Lesson 5

Using Negative Numbers to Make Sense of Contexts

Goals

- Interpret a table of signed numbers that represent how a quantity changed.
- Recognize that signed numbers can be useful to represent changes in a quantity in opposite directions, e.g., money received and money paid, inventory bought and inventory sold, etc.

Learning Targets

- I can explain and use negative numbers in situations involving money.
- I can interpret and use negative numbers in different contexts.

Lesson Narrative

In this lesson, students are introduced to conventions for using signed numbers to represent money spent and received, as well as inventory gained and lost. Students examine a table detailing the inventory and value in dollars of items sold at a hardware store. They make sense of what positive and negative numbers mean in relation to the inventory (items purchased or sold) and also in relation to the items' value in dollars.

An optional activity about the inventory in a vending machine offers additional practice interpreting signed numbers in context.

Since students do not operate on signed numbers in this grade, this lesson is simply an introduction to the convention of using signed numbers to represent a change in money or a change in inventory. Students will study addition and subtraction of signed numbers in a future course.

Student Learning Goal

Let's make sense of negative amounts of money.

Access for Students with Diverse Abilities

- Engagement: Provide Access by Recruiting Interest. (Activity 1)

Access for Multilingual Learners

- MLR2: Collect and Display (Activity 2)

Instructional Routines

- Notice and Wonder

Lesson Timeline

Warm-up	Activity 1	Activity 2	Lesson Synthesis	Assessment: Cool-down
10 min	10 min	15 min	10 min	5 min

Warm-up

Notice and Wonder: It Comes and Goes

10 min

Activity Narrative

The purpose of this *Warm-up* is to introduce positive and negative numbers in the new context of money and inventory. The table shown here will also be used in a following activity. While students may notice and wonder many things about this table, interpreting the meaning of positive and negative numbers in this context is the important discussion point.

When students articulate what they notice and wonder, they have an opportunity to attend to precision in the language they use to describe what they see. They might first propose less formal or imprecise language and then restate their observation with more precise language in order to communicate more clearly.

Launch

Arrange students in groups of 2. Display the table 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 with their partner the things they notice and wonder.

Student Task Statement

What do you notice? What do you wonder?

item	quantity	value in dollars
hammer	-12	85.14
washer	300	-15.00
bolt	-25	10.54
nail	500	-22.50
wrench	-4	51.88
flashlight	-18	123.23

Students may notice:

- Some quantities and values are negative.
- If a quantity is negative, then the value in dollars is positive.
- If a quantity is positive, then the value in dollars is negative.

Students may wonder:

- How much money did they make?
- How much money did they spend?
- Why are the quantity and the value in dollars opposite signs?
- Did they buy 12 hammers or sell 12 hammers?
- How much did one flashlight cost?

Instructional Routines

Notice and Wonder

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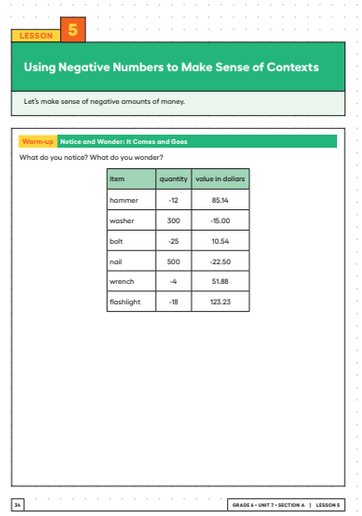
Student Workbook


LESSON 5

Using Negative Numbers to Make Sense of Contexts

Let's make sense of negative amounts of money.

Warm-up Notice and Wonder: It Comes and Goes

What do you notice? What do you wonder?

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Access for Students with Diverse Abilities (Activity 1, Launch)

Engagement: Provide Access by Recruiting Interest.
Invite students to share experiences they have in connection to a hardware store or with taking an inventory of items.

Supports accessibility for: Conceptual Processing, Memory

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 table. 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.

If the idea that a negative quantity means that an item was sold and resulted in a positive amount of money does not come up during the conversation, ask students to discuss this idea.

