Lesson 9

More About Constant Speed (Optional)

Goals

- Calculate unit rates that represent speed or pace, use them to determine unknown distances or elapsed times, and explain (orally) the solution method.
- Interpret a verbal (written) description of a situation involving two objects moving at constant speeds, and create a diagram or table to represent the situation.

Learning Target

I can solve more complicated problems about constant speed situations.

Access for Students with Diverse Abilities

- Representation (Activity 1, Activity 2)

Access for Multilingual Learners

- MLR6: Three Reads (Activity 1)
- MLR8: Discussion Supports (Activity 2)

Instructional Routines

- 5 Practices
- MLR6: Three Reads

Required Materials

Materials to Gather

- Tools for creating a visual display: Activity 1

Lesson Narrative

This lesson is optional because it goes beyond the expectations of the standards. Students apply their understanding about constant speed and time-distance ratios to reason about the movement of two objects relative to each other. Students also learn that the two unit rates associated with time-distance ratios can be distinguished as **speed** and **pace.**

Although students have solved problems in the context of constant speed (such as finding elapsed time, distance traveled, or rate of travel), the work here is more involved than previous work in that:

- The objects may be moving in opposite directions.
- The distance of interest is between two moving objects, rather than between two fixed points or between a moving object and a fixed point.
- Besides the individual speeds of the two objects, there is another speed—relating how fast one moves toward or away from the other—that can help us make sense of a situation.

In the main activity, students reason about two camels traveling toward one another. In the optional activity, they reason about two people moving away from each other.

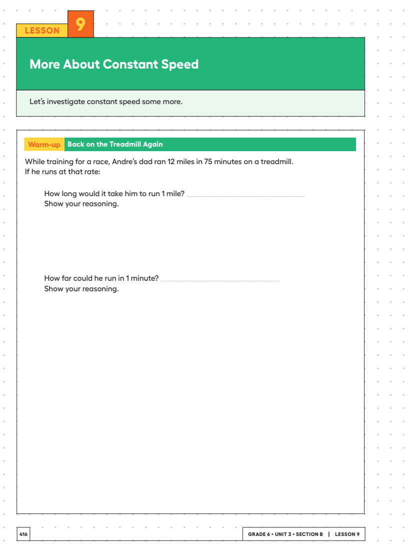
Student Learning Goal

Let's investigate constant speed some more.

Lesson Timeline

Warm-up	Activity 1	Activity 2	Lesson Synthesis	Cool-down (Assessment)
10 min	25 min	20 min	10 min	5 min

Student Workbook


LESSON 9

More About Constant Speed

Let's investigate constant speed some more.

Warm-up Back on the Treadmill Again

While training for a race, Andre's dad ran 12 miles in 75 minutes on a treadmill. If he runs at that rate:

How long would it take him to run 1 mile? Show your reasoning.

How far could he run in 1 minute? Show your reasoning.

Warm-up

Back on the Treadmill Again

10 min

Activity Narrative

In this *Warm-up,* students calculate the two unit rates associated with a ratio relating time and distance. They connect these unit rates to the terms "speed" and "pace." They learn that **speed** describes distance traveled per 1 unit of time and **pace** describes time elapsed per 1 unit of distance.

To find the time it took to run 1 mile, students may divide 75 minutes directly by 12. They may also find it more incrementally, by finding the time it took to run one or more intermediate distances, with or without using a table or a double number line diagram. (For example, they may divide both 75 and 12 by 3 to find the time to run 4 miles, and then divide that by 4 to find the time to run 1 mile).

Likewise, to find the distance run in 1 minute, students may divide 12 miles by 75 and express it as $\frac{12}{75}$ or 0.16, or they may reason indirectly. (For example, they may divide both 12 and 75 by 3 to find the distance run in 25 minutes, and then divide that by 25 to find the distance run per minute.)

Monitor for different ways of reasoning, and select students with varying approaches to share later.

Launch

Arrange students in groups of 2. Give students 3 minutes of quiet think time, followed by time to share with a partner and for a whole-class discussion.

