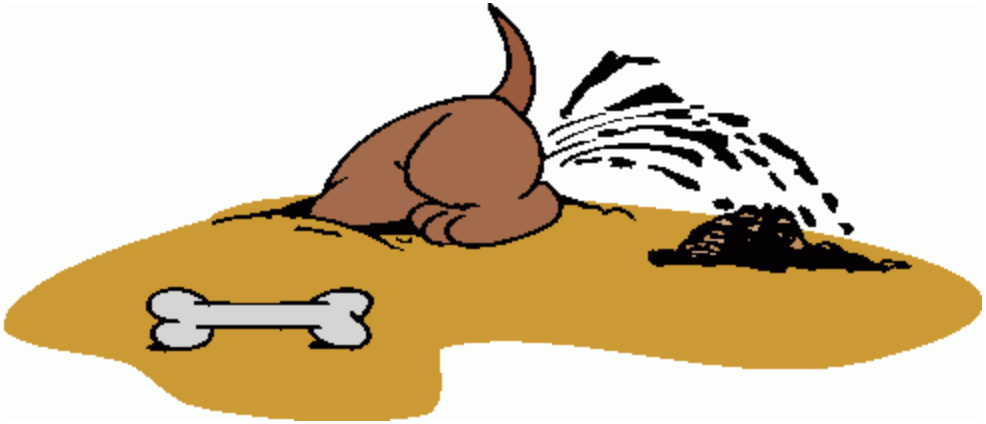
- Are the counting numbers
- {1, 2, 3, 4, 5, 6, 7, 8, …}





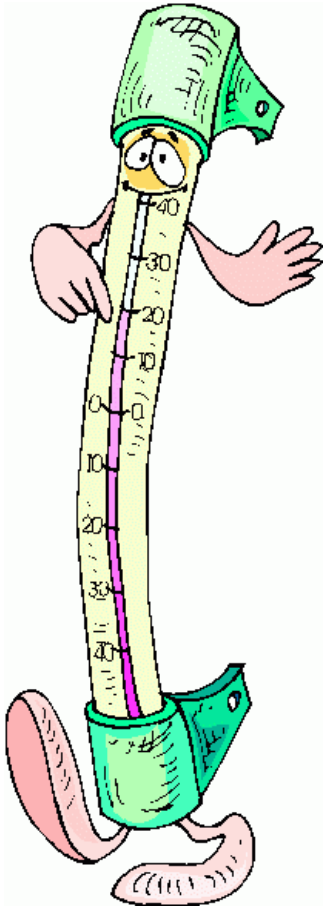
Whole Numbers

- All of the counting numbers and zero.
- {0, 1, 2, 3, 4, 5, 6, 7, …}



INTEGERS

- Are all of the natural numbers, their opposites and zero.
- {…, -4, -3, -2, -1, 0, 1, 2, 3, 4, …}



Real Numbers

- Real numbers consist of all the rational and irrational numbers.