Activity 1
The Hardware Store

10 min

Activity Narrative

The purpose of this activity is to interpret signed numbers in a situation involving money and inventory. Students reason abstractly and quantitatively when they think about change in inventory and money by using positive and negative numbers.

Launch

Arrange students in groups of 2.

Give students 5 minutes of quiet work time followed by 3 minutes for a partner discussion.

End with a whole-class discussion.

Student Task Statement

The manager of a hardware store keeps records of all of the items purchased and sold. The table shows some of the records for Tuesday.

item	quantity	value in dollars
hammer	-12	85.14
washer	300	-15.00
bolt	-25	10.54
nail	500	-22.50
wrench	-4	51.88
flashlight	-18	123.23

1. Which items were sold at the hardware store on Tuesday? Explain your reasoning.

   Hammers, bolts, wrenches, flashlights

   Sample reasoning: These items are associated with negative quantities, which means the hardware store had less of them, so they must have been sold.
   58 doughnuts went out, or she sold 58 doughnuts.

2. What does -25 mean in this situation?

   Sample response: The hardware store ended up with 25 less bolts, meaning that 25 bolts were sold.

3. What does -15.00 mean in this situation?

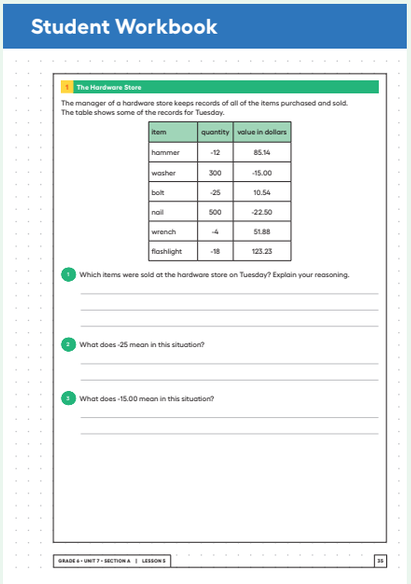
   Sample response: The hardware store had 15.00 dollars less, meaning that they spent $15.00 on washers.

4. On which item did the manager spend the most amount of money? Explain your reasoning.

   Nails

   Sample reasoning: Money spent by the hardware store is represented by a negative value in dollars, and the largest negative dollar amount is the $22.50 spent on nails.

Student Workbook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nail	500	-22.50
wrench	-4	51.88
flashlight	-18	123.23

1. Which items were sold at the hardware store on Tuesday? Explain your reasoning.

2. What does -25 mean in this situation?

3. What does -15.00 mean in this situation?

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Activity Synthesis

The goal of this discussion is to reinforce the idea that positive and negative numbers are useful for describing change. If an amount goes up, then the change is positive. If an amount goes down, that means the change is negative.

Begin by asking students to compare responses with their partner and to work to reach agreement. Then discuss the following question:

- *"How are negative numbers in this situation different from negative numbers in situations involving elevation or temperature?"*

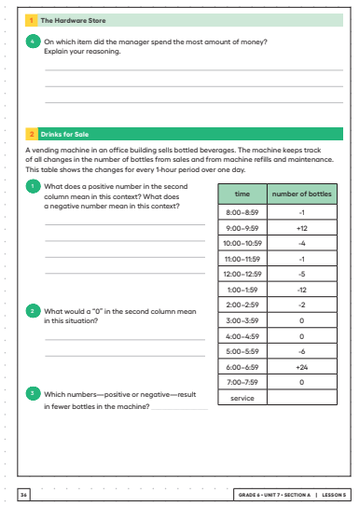
  In the situations with temperature and elevation, negative numbers represented a particular location or temperature. In this situation, negative numbers are representing how much something changes.

Access for Multilingual Learners (Activity 2, Launch)

MLR2: Collect and Display
Direct attention to words collected and displayed from the previous lesson. Invite students to borrow language from the display as needed, and update it throughout the lesson.

Advances: Conversing, Reading

Student Workbook



1 The Hardware Store

a. On which item did the manager spend the most amount of money? Explain your reasoning.

