Positive and Negative Numbers

Let's explore how we represent temperatures and elevations.

1.1 Notice and Wonder: Memphis and Bangor

What do you notice? What do you wonder?

Memphis, TN		Bangor, ME	
Saturday 5:00 PM		Saturday 6:00 PM	
Light Rain Showers	37°F	Partly Cloudy	1°F
	3°C		-17°C





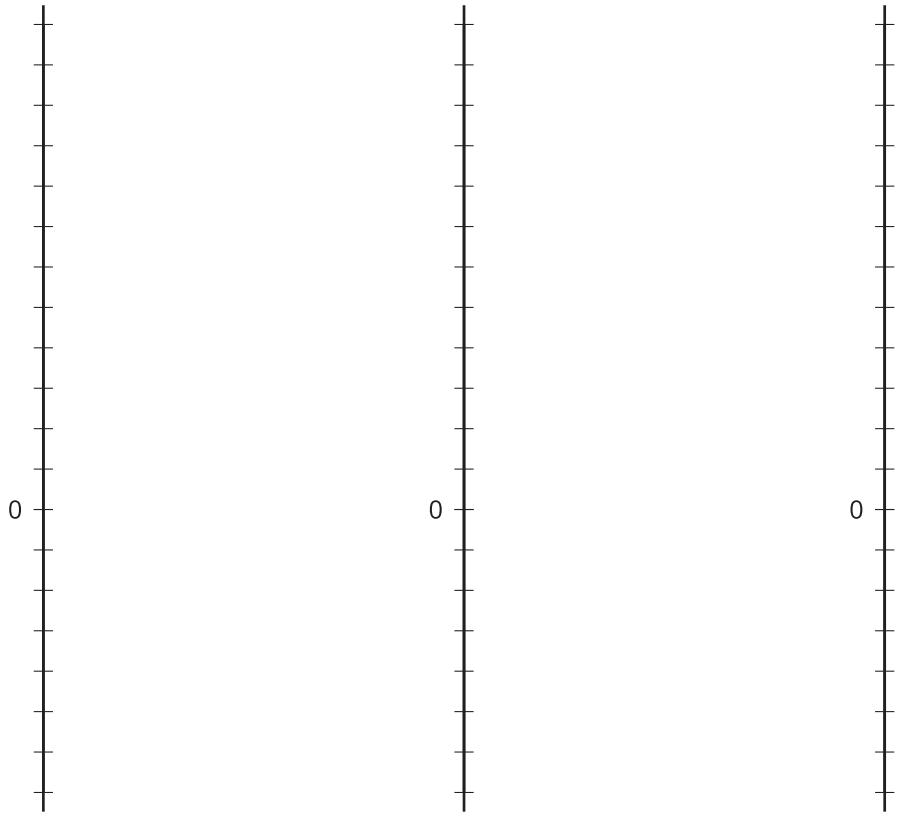
1.2 Above and Below Zero

1. Here are three number lines and three situations involving changes in temperature. Represent the change in temperature for each situation on a number line, and then answer the question.

   a. At noon, the temperature was 5 degrees Celsius. By late afternoon, it had risen 6 degrees Celsius. What was the temperature late in the afternoon?

   b. The temperature was 8 degrees Celsius at midnight. By dawn, it had dropped 12 degrees Celsius. What was the temperature at dawn?

   c. Water freezes at 0 degrees Celsius, but the freezing temperature can be lowered by adding salt to the water. A student discovered that adding half a cup of salt to a gallon of water lowers its freezing temperature by 7 degrees Celsius. What is the freezing temperature of the gallon of salt water?



2. Discuss with a partner:

   a. How did each of you name the resulting temperature in each situation?

   b. How do temperatures above 0 compare to temperatures below 0?