Student Task Statement

While training for a race, Andre's dad ran 12 miles in 75 minutes on a treadmill. If he runs at that rate:

How long would it take him to run 1 mile? Show your reasoning.

6.25 minutes

Sample reasoning:

- $75 \div 12 = 6.25$
- Using a table:

distance (miles)	time (minutes)
12	75
4	25
2	12.5
1	6.25

How far could he run in 1 minute? Show your reasoning.

0.16 mile

Sample reasoning:

- $12 \div 75 = 0.16$
- $\frac{12}{75} = \frac{4}{25} = \frac{16}{100}$, which is 0.16
- Using a table

distance (miles)	time (minutes)
12	75
$\frac{12}{15}$ or $\frac{4}{5}$ or 0.8	5
$\frac{4}{25}$ or 0.16	1

Activity Synthesis

Select students with different strategies to share with the class. Record their methods, and display them for all to see. If the strategies of dividing 75 by 12 for the first question and dividing 12 by 75 for the second question are missing, demonstrate them and add them to the display.

If not already mentioned by students, highlight that 6.25 minutes per mile and 0.16 mile per minute are two unit rates associated with the 12-to-75 ratio of distance in miles to time in minutes.

Then, introduce the distinction between speed and pace:

- When we find the number of miles per minute or meters per second that an object is moving, we are finding the **speed** of the object. The unit rate 0.16 mile per minute is the speed of running.
- When we find the number of minutes per mile of seconds per meter, we are finding the **pace** of the object. The unit rate 6.25 minutes per mile is the pace of running.

If time permits, consider asking students:

“Which unit rate—speed or pace—would you choose to find how long it would take Andre’s father to run 8 miles? Why?”

Pace, because it tells how far he runs in 1 mile, so multiplying it by 8 would give us the time to run 8 miles. Speed, because dividing 8 by 0.16 tells us many groups of 0.16 mile are in 8, which gives the number of minutes.

“Which unit rate—speed or pace—would you choose to find how many miles Andre’s father could run in 30 minutes? Why?”

Speed, because it tells us how far he could run in 1 minute, so multiplying by 30 would give the distance run. Pace, because dividing 30 by 6.25 tells us how many groups of 6.25 minutes are in 30, which gives us the number of miles.

Instructional Routines

MLR6: Three Reads

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Access for Multilingual Learners (Activity 1)

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.

Activity 1

Camels on a Desert Trail

25 min

Activity Narrative

In this activity, students reason about distance, elapsed time, and speed in the context of two animals moving toward each other at a constant speed.

To find how far apart the two camels are on a trail after different amounts of time, students are likely to find how far each camel travels each hour and then consider the combined effect on the distance between the two camels. To determine when the camels will meet, some students may reason incrementally about how long before the distance apart goes to 0 miles. Others may use a combined unit rate—the distance covered by both camels per hour (6.4 miles)—and divide it into the total distance (24 miles).

The last question presents students with a situation in which only one camel is moving toward the other. It prompts students to reason about whether some quantities in that situation—distances between the camels in 1, 2, and 3 hours, the elapsed time until the camels meet, and the point where they meet—could be the same as in the original situation.

To answer the questions, students need to make sense of the situation—by drawing diagrams, reasoning with tables, or using multiple representations—and persevere in solving problems. As they interpret given quantities, make estimates, or check that their strategies and solutions make sense in context, students practice reasoning quantitatively and abstractly.

Launch

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

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

"What is this situation about?"

two camels in a desert, a young camel and an older camel moving toward each other on a trail, two camels walking at different speeds in opposite directions

Listen for and clarify any questions about the context.

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

distance between the two towns, speed of each camel, distances traveled by each camel over time

- After the third read, reveal the question:

"How far apart will the camels be in 0, 1, 2, and 3 hours?"

and ask,

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

drawing a diagram to show what's happening, using a table to show how far each camel travels per hour

Invite students to name some possible starting points, referring to quantities from the second read.