2 Drinks for Sale

A vending machine in an office building sells bottled beverages. The machine keeps track of all changes in the number of bottles from sales and from machine refills and maintenance. This table shows the changes for every 1-hour period over one day.

1. What does a positive number in the second column mean in this context? What does a negative number mean in this context?
2. What would a "0" in the second column mean in this situation?
3. Which numbers—positive or negative—result in fewer bottles in the machine? _____

time	number of bottles
8:00–8:59	-1
9:00–9:59	+12
10:00–10:59	-4
11:00–11:59	-1
12:00–12:59	-5
1:00–1:59	-12
2:00–2:59	-2
3:00–3:59	0
4:00–4:59	0
5:00–5:59	-6
6:00–6:59	+24
7:00–7:59	0
service	

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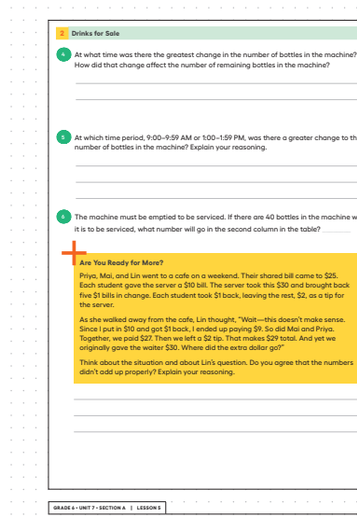
Student Workbook



2 Drinks for Sale

a. At what time was there the greatest change in the number of bottles in the machine? How did that change affect the number of remaining bottles in the machine?

b. At which time period, 9:00–9:59 AM or 1:00–1:59 PM, was there a greater change to the number of bottles in the machine? Explain your reasoning.

c. The machine must be emptied to be serviced. If there are 40 bottles in the machine when it is to be serviced, what number will go in the second column in the table? _____

Are You Ready for More?

Priya, Mai, and Lin went to a cafe on a weekend. Their shared bill came to $25. Each student gave the server a $10 bill. The server took this $30 and brought back five $1 bills in change. Each student took $1 back, leaving the rest, $2, as a tip for the server.

As she walked away from the cafe, Lin thought, "Wait—this doesn't make sense. Since I put in $10 and got $1 back, I ended up paying $9. So did Mai and Priya. Together, we paid $27. Then we left a $2 tip. That makes $29 total. And yet we originally gave the waiter $30. Where did the extra dollar go?"

Think about the situation and about Lin's question. Do you agree that the numbers didn't add up properly? Explain your reasoning.

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Activity 2

Drinks for Sale

15 min

Activity Narrative

In this activity, students interpret positive and negative numbers in the context of a changing inventory. Use this activity if students would benefit from an additional opportunity to practice interpreting the meaning of negative numbers in context.

Launch

Keep students in the same groups of 2.

Give students 8 minutes of quiet work time and 3 minutes of partner discussion.

Then follow with a whole-class discussion.

Student Task Statement

A vending machine in an office building sells bottled beverages. The machine keeps track of all changes in the number of bottles from sales and from machine refills and maintenance. This table shows the changes for every 1-hour period over one day.

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12:00–12:59	-5
1:00–1:59	-12
2:00–2:59	-2
3:00–3:59	0
4:00–4:59	0
5:00–5:59	-6
6:00–6:59	+24
7:00–7:59	0
service	

1. What does a positive number in the second column mean in this context? What does a negative number mean in this context?

   A positive number means that bottles were added to the machine. A negative number means that bottles were dispensed or removed from the machine.

2. What would a "0" in the second column mean in this situation?

   A "0" would mean no activity—the machine is not being stocked with new bottles and not dispensing any bottles (or the amount stocked is equal to the amount dispensed, but this idea is not expected at this time).

3. Which numbers—positive or negative—result in fewer bottles in the machine?

   Negative numbers result in fewer bottles in the machine because they mean that bottles are being removed.

4. At what time was there the greatest change in the number of bottles in the machine? How did that change affect the number of remaining bottles in the machine?