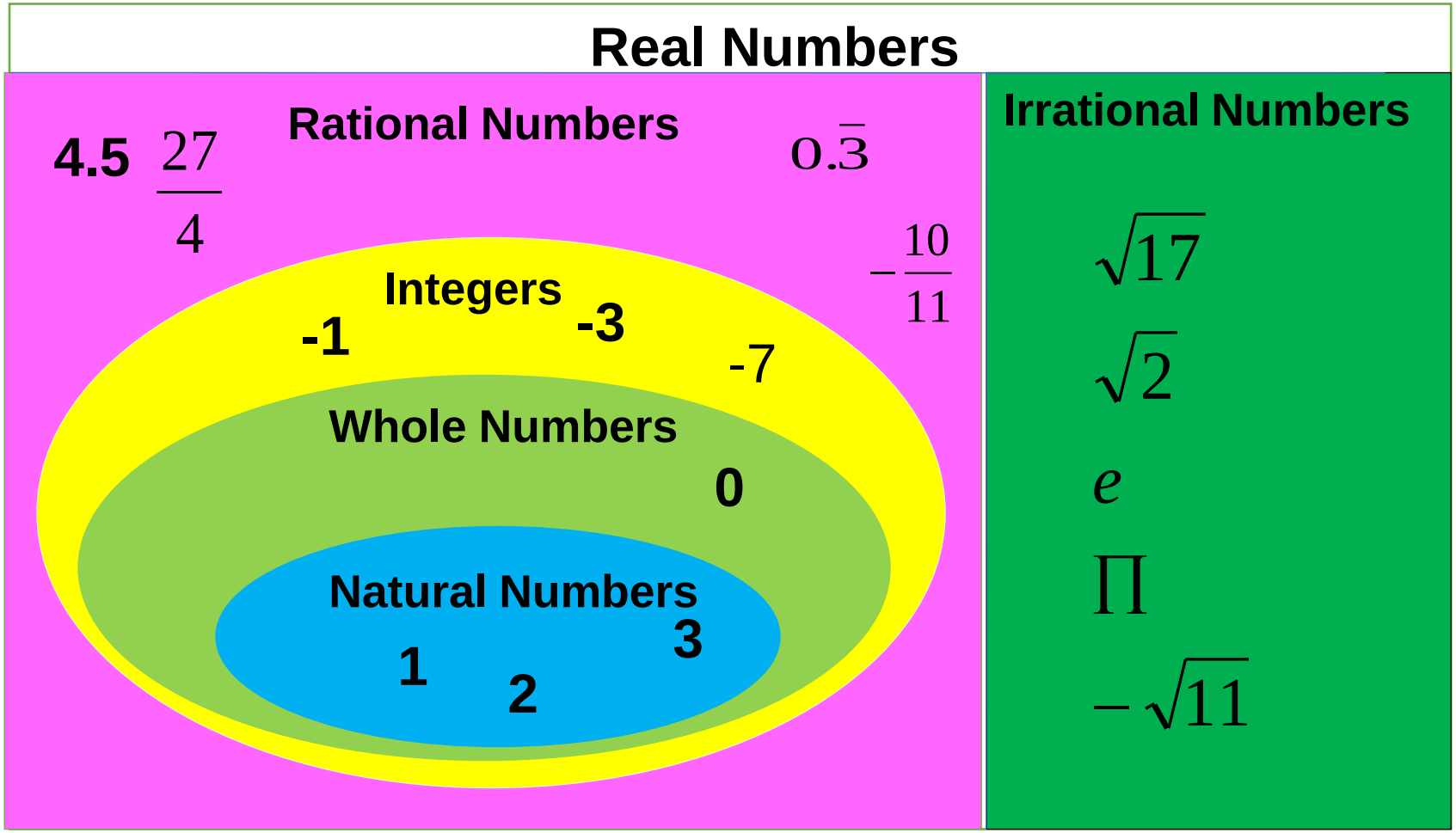
Rational Numbers

- Numbers that can be expressed as a fraction (a/b).
- This set includes the integers, terminating decimals, and repeating decimals.
- Some examples:
- $2 = {}^{2}/_{1}$
- $3\ ¼ = {}^{13}/_{4}$
- $-0.25 = -{}^{25}/_{100}$
- $1/3 = 0.33333333333333333333$