Arrange students in groups of 3–4, and provide access to calculators. Give students a few minutes of quiet think time to complete the first question and then time to discuss their responses and strategies with their group. Ask students to pause for a brief whole-class discussion afterward.

Display the table for all to see. Invite a couple of students who use different approaches to share their responses. As students explain, annotate the table to illustrate their reasoning.

Before students move on to the rest of the activity, make sure they see that:

- Each hour, the young camel travels 3.4 miles and the older camel travels 3 miles.
- Because they walk toward each other, the distance between them decreases by 3.4 + 3 or 6.4 miles each hour.
- We can use the unit rate 6.4 miles per hour to reason about distances traveled or distances apart for different amounts of times (including fractions of an hour).

Give students 8–10 minutes to work on the rest of the activity with their group.

Student Task Statement

A young camel in Town A is traveling on a flat desert trail to Town B, which is 24 miles away. An older camel in Town B is traveling on the same trail to Town A. The two camels depart at the same time.

The young camel walks at a speed of 3.4 miles per hour while the older camel walks 3 miles per hour.

For each question, explain or show your reasoning.

1. How far apart will they be in 0, 1, 2, and 3 hours? Complete the first four rows of the table.

elapsed time (hours)	distance apart (miles)
0	24
1	17.6
2	11.2
3	4.8

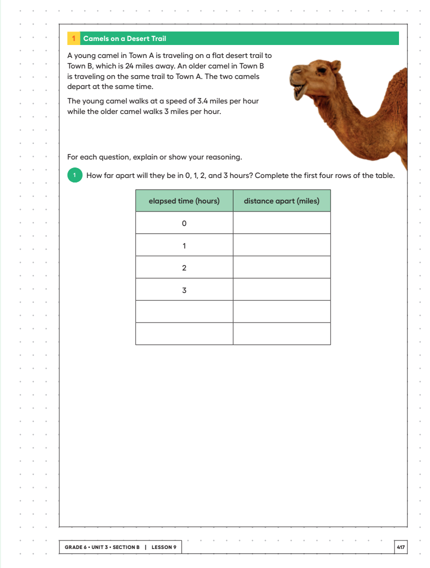
Sample reasoning: After 1 hour, the young camel will have walked 3.4 miles and the older camel will have walked 3 miles. The distance between them shortens by 6.4 miles every hour. 24 − 6.4 = 17.6

Access for Students with Diverse Abilities (Activity 1, Student Task)

Representation: Internalize Comprehension.
Represent the same information through different modalities by using drawings or diagrams. If students are unsure where to begin, suggest that they draw a picture or diagram that represents the situation.

Supports accessibility for: Conceptual Processing, Visual-Spatial Processing

Student Workbook


1 Camels on a Desert Trail

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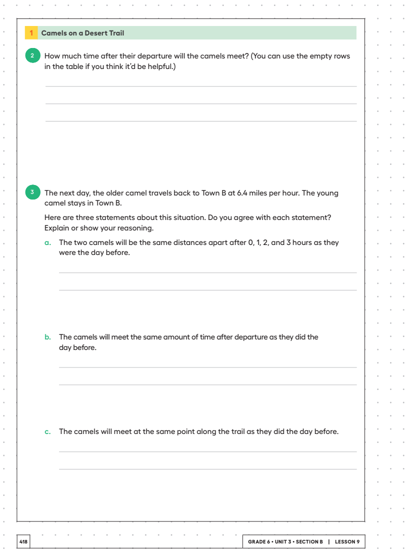
For each question, explain or show your reasoning.

1 How far apart will they be in 0, 1, 2, and 3 hours? Complete the first four rows of the table.

elapsed time (hours)	distance apart (miles)
0	
1	
2	
3	

Student Workbook


1 Camels on a Desert Trail

2 How much time after their departure will the camels meet? (You can use the empty rows in the table if you think it'd be helpful.)

