Lesson 15

Changes on the Earth (Optional)

Goal

Calculate a percent increase or decrease, and interpret (orally and in writing) its meaning in the situation.

Learning Target

I can use percentages to describe changes in real-world situations.

Lesson Narrative

This lesson is optional. In this lesson, students calculate percentages of increase or decrease based on information about how some different places on Earth have changed over time. Students choose which pairs of values to compare to make sense of the situation. Students attend to precision of language as they calculate and report values to describe these changes.

The *Warm-up* and main activity focus on changes with the Aral Sea, which has been drying up since the 1960s. The last activity is optional because it provides an opportunity for additional practice while focusing on the Great Barrier Reef.

Student Learning Goal

Let's use percentages to make sense of changes on Earth.

Access for Students with Diverse Abilities

- Representation (Activity 1)

Access for Multilingual Learners

- MLR1: Stronger and Clearer Each Time (Activity 2)
- MLR5: Co-Craft Questions
- MLR6: Three Reads

Instructional Routines

- MLR5: Co-Craft Questions
- MLR6: Three Reads

Lesson Timeline

5 min	20 min	10 min	10 min
Warm-up	Activity 1	Activity 2	Lesson Synthesis

Assessment

5 min — Cool-down

Instructional Routines

MLR5: Co-Craft Questions

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Access for Multilingual Learners (Warm-up)

MLR5: Co-Craft Questions

This activity uses the *Co-Craft Questions* math language routine to advance reading and writing as students make sense of a context and practice generating mathematical questions.

Student Workbook

Warm-up

Satellite Images

5 min

Activity Narrative

In this *Warm-up*, students examine satellite images that show how the size of the Aral Sea has changed over time. This prepares them for later in the lesson when they will calculate percentages that represent the situation.

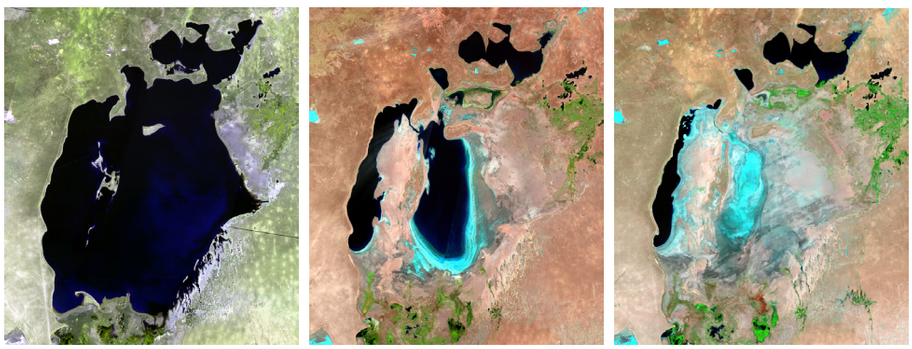
Launch

Arrange students in groups of 2. Introduce the context of satellite images of a body of water. Use *Co-Craft Questions* to orient students to the context and elicit possible mathematical questions.

Give students 1–2 minutes to write a list of mathematical questions that could be asked about the situation before comparing questions with a partner.

Student Task Statement

1977 2006 2019



Sample responses:

- If you wanted to create a scale drawing of this lake on a piece of 8.5-by-11-inch paper, what scale could you use?
- Estimate the area of the lake in 1977.
- Was the middle photo taken closer in time to the first photo or the last photo? By how many years?
- By what percentage did the area of the lake decrease from 1977 to 2006?
- By what percentage did the area of the lake decrease from 1977 to 2019?

Activity Synthesis

Invite several partners to share one question with the class and record responses. Ask the class to make comparisons among the shared questions and their own. Ask,

"What do these questions have in common? How are they different?"

Listen for and amplify language related to the learning goal, such as "area," "percent increase," and "percent decrease".

Explain that these are satellite photos of the Aral Sea, in central Asia. The amount of water in the sea has been decreasing since the 1960s when two rivers, the Syr Darya and the Amu Darya, were diverted to irrigate land to grow cotton and other crops. The Aralkum Desert is taking over the land where the Aral Sea used to be. Invite students to brainstorm how these changes may be affecting the people that live in this region.

Activity 1
The Aral Sea

20 min

Activity Narrative

In this activity, students examine two tables of information related to the Aral Sea. They choose what pairs of values to compare, and they calculate the percent increase or decrease between the values. They write sentences describing what each percentage represents about the situation. As students choose what aspects of the data to focus on for their calculations, they are making sense of the problem. As students clearly state what each percentage represents, about the situation, they are attending to precision.