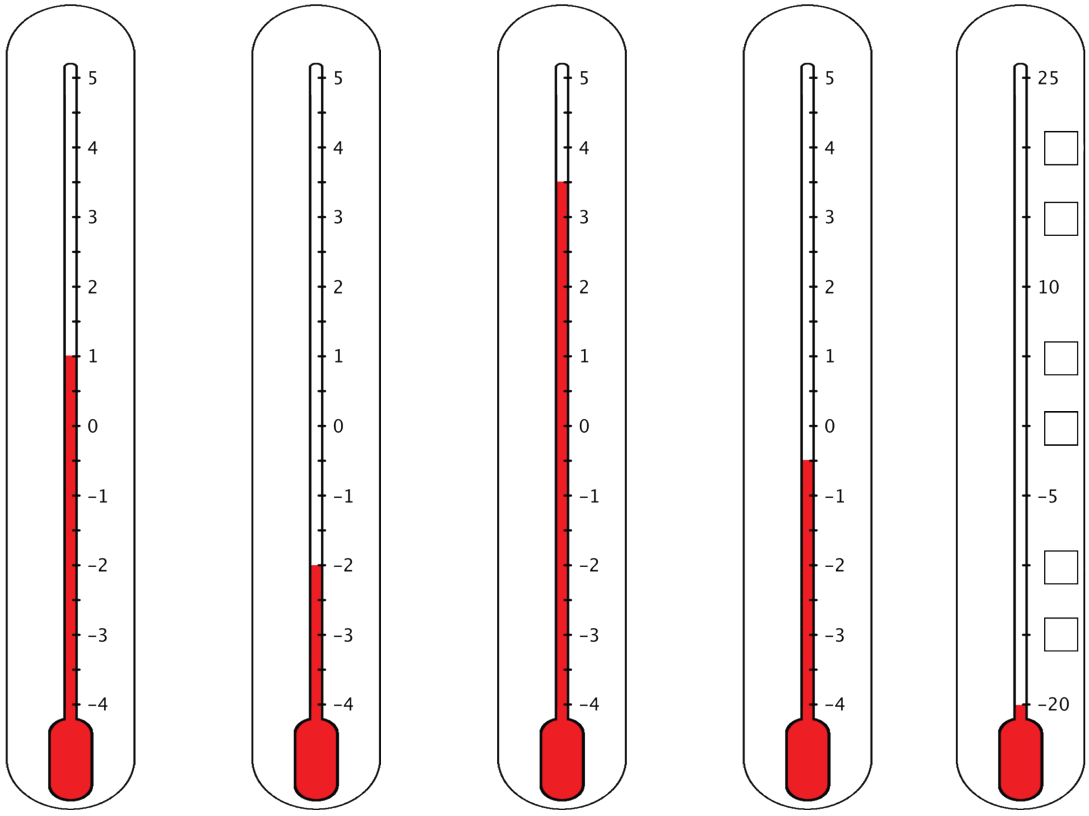
   c. Come up with an example other than temperature where numbers below 0 make sense.

   d. Come up with an example where numbers below 0 do not make sense.

1.3 What's the Temperature?

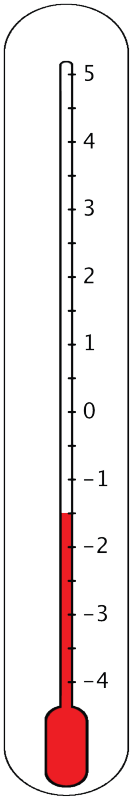
1. Here are five thermometers. The first four thermometers show temperatures in degrees Celsius ($^\circ C$). Write the temperatures in the blanks.

a. _____ b. _____ c. _____ d. _____ e.



2. The last thermometer is missing some numbers. Write them in the boxes.

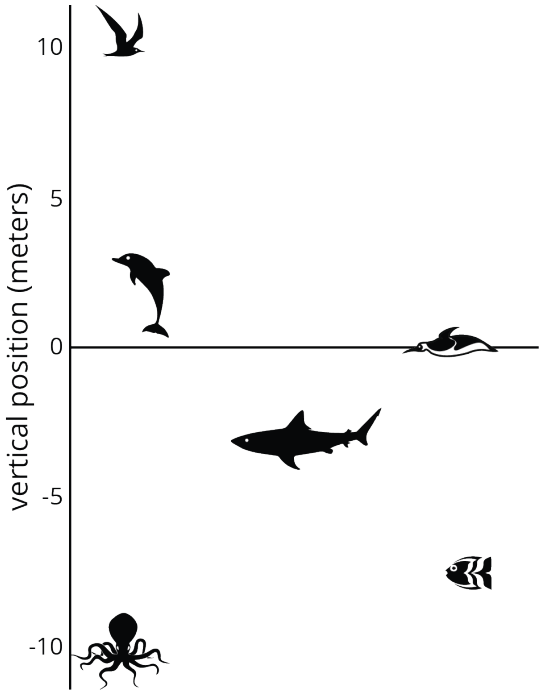
3. Elena says that the thermometer shown here reads $-2.5^\circ C$ because the line is above $-2^\circ C$. Jada says that it is $-1.5^\circ C$. Do you agree with either of them? Explain your reasoning.



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1.4 Seagulls Soar, Sharks Swim

Here is a picture of some sea animals. The number line on the left shows the vertical position, in meters, of each animal above or below sea level.



1. How far above or below sea level is each animal? Measure to their eye level.

2. A mobula ray is 3 meters above the surface of the ocean. How does its vertical position compare to the height or depth of:
   a. The jumping dolphin?
   b. The flying seagull?
   c. The octopus?
3. An albatross is 5 meters above the surface of the ocean. How does its vertical position compare to the height or depth of:
   a. The jumping dolphin?
   b. The flying seagull?
   c. The octopus?
4. A clownfish is 2 meters below the surface of the ocean. How does its vertical position compare to the height or depth of:
   a. The jumping dolphin?
   b. The flying seagull?
   c. The octopus?