3 The next day, the older camel travels back to Town B at 6.4 miles per hour. The young camel stays in Town B.

Here are three statements about this situation. Do you agree with each statement? Explain or show your reasoning.

a. The two camels will be the same distances apart after 0, 1, 2, and 3 hours as they were the day before.

b. The camels will meet the same amount of time after departure as they did the day before.

c. The camels will meet at the same point along the trail as they did the day before.

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2. How much time after their departure will the camels meet? (You can use the empty rows in the table if you think it'd be helpful.)

3.75 hours
Sample reasoning:

- After 3 hours, there are 4.8 miles left between the camels. If their distance apart shrinks by 6.4 miles each hour, then it shrinks by 1.6 miles in a quarter of an hour, 3.2 miles in a half hour, and 4.8 miles in three-quarters of an hour. $3 + 0.75 = 3.75$
- Using a table:

elapsed time (hours)	distance apart (miles)
0	24
1	17.6
2	11.2
3	4.8
3.5	1.6
3.75	0

- If the two camels cover 24 miles and the distance changes 6.4 miles each hour, then they meet in $24 \div 6.4$ or 3.75 hours.

3. The next day, the older camel travels back to Town B at 6.4 miles per hour. The young camel stays in Town B.

Here are three statements about this situation. Do you agree with each statement? Explain or show your reasoning.

Sample response: Each hour the total distance between them is decreasing by 6.4 miles, so the amount of time it will take them to meet is the same as if one camel stays put and the other travels at 6.4 miles per hour. However, the location of their meeting would change.

a. The two camels will be the same distances apart after 0, 1, 2, and 3 hours as they were the day before.

Agree
Sample reasoning: Since one camel stays in place and the other camel travels at 6.4 miles per hour, the distance between them shortens by 6.4 each hour, just as it did the day before.

b. The camels will meet the same amount of time after departure as they did the day before.

Agree
Sample reasoning: Since the distance between them shrinks at the same rate as before, they will still meet 3.75 hours after the older camel departs Town A.

c. The camels will meet at the same point along the trail as they did the day before.

Disagree
Sample reasoning: They will meet in Town B because the young camel stays there.

Building on Student Thinking

Some students may be unsure how to calculate distances apart. Ask them what quantities, besides elapsed time, might be needed to find the distances between the camels. Students are likely to mention how far the young camel and the older camel have each traveled. Encourage them to amend the table (or to create a new table) with two more columns to show those quantities. Here is an example:

elapsed time (hours)	distance traveled by young camel (miles)	distance traveled by older camel (miles)	distance apart (miles)

Are You Ready for More?

A horse departs from Town B at the same time as the older camel and also heads toward Town A. It meets the young camel 2.5 hours later. How fast was the horse going? Explain or show your reasoning.

6.2 miles per hour

Sample reasoning:

- In 2.5 hours, the young camel travels $(2.5) \cdot (3.4)$ or 8.5 miles. This means the horse travels $24 - 8.5$ or 15.5 miles in 2.5 hours. $15.5 \div 2.5 = 6.2$
- If the horse and the young camel meet in 2.5 hours, their distance apart shortens by $24 \div (2.5)$ or 9.6 miles each hour. Since the young camel walks at 3.4 miles per hour, this means that the horse travels at $9.6 - 3.4$, or 6.2, miles per hour.

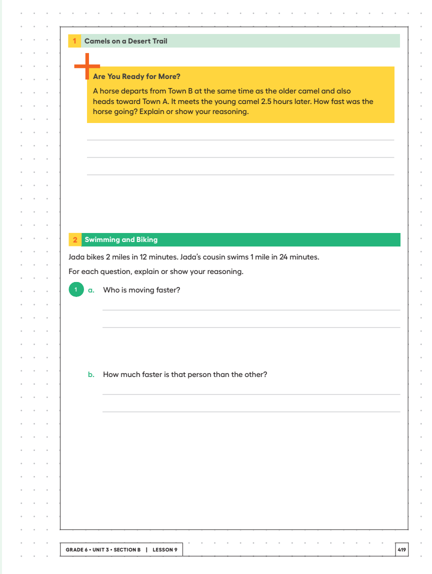
Activity Synthesis

Select previously identified students to share their responses to the question of when the two camels will meet. Start with students who use multiple steps and move toward those using more efficient strategies (as shown in the student responses).