Launch

Use *Three Reads* to support reading comprehension and sense-making about this problem. Display only the problem stem and the tables, without revealing the questions.

- For the first read, read the problem aloud, then ask,

"What is this situation about?"

the size of the Aral Sea and how its shrinking affected other people around it

- After the second read, ask students to list any quantities that can be counted or measured.

area of irrigated land, area of the sea, water level, salinity, fish catch, prevalence of disease, concentration of chemicals

Listen for and clarify any questions about the quantities in relation to the context.

Instructional Routines

MLR6: Three Reads

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Access for Multilingual Learners (Activity 1)

MLR6: Three Reads

This activity uses the *Three Reads* math language routine to advance reading and representing as students make sense of what is happening in the text.

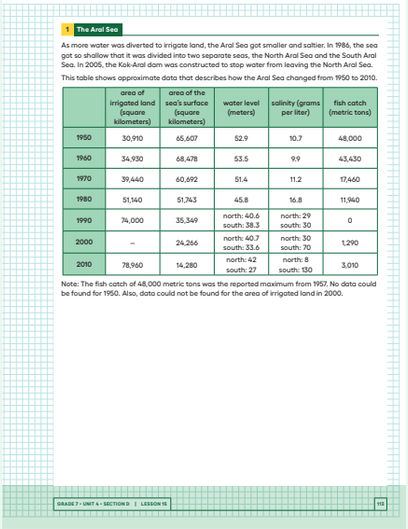
Access for Students with Diverse Abilities (Activity 1, Launch)

Representation: Access for Perception.

Begin by showing a video about the Aral Sea to support understanding of the context.

Supports accessibility for: Conceptual Processing, Language

Student Workbook



1 The Aral Sea

As more water was diverted to irrigate land, the Aral Sea got smaller and saltier. In 1986, the sea got so shallow that it was divided into two separate seas, the North Aral Sea and the South Aral Sea. In 2005, the Kok-Aral dam was constructed to stop water from leaving the North Aral Sea.

This table shows approximate data that describes how the Aral Sea changed from 1950 to 2010.

	area of irrigated land (square kilometers)	area of the sea's surface (square kilometers)	water level (meters)	salinity (grams per liter)	fish catch (metric tons)
1950	30,910	65,607	52.9	10.7	48,000
1960	34,930	68,478	53.5	9.9	43,430
1970	39,440	60,692	51.4	11.2	17,460
1980	51,140	51,743	45.8	16.8	11,940
1990	74,000	35,349	north: 40.6 south: 38.3	north: 29 south: 30	0
2000	–	24,266	north: 40.7 south: 33.6	north: 30 south: 70	1,290
2010	78,960	14,280	north: 42 south: 27	north: 8 south: 130	3,010

Note: The fish catch of 48,000 metric tons was the reported maximum from 1957. No data could be found for 1950. Also, data could not be found for the area of irrigated land in 2000.

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- After the third read, reveal the question:

"Using the information in the tables, calculate at least 4 percentages of increase or decrease that describe the situation with the Aral Sea."

and ask,

💬 *"What are some ways we might get started on this?"*

Invite students to name some possible starting points, referencing quantities from the second read. (Select a value to be the point of reference, and then calculate how some other value changed in relation to the reference value.)

Keep students in the same groups.

Give students 8–10 minutes of partner work time.

Student Task Statement

As more water was diverted to irrigate land, the Aral Sea got smaller and saltier. In 1986, the sea got so shallow that it was divided into two separate seas, the North Aral Sea and the South Aral Sea. In 2005, the Kok-Aral dam was constructed to stop water from leaving the North Aral Sea.

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Note: The fish catch of 48,000 metric tons was the reported maximum from 1957. No data could be found for 1950. Also, data could not be found for the area of irrigated land in 2000.

This table shows approximate data that describes some health conditions of school-age children living around the Aral Sea.