5. The vertical distance between a new dolphin and the dolphin in the picture is 3 meters. What is the new dolphin's distance from the surface of the ocean?

Are you ready for more?

The North Pole is in the ocean. So its elevation is 0, or sea level. The South Pole is on land, about 1.7 miles above sea level. Sea level at either pole is about 3,949 miles from the center of Earth.

A submarine is directly below the North Pole at an elevation of about -2.7 miles. A person is standing on the South Pole. How far apart are the submarine and the person?

1.5 High Places, Low Places

1. The table shows the elevations of various cities.

city	elevation (feet)
Harrisburg, PA	320
Bethell, IN	1,211
Denver, CO	5,280
New Orleans, LA	-8
Death Valley, CA	-282
New York City, NY	33
Miami, FL	0

   a. Which city on the list has the second highest elevation?

   b. How would you describe the elevation of Harrisburg, PA, in relation to sea level?

   c. How would you describe the elevation of Death Valley, CA, in relation to sea level?

   d. How would you describe the elevation of Miami, FL?

   e. A different city not on this list has a higher elevation than New Orleans, LA. Select **all** numbers that could represent the new city's elevation. Be prepared to explain your reasoning.

      - -11 feet
      - 3 feet
      - -4 feet
      - -9 feet
      - 0 feet

Pause here for a whole-class discussion.

2. Here are two tables that show the elevations of the highest mountain peaks on land and the lowest trenches in the ocean. Distances are measured from sea level.

mountain	continent	elevation (meters)
Everest	Asia	8,848
Kilimanjaro	Africa	5,895
Denali	North America	6,168
Aconcagua	South America	6,961

trench	ocean	elevation (meters)
Mariana Trench	Pacific	-11,033
Puerto Rico Trench	Atlantic	-8,600
Tonga Trench	Pacific	-10,882
Sunda Trench	Indian	-7,725



a. Which trench in the ocean is the lowest in the world? What is its elevation?

b. Which mountain's peak is the highest in the world? What is its elevation?

c. Which is farther from sea level: the deepest point in the ocean, or the top of the highest mountain in the world? Explain your reasoning.

d. Plot the elevations of the mountain peaks and ocean trenches on the vertical number line.

Are you ready for more?

A spider spins a web in the following way:

- It starts at sea level.
- It moves up one inch in the first minute.
- It moves down two inches in the second minute.
- It moves up three inches in the third minute.
- It moves down four inches in the fourth minute.

Assuming that the pattern continues, what will the spider's elevation be after an hour has passed?

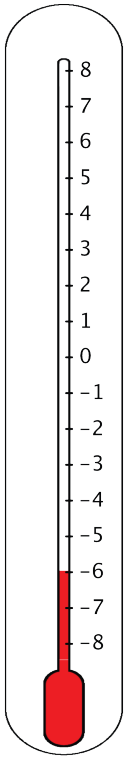
Lesson 1 Summary

Positive numbers are numbers that are greater than zero. **Negative numbers** are numbers that are less than zero. The meaning of a negative number in a context depends on the meaning of zero in that context.

For example, if we measure temperatures in degrees Celsius, 0 degrees Celsius corresponds to the temperature at which water freezes.

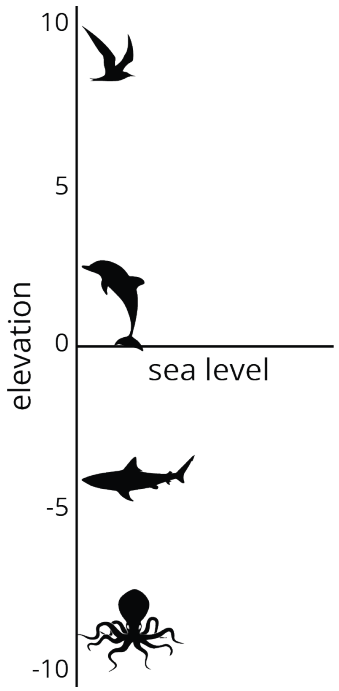
In this context, positive temperatures are warmer than the freezing point, and negative temperatures are colder than the freezing point. A temperature of -6 degrees Celsius means that it is 6 degrees away from 0 and that it is less than 0. This thermometer shows a temperature of -6 degrees Celsius.

If the temperature rises a few degrees and gets very close to 0 degrees, without reaching it, the temperature is still a negative number.



Another example is elevation, which is a distance above or below sea level. An elevation of 0 refers to sea level. Positive elevations are higher than sea level, and negative elevations are lower than sea level.

In this context, a bird flying in the sky would have a positive elevation because it is higher than sea level. An octopus or a shark would have a negative elevation because it is swimming below sea level.



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