Then invite other students to share their agreement or disagreement about the three statements in the last question and why they agree or disagree.

If not mentioned by students, highlight how the unit rate of 6.4 miles per hour applies in both situations. The rate at which the distance apart shrinks each hour is the same when the two camels were walking toward each other (at 3.4 miles per hour and 3 miles per hour) and when one was walking (at 6.4 miles per hour) and the other was stationary.

Student Workbook


1 Camels on a Desert Trail

Are You Ready for More?

A horse departs from Town B at the same time as the older camel and also heads toward Town A. It meets the young camel 2.5 hours later. How fast was the horse going? Explain or show your reasoning.

2 Swimming and Biking

Jada bikes 2 miles in 12 minutes. Jada's cousin swims 1 mile in 24 minutes.

For each question, explain or show your reasoning.

a. Who is moving faster?

b. How much faster is that person than the other?

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Instructional Routines

5 Practices

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Activity 2: Optional
Swimming and Biking

20 min

Activity Narrative

In this activity, students continue to practice working with rates in the context of constant speed. They can apply previously gained insights to solve problems about two people moving away from each other.

As in the previous activity, students can approach the problems in many ways, reason about different unit rates, and make sense of the situation by creating a drawing or diagram. No representations are given, though students may create tables—or double, triple, or quadruple number line diagrams—to support their thinking. (See student responses for examples.)

Monitor for students who use different rates to find out who—Jada or her cousin—travels faster. Students may compare:

- Elapsed time for the same distance (1 or 2 miles)
- Distance traveled in the same amount of time (12 or 24 minutes)
- Pace of each person (in minutes per mile or hours per mile)
- Speed of each person (in miles per hour or miles per minute)

When quantifying how much faster one person is than the other, some students may compare additively (7.5 more miles per hour or $\frac{1}{8}$ mile farther per minute) while others compare multiplicatively (4 times as fast). Both are valid ways to show understanding.

To find out how far apart the two people will be after a duration and when they will reach a certain distance apart, students may use individual pace or speed, or calculate the combined speed (the combined distance traveled per minute or hour).

Specifying the units and explaining the context for a rate gives students an opportunity to attend to precision.

Launch

Give students 5–6 minutes of quiet work time and then time to discuss their thinking with their group, if needed.

Select students who used each strategy described in the *Activity Narrative* to share later. Aim to elicit both key mathematical ideas and a variety of student voices, especially from students who haven't shared recently.

Student Task Statement

Jada bikes 2 miles in 12 minutes. Jada's cousin swims 1 mile in 24 minutes.

For each question, explain or show your reasoning.

1. **a.** Who is moving faster?

   Jada bikes faster than her cousin swims.

   Sample reasoning:

   - Since Jada bikes 2 miles in 12 minutes, she bikes 4 miles in 24 minutes. Her cousin swims only 1 mile in the same amount of time.
   - It takes Jada 6 minutes to bike 1 mile. It takes her cousin 24 minutes to swim the same distance.

   b. How much faster is that person than the other?

   Sample responses:

   - Jada is faster by 7.5 miles per hour. She travels 10 miles per hour. Her cousin travels 2.5 miles per hour.
   - Jada is faster by $\frac{1}{8}$ mile per minute. Jada's speed is $\frac{1}{6}$ mile per minute. Her cousin's speed is $\frac{1}{24}$ mile per minute. The difference is $\frac{1}{6} - \frac{1}{24}$ or $\frac{4}{24} - \frac{1}{24}$, which is $\frac{3}{24}$ or $\frac{1}{8}$.
   - Jada bikes 4 times as fast as her cousin swims. It takes Jada 6 minutes to travel 1 mile, and it takes her cousin 24 minutes, which is 4 times as long.