	Kazalinsk district	Zhanakorgan district
distance from the Aral Sea	less than 200 kilometers	about 500 kilometers
prevalence of cough	8.1%	4.6%
prevalence of restrictive pulmonary dysfunction	10%	3%
prevalence of diarrhea	11.3%	5.6%
prevalence of hypercalciuria	38.6%	12.8%
sodium concentration in urine	3.54	2.89
calcium concentration in urine	0.75	0.33
sodium concentration in hair	738	471
bromine concentration in hair	9.57	6.22
nickel concentration in hair	1.6	0.85
mercury concentration in hair	1.31	0.88

Note: Units for urine concentrations are mmol uNa or uCA per mmol creatinine. Units for hair concentrations are μg of the element per g of hair.

Using the information in the tables, calculate at least 4 percentages of increase or decrease that describe the situation with the Aral Sea. For each percentage, write a sentence that clearly describes what the percent increase or percent decrease represents.

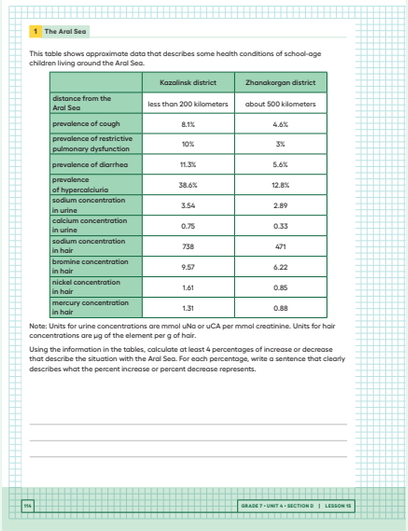
Sample responses:

- From 1990 to 2010, the water level in the South Aral Sea decreased by 29.5%, while the water level in the North Aral Sea increased by 3.4%.
- The salinity of the North Aral Sea decreased by 73.3% from 2000 to 2010.
- The prevalence of cough is 76% greater for children that live within 200 kilometers of the Aral Sea than for children that live 500 kilometers away.

Activity Synthesis

The purpose of this discussion is for students to attend to precision in the language they use to describe how their percentages represent the situation with the Aral Sea. If time permits, ask students to prepare a display that shows their percentages and sentences. Encourage students to include details that will help others interpret their thinking.

Student Workbook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Instructional Routines

MLR6: Three Reads

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Building on Student Thinking

Some students may struggle with representing 0.89% as a decimal. Consider asking

"How does 0.89% compare to 1%? How could you calculate the new value after a 1% increase?"

Invite several students to share one of their sentences. Ask the class to respond to the sentence. This could include restating in their own words how the percentage represents the situation with the Aral Sea or giving feedback that would help clarify or strengthen the sentence. Consider asking:

- *"What kinds of additional details or language helped you understand the percentage?"*
- *"Were there any additional details or language that you have questions about?"*
- *"Did anyone calculate the same percentage but would explain it differently?"*
- *"What did the sentences have in common? How were they different?"*

Invite students to think about how the percentages they calculated tell a story with the data. Consider asking:

- *"How did you decide which percentages to compare?"*
- *"How did the way you reported the values impact the conclusions that could be made?"*
- *"How might the data have been described in a news report?"*

Activity 2: Optional

The Great Barrier Reef

10 min

Activity Narrative

In this activity students apply reasoning about percent increase and decrease to information about the Great Barrier Reef. They calculate the percentage by which the coral coverage has decreased. They also calculate what the new area would be after a potential percent increase.

In the *Are You Ready for More?* task students explore a repeated percent increase. Although students have not learned about compounded rates, they can continue multiplying the area by 1.0089 until they reach the desired value, tracking the number of times they multiply. Students attempting this process may benefit from being shown how most calculators will use the result of the previous calculation and repeat the same operation when the "=" button is pressed repeatedly.

Launch

Give students 4–5 minutes of quiet work time followed by time for partner discussion.

Then hold a whole-class discussion.

Student Task Statement

The Great Barrier Reef in Australia is the longest and largest coral reef in the world. Studies show that the amount of area that is actually covered by coral has been decreasing.

1. Find the percent decrease, and describe what this percentage represents.

year	area covered by coral (square meters)
1985	96,600
2012	47,610

From 1985 to 2012, the area of the Great Barrier Reef that is covered by coral decreased 50.7%.

2. One cause of the decrease in coral is the crown-of-thorns starfish that eat the coral polyps. Researchers predict that if these starfish were removed, the area covered by coral would increase by 0.89% each year.

If the starfish had been removed when the coral coverage was 47,610 square miles, what would the area of coral coverage have been one year later?

48,034 square miles

Are You Ready for More?