The greatest change happened at 6:00–6:59. The number of bottles in the machine increased by 24.

5. At which time period, 9:00–9:59 AM or 1:00–1:59 PM, was there a greater change to the number of bottles in the machine? Explain your reasoning.

In both cases, the number of bottles changed by 12. From 9:00–9:59, it increased by 12, and from 1:00–1:59, it decreased by 12.

6. The machine must be emptied to be serviced. If there are 40 bottles in the machine when it is to be serviced, what number will go in the second column in the table?

-40

Are You Ready for More?

Priya, Mai, and Lin went to a cafe on a weekend. Their shared bill came to $25. Each student gave the server a $10 bill. The server took this $30 and brought back five $1 bills in change. Each student took $1 back, leaving the rest, $2, as a tip for the server.

As she walked away from the cafe, Lin thought, "Wait—this doesn't make sense. Since I put in $10 and got $1 back, I ended up paying $9. So did Mai and Priya. Together, we paid $27. Then we left a $2 tip. That makes $29 total. And yet we originally gave the waiter $30. Where did the extra dollar go?"

Think about the situation and about Lin's question. Do you agree that the numbers didn't add up properly? Explain your reasoning.

Disagree

Sample explanations:

- It doesn't matter that the students originally paid $30. Between the bill, which is $25, and the $2 tip, the students paid $27 in total.
- Lin mistakenly thought that the $2 was in addition to the $27 the three of them paid, but the $27 actually already included the $2 tip, since the original bill was $25.
- Since the bill was $25 for three people, each person's share was $\$\frac{25}{3}$. Together they left a tip of $2, which means each person pitched in $\$\frac{2}{3}$. Each person then paid a total of $\frac{25}{3} + \frac{2}{3}$, which is $\frac{27}{3}$, or $9. This matches the fact that they each gave a $10 bill and took $1 for the change.

Activity Synthesis

The goal of the discussion is to allow students to share their thoughts on the meaning of positive and negative numbers in context. Ask students to share their responses with their partner and work to reach agreement. Ask students to create a story explaining the numbers in the table. Invite students to share their story with a partner before inviting 1–2 students to share their stories with the class. Tell students that tables like this (but perhaps more complicated) are used all the time to tell stories about what is happening in the world.

Lesson Synthesis

The purpose of this discussion is for students to think of different contexts where positive and negative numbers could represent gaining or losing. Here are some questions for discussion:

- *"What did the positive and negative numbers represent in this lesson?"*

  Positive numbers represented a gain, like receiving money or adding bottles to the machine. Negative numbers represented a loss, like spending money by buying something or removing bottles from the machine.

- *"What other situations can you think of where you gain or lose an amount and could use negative numbers to talk about them? What would positive and negative changes mean in those situations?"*

  Some examples include speed, number of followers, field position in football, stock prices.

Lesson Summary

Changes in a quantity can be represented with positive and negative numbers. If the quantity increases, the change is positive. If it decreases, the change is negative.

- Suppose 5 gallons of water is put in a washing machine. We can represent the change in the number of gallons as +5. If 3 gallons is emptied from the machine, we can represent the change as -3.

It is especially common to represent money we receive with positive numbers and money we spend with negative numbers.

- Suppose Clare gets $30.00 for her birthday and spends $18.00 buying lunch for herself and a friend. To her, the value of the gift can be represented as +30.00 and the value of the lunch as -18.00.

Whether a number is considered positive or negative depends on a person's perspective. If Clare's grandmother gives her $20 for her birthday, Clare might see this as +20 because to her, the amount of money that she has increased. But her grandmother might see it as -20, because to her, the amount of money that she has decreased.

In general, when using positive and negative numbers to represent changes, we have to be very clear about what it means when the change is positive and what it means when the change is negative.