2. One day Jada and her cousin line up on the end of a swimming pier on the edge of a lake. At the same time, they start swimming and biking in opposite directions.

   a. How far apart will they be after 15 minutes?

   $3\frac{1}{8}$ or 3.125 miles

   Sample reasoning:

   Using tables:

time (minutes)	Jada's distance (miles)
12	2
24	4
60	10
15	2.5

Access for Students with Diverse Abilities (Activity 2, Student Task)

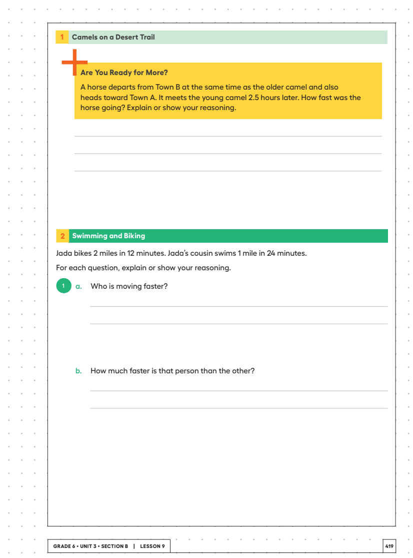
Representation: Access for Perception.
Invite students to act out the scenario of Jada biking while her cousin swims in the opposite direction.

Supports accessibility for: Language, Conceptual Processing

Building on Student Thinking

Some students may confuse the meaning of the speed and pace, thinking that 24 minutes per mile is faster than 6 minutes per mile. Ask them to check that the rates they calculated are labeled with the appropriate units. Then, prompt them to consider what the words "per mile" tell us about the situation.

Student Workbook


1 Camels on a Desert Trail

Are You Ready for More?

A horse departs from Town B at the same time as the older camel and also heads toward Town A. It meets the young camel 2.5 hours later. How fast was the horse going? Explain or show your reasoning.

2 Swimming and Biking

Jada bikes 2 miles in 12 minutes. Jada's cousin swims 1 mile in 24 minutes.

For each question, explain or show your reasoning.

1 a. Who is moving faster?

b. How much faster is that person than the other?

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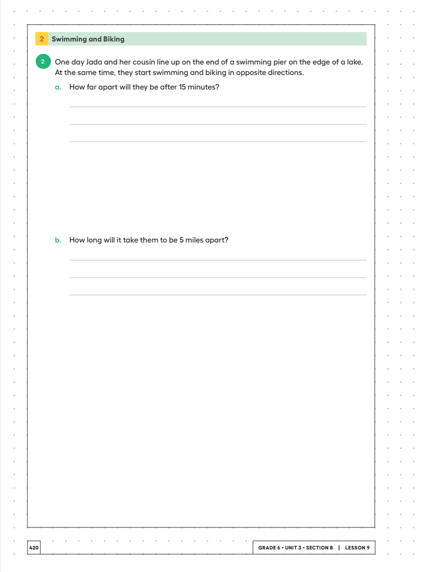
Student Workbook


2 Swimming and Biking

2 One day Jada and her cousin line up on the end of a swimming pier on the edge of a lake. At the same time, they start swimming and biking in opposite directions.

a. How far apart will they be after 15 minutes?

b. How long will it take them to be 5 miles apart?

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time (minutes)	Jada's cousin's distance (miles)
24	1
6	0.25
60	2.5
15	0.625