If removing the crown-of-thorns starfish, starting in 2012, is the only thing we did to reverse the decline, how many years would it take for the area covered by coral to return to its 1985 level?

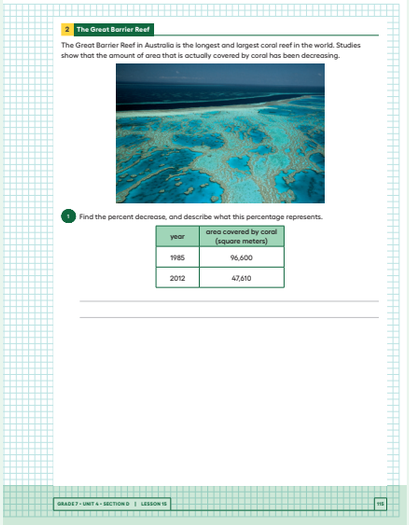
80 years

Start with 47,610. Keep multiplying by 1.0089 until the product is at least 96,600. Keep track of how many times you multiplied.

Activity Synthesis

Invite students to share their sentences from the first question. Ask the class to give feedback on whether the sentence clearly describes what the percentage represents.

Student Workbook



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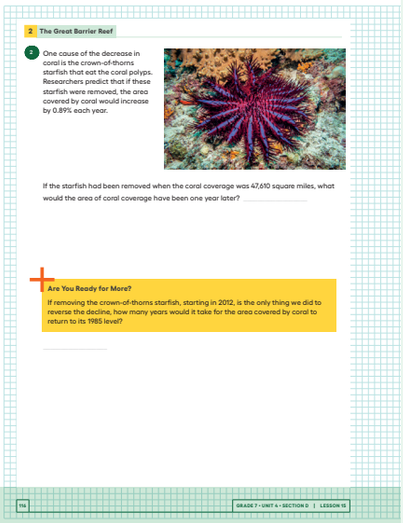
Student Workbook



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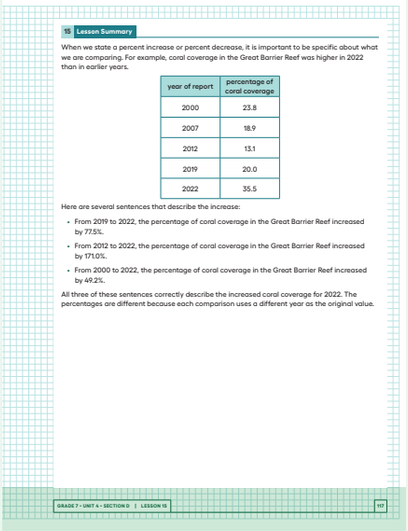
Access for Multilingual Learners (Activity 2, Synthesis)

MLR1: Stronger and Clearer Each Time.

Before the whole-class discussion, give students time to meet with 2–3 partners to share and get feedback on their first draft response to the first question. Invite listeners to ask questions and give feedback that will help their partner clarify and strengthen their ideas and writing. Give students 3–5 minutes to revise their first draft based on the feedback they receive.

Advances: Writing, Speaking, Listening

Student Workbook



15 Lesson Summary

When we state a percent increase or percent decrease, it is important to be specific about what we are comparing. For example, coral coverage in the Great Barrier Reef was higher in 2022 than in earlier years.

year of report	percentage of coral coverage
2000	23.8
2007	18.9
2012	13.1
2019	20.0
2022	35.5

Here are several sentences that describe the increase:

- From 2019 to 2022, the percentage of coral coverage in the Great Barrier Reef increased by 77.5%.
- From 2012 to 2022, the percentage of coral coverage in the Great Barrier Reef increased by 171.0%.
- From 2000 to 2022, the percentage of coral coverage in the Great Barrier Reef increased by 49.2%.

All three of these sentences correctly describe the increased coral coverage for 2022. The percentages are different because each comparison uses a different year as the original value.

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Lesson Synthesis

Share with students,

- *"Today we calculated percentages to make sense of situations involving change."*

Invite students to share how percentages can be used to describe situations. Here are some questions to elicit student thinking:

- *"How did you decide which values to compare with a percentage?"*
- *"How did you decide which value should correspond to 100%?"*
- *"When reporting the percentage of increase or decrease, why is it important to clearly describe what it represents?"*
- *"Why does it matter how you report percent increase and decrease about real-world situations?"*

Lesson Summary

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All three of these sentences correctly describe the increased coral coverage for 2022. The percentages are different because each comparison uses a different year as the original value.