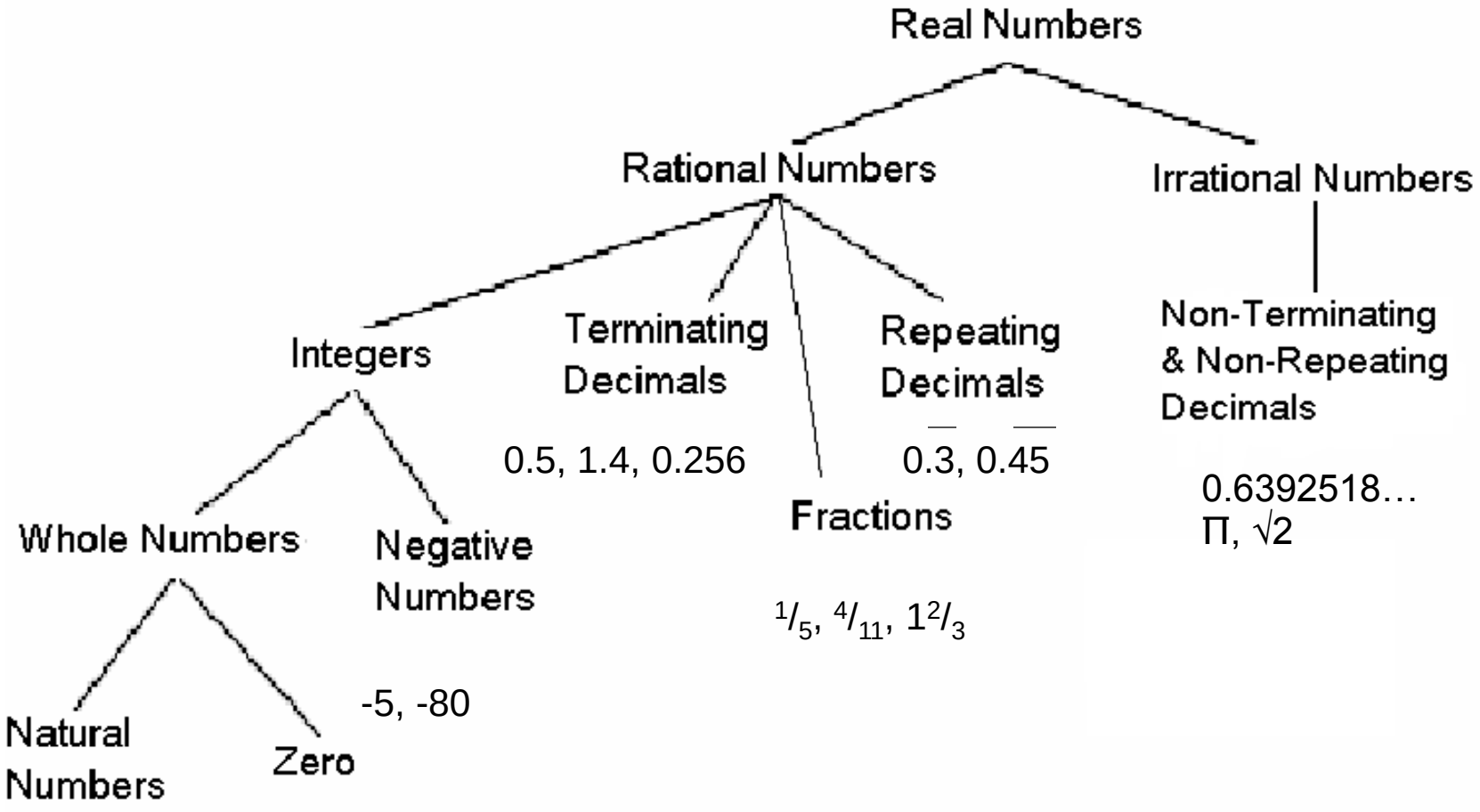
Irrational Numbers

- Numbers that **CANNOT** be expressed as a fraction of integers.
- In decimal form, they are the numbers that go on forever without a repeating pattern.
- Some examples:
- $\sqrt{2}$ = 1.4142…
- π = 3.1415…
- 45.9492…

Venn Diagram of REAL Number System



Tree Diagram of Real Number System



Let's practice

Directions: Identify each number below as natural, whole, integer, rational, irrational, or real. More than one answer can apply.

1. $\frac{7}{8}$ **Rational, real**

2. 0 **Whole, integer, rational, real**

3. -9 **integer, rational, real**

4. $-\frac{4}{5}$ **rational, real**

Let's practice

Directions: Identify each number below as natural, whole, integer, rational, irrational, or real. More than one answer can apply.

5. $\sqrt{6}$ **irrational, real**

6. 8 **Natural, Whole, integer, rational, real**

7. $\sqrt{16}$ **Natural, Whole, integer, rational, real**

8. $-\sqrt{25}$ **integer, rational, real**

Use < (less than), > (greater than), or = (equal to) to compare

1. $\frac{2}{3} = .\overline{6}$

2. $\frac{5}{8} < .65$

3. $\frac{5}{9} > .5$

4. $\frac{3}{10} < \frac{1}{3}$

5. $\frac{12}{12} = 1$

6. $\pi > \frac{21}{7}$

7. $\frac{7}{6} < \frac{6}{5}$

8. $\frac{5}{20} = .25$

Radical Expressions

Each square root is between two integers. Name the two integers.