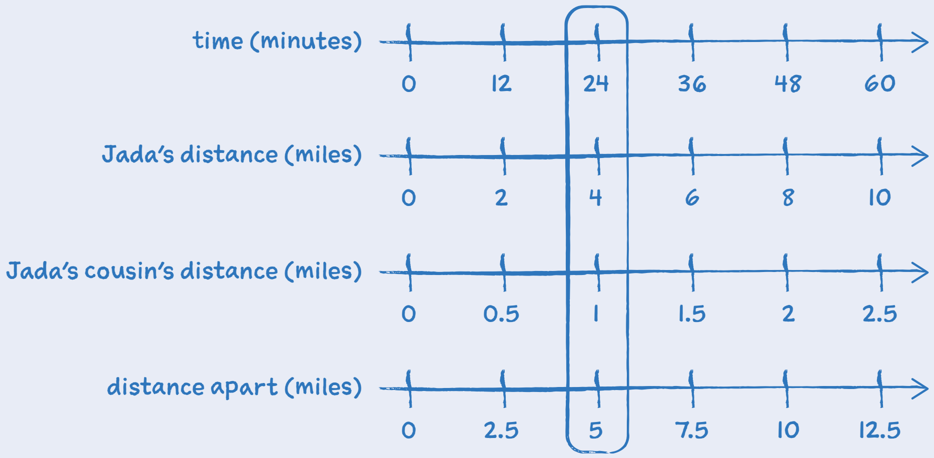
$2.5 + 0.625 = 3.125$

- Jada bikes $\frac{1}{6}$ mile per minute, so she bikes $\frac{15}{6}$ or $2\frac{1}{2}$ miles in 15 minutes. Her cousin swims $\frac{1}{24}$ mile per minute, so she swims $\frac{15}{24}$ or $\frac{5}{8}$ mile in 15 minutes. $2\frac{1}{2} + \frac{5}{8} = 3\frac{1}{8}$
- Jada bikes 10 miles per hour, so in $\frac{1}{4}$ hour, she bikes 2.5 miles. Her cousin swims 2.5 miles per hour, so in $\frac{1}{4}$ hour she swims $2.5 \div 4$, which is 0.625 mile. $2.5 + 0.625 = 3.125$

b. How long will it take them to be 5 miles apart?

24 minutes or 0.4 hour

Sample reasoning:



- Every 12 minutes Jada's distance from the pier increases by 2 miles and her cousin's distance increases by 0.5 mile. So every 12 minutes, the distance between them increases by 2.5 miles. In 24 minutes, they will be 5 miles apart.
- Jada and her cousin are moving away from each other at a rate of 12.5 miles per hour. $5 \div 12.5 = 0.4$, so it will take them 0.4 hour to be 5 miles apart.

Activity Synthesis

Invite previously selected students to share how they determined whether Jada or her cousin traveled faster and how much faster one is than the other. Sequence the strategies from most common to least common. If any student used a drawing or diagram to represent the situation, consider having them share first.

One key takeaway of the discussion is that students can find and use different rates or unit rates to solve problems. Some rates can be more helpful than others, depending on the question we are trying to answer. To emphasize these ideas, consider recording the rates that students mention, organizing them in a table, and displaying them for all to see:

<table>
<tr><th></th><th>Jada</th><th>Jada’s Cousin</th></tr>
<tr><td>elapsed time for the same distance</td><td>12 minutes for 2 miles</td><td>48 minutes for 2 miles</td></tr>
<tr><td>distance traveled in the same time</td><td>2 miles in 12 minutes
4 miles in 24 minutes</td><td>0.5 mile in 12 minutes
1 mile in 24 minutes</td></tr>
<tr><td rowspan="2">individual pace</td><td>6 minutes per mile</td><td>24 minutes per mile</td></tr>
<tr><td>$\frac{1}{10}$ hour per mile</td><td>$\frac{4}{10}$ hour per mile</td></tr>
<tr><td rowspan="2">individual speed</td><td>$\frac{1}{6}$ mile per minute</td><td>$\frac{1}{24}$ mile per minute</td></tr>
<tr><td>10 miles per hour</td><td>2.5 miles per hour</td></tr>
<tr><td rowspan="2">combined speed</td><td colspan="2">$\frac{5}{24}$ mile per minute</td></tr>
<tr><td colspan="2">12.5 miles per hour</td></tr>
</table>

To connect the discussion to the learning goals, consider asking questions such as:

- *“We found the distance between two people who were moving away from each other. How is that different from finding the distance between a moving person and a fixed point?”*

  The former involves combining two individual distances and thinking about two speeds.