Cool-down

The Great Salt Lake

5 min

Student Task Statement

This table shows information about the Great Salt Lake, in Utah.

date	depth at deepest point (feet)
June 1986	37
November 2022	14
June 2023	19

Find a percentage of increase or decrease that describes the situation. Write a sentence that clearly describes what the percent increase or percent decrease represents.

Sample responses:

- From 1986 to 2022, the depth of the Great Salt Lake decreased by 62.2%.
- From 1986 to 2023, the depth of the Great Salt Lake decreased by 48.6%.
- From 2022 to 2023, the depth of the Great Salt Lake increased by 35.7%; however, this increase was equal to only 13.5% of its previous depth from 1986.

Responding To Student Thinking

Press Pause

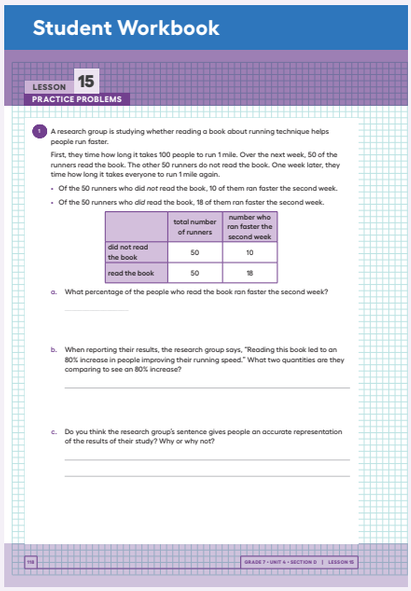
By this point in the unit, there should be some student mastery of finding percent increase or decrease. If students struggle, make time to revisit related work in the sections referred to here. See the Course Guide for ideas to help students re-engage with earlier work.

Grade 7, Unit 4, Section B Percent Increase and Decrease

Grade 7, Unit 4, Section C Applying Percentages

Practice Problems

6 Problems


Student Workbook

LESSON 15
PRACTICE PROBLEMS

1. A research group is studying whether reading a book about running technique helps people run faster.

First, they time how long it takes 100 people to run 1 mile. Over the next week, 50 of the runners read the book. The other 50 runners do not read the book. One week later, they time how long it takes everyone to run 1 mile again.

- Of the 50 runners who did not read the book, 10 of them ran faster the second week.
- Of the 50 runners who *did* read the book, 18 of them ran faster the second week.

	total number of runners	number who ran faster the second week
did not read the book	50	10
read the book	50	18

a. What percentage of the people who read the book ran faster the second week?

b. When reporting their results, the research group says, "Reading this book led to an 80% increase in people improving their running speed." What two quantities are they comparing to see an 80% increase?

c. Do you think the research group's sentence gives people an accurate representation of the results of their study? Why or why not?

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Problem 1

A research group is studying whether reading a book about running technique helps people run faster.

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- Of the 50 runners who did *not* read the book, 10 of them ran faster the second week.
- Of the 50 runners who *did* read the book, 18 of them ran faster the second week.

	total number of runners	number who ran faster the second week
did not read the book	50	10
read the book	50	18

a. What percentage of the people who read the book ran faster the second week?

36%

b. When reporting their results, the research group says, "Reading this book led to an 80% increase in people improving their running speed." What two quantities are they comparing to see an 80% increase?

They are comparing the number of runners who ran faster after reading the book to the number of runners who ran faster without having read the book.

c. Do you think the research group's sentence gives people an accurate representation of the results of their study? Why or why not?

Sample response: No. The sentence could make people think that 80% of the people who read the book ran faster afterwards.

Problem 2

from Unit 4, Lesson 14

Jada measured the height of a plant in a science experiment and finds that, to the nearest $\frac{1}{4}$ of an inch, it is $4\frac{3}{4}$ inches.

a. What is the largest the actual height of the plant could be?

at most $4\frac{7}{8}$ inches tall (If it were taller, then $4\frac{3}{4}$ would not be the nearest quarter-inch measurement.)

b. What is the smallest the actual height of the plant could be?

at least $4\frac{5}{8}$ inches tall

c. How large could the percent error in Jada's measurement be?

about 2.6% ($0.125 \div 4\frac{3}{4}$)

Problem 3

from Unit 4, Lesson 14

The reading on a car's speedometer has 1.6% maximum error. The speed limit on a road is 65 miles per hour.

a. The speedometer reads 64 miles per hour. Is it possible that the car is going over the speed limit?