Math Community

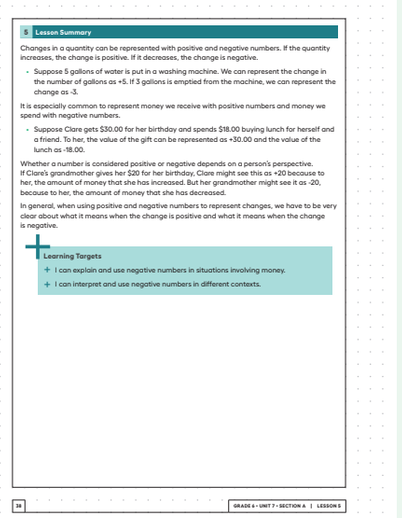
Before distributing the *Cool-downs*, display the Math Community Chart and these questions:

- *"What norm(s) should stay the way they are?"*
- *"What norm(s) do you think should be made more clear? How?"*
- *"What norms are missing that you would add?"*
- *"What norm(s) should be removed?"*

Ask students to respond to one or more of the questions after completing the *Cool-down* on the same sheet.

After collecting the *Cool-downs*, identify themes from the norms questions. There will be many opportunities throughout the year to revise the classroom norms, so focus on revision suggestions that multiple students made to share in the next exercise. One option is to list one addition, one revision, and one removal that the class has the most agreement about. Plan to discuss the potential revisions over the next few lessons.

Student Workbook



5 Lesson Summary

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In general, when using positive and negative numbers to represent changes, we have to be very clear about what it means when the change is positive and what it means when the change is negative.

Learning Targets

+ I can explain and use negative numbers in situations involving money.
+ I can interpret and use negative numbers in different contexts.

Responding To Student Thinking

Points to Emphasize
If most students struggle with interpreting the values in the table as a change in balance rather than the actual balance, revisit this context in the activity referred to here. For example, discuss how a forward or backward jump by the bug would be represented using a signed number and that the distance jumped is different from the position of the bug.

Grade 6, Unit 7, Lesson 6, Activity 1 Jumping Bug

Cool-down

Event Planner

5 min

Student Task Statement

The table shows records of the money-related activities of an event planner over the period of a week.

date	items	amount in dollars
May 1	rent	-850.00
May 2	birthday party decorations	106.75
May 3	utilities (electricity, gas, phone)	-294.50
May 5	wedding invitations	240.55
May 5	office supplies	-147.95
May 6	anniversary party catering	158.20
May 7	conference event scheduling	482.30

1. For which items did the event planner receive money?

   birthday party decorations, wedding invitations, anniversary party catering, conference event scheduling

2. What does the number -147.95 mean in this context?

   $147.95 was spent on office supplies.

3. Did the bakery owner receive more or spend more money on May 5? Explain your reasoning.

   Received more money

   Sample reasoning: Over $240 was received, and less than $150 was spent.

Lesson 5

Practice Problems

5 Problems

Problem 1

Write a positive or negative number to represent each change in the high temperature.

a. Tuesday's high temperature was 4 degrees less than Monday's high temperature.

-4

b. Wednesday's high temperature was 3.5 degrees less than Tuesday's high temperature.

-3.5

c. Thursday's high temperature was 6.5 degrees more than Wednesday's high temperature.

+6.5 or 6.5

d. Friday's high temperature was 2 degrees less than Thursday's high temperature.

-2

Problem 2

Decide whether each of the following quantities can be represented by a positive number or by a negative number. Give an example of a quantity with the opposite sign in the same situation.

a. Tyler's puppy gained 5 pounds.

Positive

Sample response: Tyler's puppy lost 5 pounds.

b. The aquarium leaked 2 gallons of water.

Negative

Sample response: 2 gallons of water were added to the aquarium.

c. Andre received a gift of $10.

Positive

Sample response: Andre gave a gift of $10.

d. Kiran gave a gift of $10.

