





UNIT 7, LESSON 1

Positive and Negative Numbers



1.1

Warm-up

5 mins

Notice and Wonder: Memphis and Bangor

Standards Alignment

Addressing



6.NS.C.5

6.NS.C.6

Instructional Routines

Notice and Wonder

Materials

None

Activity Narrative

The purpose of this *Warm-up* is to introduce students to temperatures measured in degrees Celsius, which will be useful when students read thermometers using the Celsius scale in a later activity. Many students have an intuitive understanding of temperature ranges in degrees Fahrenheit that are typical of the city or town in which they live, but many are unfamiliar with the Celsius scale.

While students may notice and wonder many things about these images, the idea that there are different scales for measuring temperature is an important discussion point.

Launch

Arrange students in groups of 2. Display the image for all to see. Ask students to think of at least one thing they notice and at least one thing they wonder. Give students 1 minute of quiet think time, and then 1 minute to discuss the things they notice and wonder with their partner.



Student Task Statement

What do you notice? What do you wonder?



Student Response



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Activity Synthesis

Ask students to share the things they noticed and wondered. Record and display their responses without editing or commentary. If possible, record the relevant reasoning on or near the image. Next, ask students, "Is there anything on this list that you are wondering about now?" Encourage students to observe what is on display and respectfully ask for clarification, point out contradicting information, or voice any disagreement.

Explain to students that temperatures are usually measured in either degrees Fahrenheit, which is what they are probably most familiar with, or degrees Celsius, which may be new for them. Tell them that many other countries measure temperature in degrees Celsius and that scientists often use this temperature scale. One thing that is special about the Celsius scale is that at sea level, water freezes at 0 degrees and boils at 100 degrees.

1.2 Activity

10 mins

Above and Below Zero

Standards Alignment

Addressing



6.NS.C.5

Materials

None

Activity Narrative

In this task, students are introduced to certain contexts for which it would be difficult to answer mathematical questions if restricted to only positive numbers. The need for negative numbers leads to the natural representation of them on the number line.

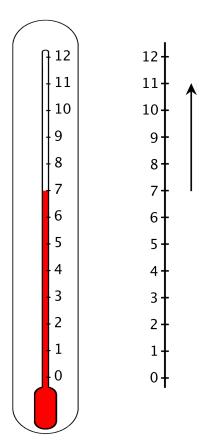
This task is not about operations with signed numbers, but rather why we extend our number system beyond positive numbers. Students reason abstractly and quantitatively when they represent the change in temperature on a number line (MP2).

In the digital version of the activity, students use an applet to represent changes in temperature. The applet allows students to quickly represent an increase or decrease in temperature.

Print Digital

Launch

Display this image for all to see.





Tell students, "The thermometer showed a temperature of 7 degrees Celsius one morning. Later, the temperature increased 4 degrees. We can use a vertical number line to represent this change in temperature."

Arrange students in groups of 2. Give students 2 minutes of quiet work time for the first question. Then give students 2 minutes to discuss the second question with their partner, and follow with a whole-class discussion.

Student Task Statement

- 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.

Student Response



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Building on Student Thinking

If students count tick marks rather than the space between tick marks, and they include the starting tick mark in their count, consider asking:

- "How did you represent the change in temperature on your number line?"
- "What would a temperature change of 1 degree Celsius look like on a number line?"

Activity Synthesis

The purpose of this discussion is to introduce a **negative number** as a number that is less than zero, in contrast to a **positive number** as a number greater than zero. Some students will have a pre-existing understanding of positive and negative numbers.

Begin by inviting several students to share the different ways they described the final temperature in the second situation (4 degrees below zero, -4 degrees Celsius). Tell students that this is an example of a negative number because it describes a number less than zero, and we use the - symbol to show that.

Ask students how they would describe a number that is greater than zero (a positive number). Explain that a + symbol is used to indicate a positive number, though it is not always written out. For example, +7 and 7 both represent positive 7. Negative 7 is represented as -7.

1.3 Activity

20 mins

High Places, Low Places

Standards Alignment

Addressing



6.NS.C.5

Instructional Routines

MLR5: Co-Craft Questions

Materials

None

Activity Narrative

This activity presents a second, natural context for negative numbers, and students start comparing positive and negative numbers in preparation for ordering them in a following activity. Students may use the structure of a vertical number line in order to compare the relative location of each elevation (MP7).

In the digital version of the activity, students use an applet to represent the elevations of the highest points on land and lowest points in the ocean on a vertical number line. The applet allows students to drag points to a vertical number line to mark different mountains or trenches and quickly check their answers.

Launch

Display the table of elevations for all to see. Ask students to think of a way to explain in their own words what the numbers mean, and invite 2-3 students to share their ideas.

If not mentioned in students' explanations, tell students that the term "elevation" is commonly used to describe the height of a place (such as a city) or an object (such as an aircraft) compared to sea level. Denver, CO, is called "The Mile High City" because its elevation is 1 mile, or 5,280 feet, above sea level.

Arrange students in groups of 2. Give students 5 minutes of quiet work time to answer the first set of questions, and pause for a whole-class discussion afterward. Ask students to share their responses and thinking. Ensure that students understand what is meant by an elevation that is below sea level. Then give students 5 more minutes of quiet work time to finish the remaining questions.