Yes, the car might be going more than 65 mph. 1.6% of 64 is 1.024, so the car could be going 65.024 mph, which is over the speed limit.

b. The speedometer reads 66 miles per hour. Is the car definitely going over the speed limit?

No, the car might be going less than 65 mph. 1.6% of 66 is 1.056, so the car could be going as slow as 64.944 mph, which is less than the speed limit.

Problem 4

from Unit 2, Lesson 5

Water is running into a bathtub at a constant rate. After 2 minutes, the tub is filled with 2.5 gallons of water. Write two equations for this proportional relationship. Use w for the amount of water (gallons) and t for time (minutes). In each case, what does the constant of proportionality tell you about the situation?

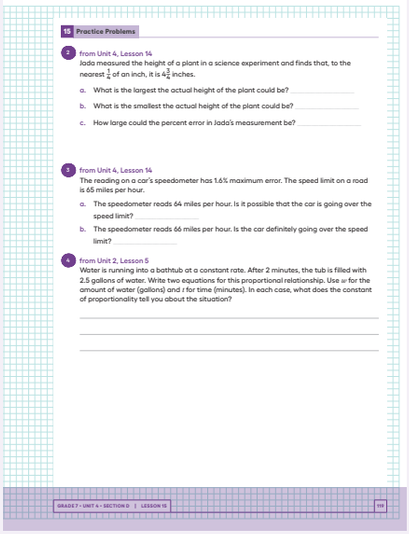
$w = 1.25t$

Every minute the amount of water increases by 1.25 gallons.

$t = 0.8w$

Every 0.8 minutes the amount of water increases by 1 gallon.

Student Workbook


15 Practice Problems

2 from Unit 4, Lesson 14
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a. What is the largest the actual height of the plant could be?
b. What is the smallest the actual height of the plant could be?
c. How large could the percent error in Jada's measurement be?

3 from Unit 4, Lesson 14
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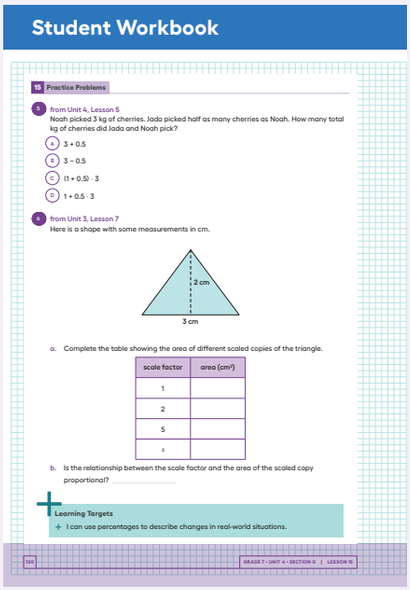
Student Workbook

15 Practice Problems

5 from Unit 4, Lesson 5
Noah picked 3 kg of cherries. Jada picked half as many cherries as Noah. How many total kg of cherries did Jada and Noah pick?
A 3 + 0.5
B 3 − 0.5
C (1 + 0.5) · 3
D 1 + 0.5 · 3

6 from Unit 3, Lesson 7
Here is a shape with some measurements in cm.
2 cm
3 cm
a. Complete the table showing the area of different scaled copies of the triangle.

scale factor	area (cm²)
1	
2	
5	
s	

b. Is the relationship between the scale factor and the area of the scaled copy proportional? _____

Learning Targets
+ I can use percentages to describe changes in real-world situations.

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Problem 5

from Unit 4, Lesson 5

Noah picked 3 kg of cherries. Jada picked half as many cherries as Noah. How many total kg of cherries did Jada and Noah pick?

A. 3 + 0.5

B. 3 − 0.5

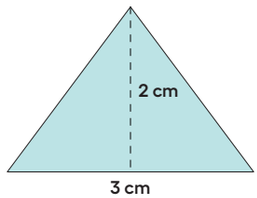
C. (1 + 0.5) · 3

D. 1 + 0.5 · 3

Problem 6

from Unit 3, Lesson 7

Here is a shape with some measurements in cm.



a. Complete the table showing the area of different scaled copies of the triangle.

scale factor	area (cm^2)
1	3
2	12
5	75
s	$3s^2$

b. Is the relationship between the scale factor and the area of the scaled copy proportional?

no