Negative

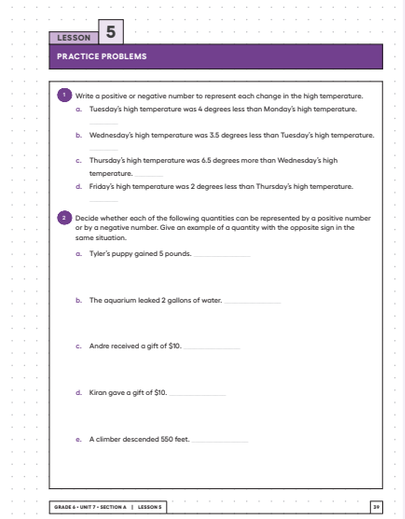
Sample response: Kiran received a gift of $10.

e. A climber descended 550 feet.

Negative

Sample response: A climber ascended 550 feet.

Student Workbook



LESSON 5

PRACTICE PROBLEMS

1. Write a positive or negative number to represent each change in the high temperature.
   a. Tuesday's high temperature was 4 degrees less than Monday's high temperature. _____
   b. Wednesday's high temperature was 3.5 degrees less than Tuesday's high temperature. _____
   c. Thursday's high temperature was 6.5 degrees more than Wednesday's high temperature. _____
   d. Friday's high temperature was 2 degrees less than Thursday's high temperature. _____
2. Decide whether each of the following quantities can be represented by a positive number or by a negative number. Give an example of a quantity with the opposite sign in the same situation.
   a. Tyler's puppy gained 5 pounds. _____
   b. The aquarium leaked 2 gallons of water. _____
   c. Andre received a gift of $10. _____
   d. Kiran gave a gift of $10. _____
   e. A climber descended 550 feet. _____

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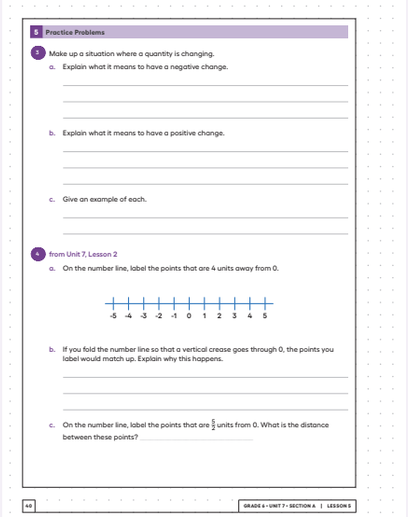
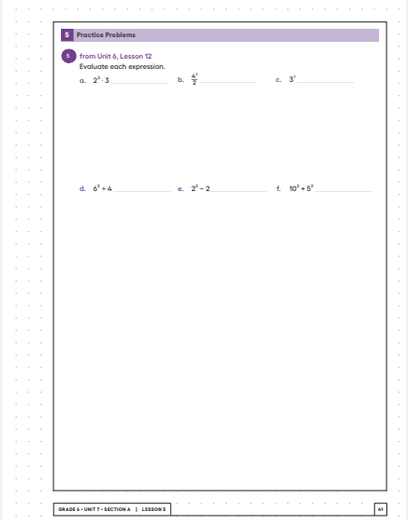
Student Workbook



Student Workbook



Problem 3

Make up a situation where a quantity is changing.

Sample response: Students sell candy at the concession stand.

a. Explain what it means to have a negative change.

When they sell candy, the change is negative.

b. Explain what it means to have a positive change.

When they get more candy to sell, the change is positive.

c. Give an example of each.

For example, in one hour the number of packages of candy changed by −5 because they sold 5, and in the next hour it changed by 20 because they got 20 more to sell.

Problem 4

from Unit 7, Lesson 2

a. On the number line, label the points that are 4 units away from 0.

b. If you fold the number line so that a vertical crease goes through 0, the points you label would match up. Explain why this happens.

The two points match up because they are opposites; they are each same distance from 0.

c. On the number line, label the points that are $\frac{5}{2}$ units from 0. What is the distance between these points?

See image. The distance between them is 5 units, because each one is 2.5 units away from 0.

Problem 5

from Unit 6, Lesson 12

Evaluate each expression.

a. $2^3 \cdot 3$

24

b. $\frac{4^2}{2}$

8

c. 3^1

3

d. $6^2 \div 4$

9

e. $2^3 - 2$

6

f. $10^2 + 5^2$

125