Access for English Learners

MLR5 Co-Craft Questions. Keep books or devices closed. Display only the table of elevations from the Task Statement, without revealing the questions, and ask students to record possible mathematical questions that could be asked about the situation. Invite students to compare their questions before revealing the task. Ask, "What do these questions have in common? How are they different?" Reveal the intended questions for this task and invite additional connections.

Advances: Reading, Writing



Access for Students with Disabilities

Engagement: Develop Effort and Persistence. Chunk this task into more manageable parts. Have students complete the first problem, then plot the elevations of high points, and then plot the elevations of low points. Check in with students to provide feedback and encouragement after each chunk.

Supports accessibility for: Attention, Social-Emotional Functioning



Student Task Statement

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

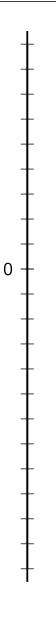
Pause here for a whole-class discussion.

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

mountain	continent	elevation (meters)
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.

Student Response



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Are You Ready for More?



Activity Synthesis

The goal of this discussion is for students to compare negative elevations. Begin by displaying a blank vertical number line for all to see.



Ask students where the elevation of New Orleans, LA could be on this number line, and plot and label the point for all to see. Continue adding points to the number line for the 5 elevations given for the new city not on the list (-11 feet, 3 feet, -4 feet, -9 feet, 0 feet). Discuss the following questions:

- "What does it mean when a point is above 0 on a vertical number line?" (The number is positive, and the elevation represented by that point is above sea level.)
- "What does it mean when a point is below 0 on a vertical number line?" (The number is negative, and the elevation represented by that point is below sea level.)
- "Is -11 feet higher or lower in elevation than -8 feet?" (-11 is lower in elevation because it is lower than -8 on the vertical number line.)
- "Is -4 feet higher or lower in elevation than -8 feet?" (-4 is higher in elevation because it is higher than -8 on the vertical number line.)

Lesson Synthesis

The goal of this discussion is for students to explain what zero represents in certain contexts and how that affects the meaning of positive and negative numbers.

Ask students to recall the situations from earlier activities (temperature in degrees Celsius and elevation). Ask students:

- "What does zero represent in each situation?" (freezing point of water, sea level)
- "What does a positive number represent in each situation?" (temperatures above freezing, elevations above sea level)
- "Where would positive numbers be located on a vertical number line?" (above zero, on the same side as 1)
- "What does a negative number represent in each situation?" (temperatures below freezing, elevations below sea level)
- "Where would negative numbers be located on a vertical number line?" (below zero, on the same side as -1)



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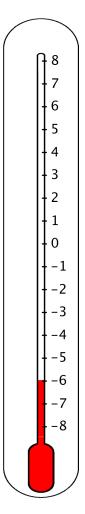
Student Lesson Summary

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.

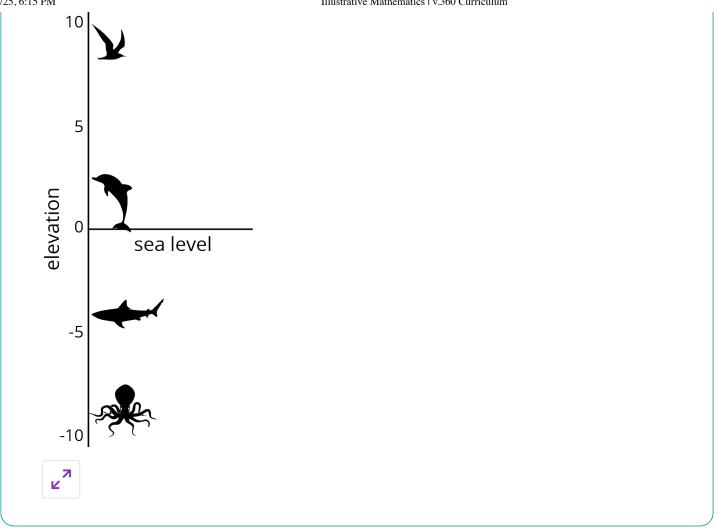
If the temperature rises a few degrees and gets very close to 0 degrees, without reaching it, the temperature is still a negative number.

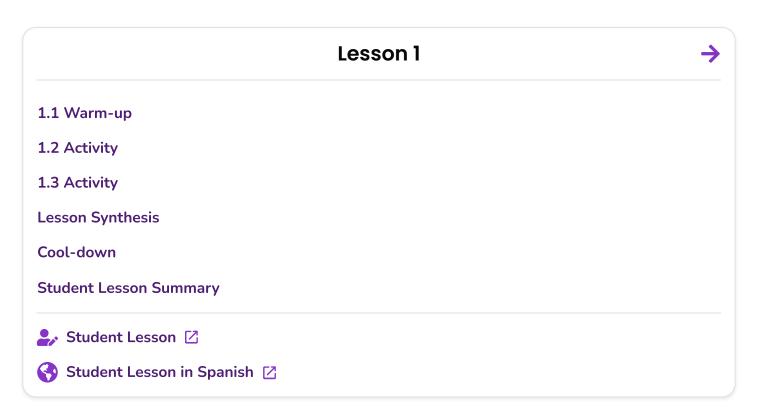




Another example is elevation, which is a distance above or below sea level. An elevation of 0 refers to sea level. Positive elevations are higher than sea level, and negative elevations are lower than sea level.

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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