1. $\sqrt{119}$ **10 and 11**

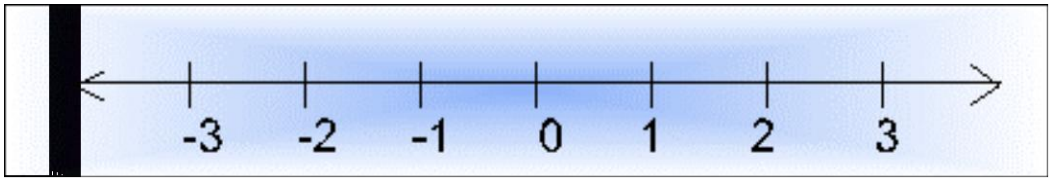
2. $\sqrt{15}$ **3 and 4**

Use a calculator to find each value. Round to the nearest tenth.

3. $\sqrt{2}$ **1.4**

4. $\sqrt{123}$ **11.1**

The Real Number Line



The **negative real numbers** are the coordinates of points to the left of the origin *0*.

The real number zero is the coordinate of the origin *O*.

The positive real numbers are the coordinates of points to the right of the origin *O*.

Ordering Real Numbers

- The symbols:

1. $a < b$ (a is **less than** b)
2. $a > b$ (a is **greater than** b)
3. $a = b$ (a is **equal to** b)

- The new rules:

1. If a is negative and b is positive: $a < b$
2. If a and b are positive and $a > b$, than $– a < - b$.

- Examples:

1. $-3 < 5$
2. $-7 < -3$

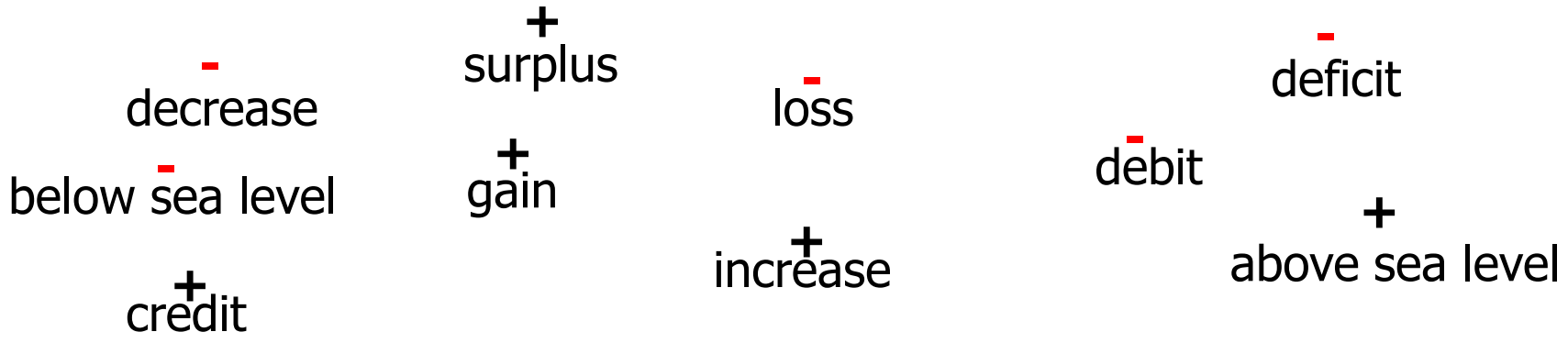
Do you know HOW?

- On your number line, plot:

  -7, 9, -3/2, 2.7, 5.9, and ¼
- Which is greater, -143 or 12?
- Which is greater, -41 or -1?
- Which is greater, 0 or 5?
- Which is greater, 0 or -5?

What do Positive and Negative Numbers MEAN?

To which of the following words describing **change** would you associate with positive numbers? Which with negative numbers?



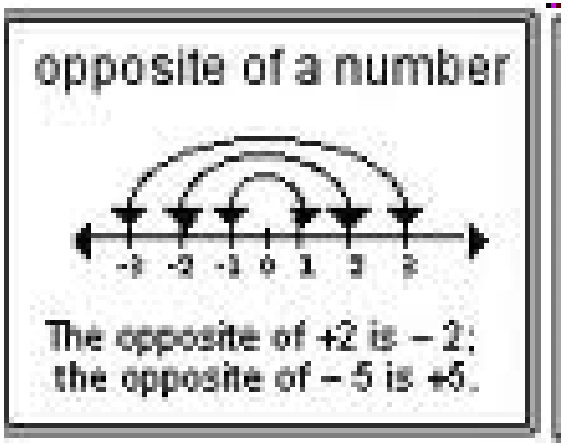
Can you think of any more?

Use an integer to describe the following:

- Kalamazoo is 780 feet above sea level.
- I lost $5 betting at the track.
- The temperature decreased by 7 degrees.
- I dove 20 feet below sea level.
- I made $143 on that stock!
- The temperature warmed up by 3 degrees.
- Illegal formation: 10 yard penalty!

Opposites

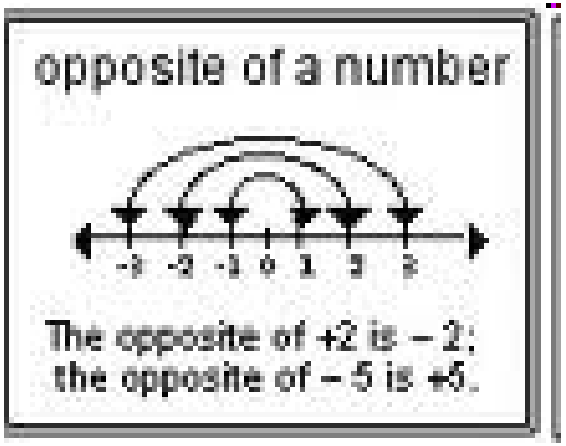
- To find the opposite of a (nonzero) real number, change its sign.
- The opposite is equally far from the origin, but in the “opposite” direction.



Opposites

- To find the opposite of a (nonzero) real number, change its sign.
- Find the opposite of:

1. 679
2. -34
3. -13
4. ¼



Distance and Absolute Value

- A distance is never negative

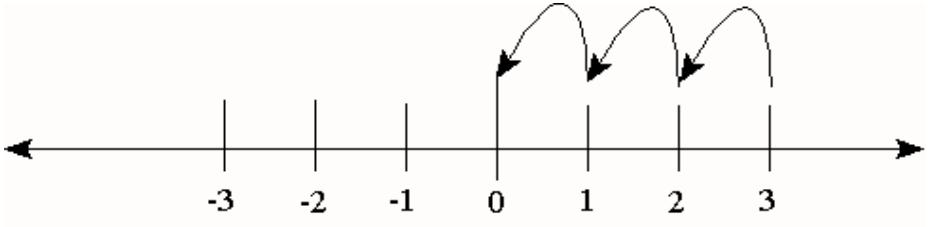
- The **absolute value** of a number is its distance from the origin on the number line.

Number line

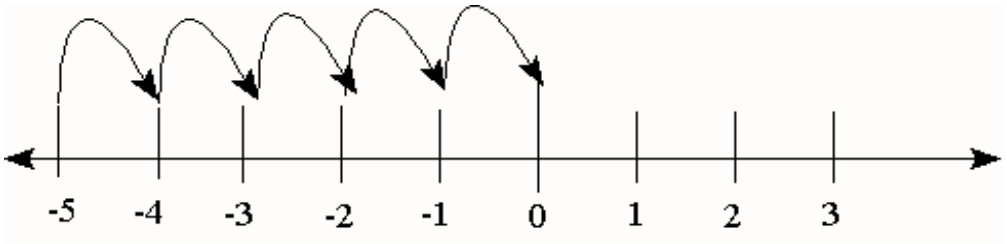
- How far is 3 from zero?
- How far is -3 from zero?

|x| "the absolute value of x"

- |3| asks how far from zero is 3?



- |-5| asks how far from zero is -5?



Absolute Value

- Always gives a positive answer or zero.
- If there is arithmetic inside the absolute value symbol do that first, then take the absolute value of the answer.

Summary

- Real numbers include natural numbers, whole numbers, integers, rational numbers, and irrational numbers.

- Real numbers can be laid out along a number line.

- Positive numbers > Negative Numbers
- Negative numbers are ordered in reverse

- Positive and negative numbers can describe change.

- Changing the sign of a real number gives its opposite.
- Absolute value is like distance, sign is like a direction.

Lesson Quiz

Write all classifications that apply to each number.

1. $\sqrt{2}$ real, irrational

2. $-\frac{\sqrt{16}}{2}$ real, integer, rational

3. $\frac{\sqrt{25}}{0}$ not a real number

4. $\sqrt{4} \bullet \sqrt{9}$ rational