- *“We figured out the speed at which Jada and her cousin each traveled from the pier. Can we find out how fast they are traveling away from each other? How?”*

  Yes, it is the sum of their individual speeds.

Access for Multilingual Learners (Activity 2, Synthesis)

MLR8: Discussion Supports. Display sentence frames to support students when they explain their strategy. For example, “First, I __________. Then, I ...” or “I know that __________ is moving faster because ...” Some students may benefit from the opportunity to rehearse what they will say with a partner before they share with the whole class.

Advances: Speaking, Representing

“Which rate or unit rate may be especially helpful for answering how far apart Jada and her cousin will be after 15 minutes? Why?”

their combined speed in miles per minute, which can be multiplied by 15, or the combined speed in miles per hour, which can be multiplied by $\frac{1}{4}$ or divided by 4

“Which rate or unit rate may be especially helpful for answering how long it will take them to be 5 miles apart? Why?”

individual distances traveled in 24 minutes, because they are 1 mile and 4 miles, which add up to 5 miles

Lesson Synthesis

To reiterate that a ratio of distance and time has two associated unit rates that we call speed (or distance per unit of time) and pace (time per unit of distance), ask students:

“Suppose an ant travels 40 centimeters in 8 seconds at a constant speed. What is its speed?”

5 centimeters per second

“What is its pace?”

$\frac{8}{40}$ or second per centimeter

“How is speed calculated?”

Divide distance by time, or 40 by 8, in this case

“How do we calculate pace?”

Divide time by distance, or 8 by 40, in this case

Then discuss how unit rates can be used to solve constant-speed problems such as those seen in the lesson. Consider asking:

“If we know the speed of an object, such as 5 centimeters per second, how can we use it to find the distance traveled in 12 seconds?”

Multiply the speed by 12, $12 \cdot 5 = 60$

“How is solving problems about the distance between two moving objects different from solving problems about one object?”

There are two unit rates and two distances to consider.

“Suppose two ants start at the same point. At the same moment, each ant moves away in opposite directions at a constant speed of 5 centimeters per second. How can we find their distance apart after 12 seconds?”

We can:

- find the distance of each ant in 12 seconds and add the two distances: $(12 \cdot 5) + (12 \cdot 5) = 60 + 60 = 120$
- find the distance between the two ants after 1 second and multiply that by 12: $12 \cdot 10 = 120$

Lesson Summary

We can describe how fast an object moves by its *speed* and *pace*.

- **Speed** tells us how far an object moves in a certain amount of time. We measure speed in units of distance per unit of time, like miles per hour or meters per second.
- **Pace** tells us how much time it takes an object to travel a certain distance. We measure pace in units of time per unit of distance, like hours per mile or seconds per meter.

A cyclist who bikes 20 kilometers in 2 hours has:

- A speed of 10 kilometers per hour.
- A pace of $\frac{1}{10}$, or 0.1, hour per kilometer.

distance (kilometers)	time (hours)
20	2
10	1
1	$\frac{1}{10}$

Speed and pace are the two unit rates describing a situation that involves a ratio of distance and time. They can help us compare the movements of objects that are each traveling at a constant speed.

Suppose two remote-control cars are racing at a constant speed from a starting line. Car A travels 24 meters in 8 seconds. Car B travels 50 meters in 20 seconds. Which car travels faster?

- The speed of Car A is $\frac{24}{8}$ or 3 meters per second. The speed of Car B is $\frac{50}{20}$ or 2.5 meters per second. Car A travels farther in 1 second, so it is faster.
- The pace of Car A is $\frac{8}{24}$ or $\frac{1}{3}$ second per meter. The pace of Car B is $\frac{20}{50}$ or $\frac{2}{5}$ second per meter. Car B takes more time to travel 1 meter, so it is slower.

How much farther is one car from the other 10 seconds after the start of the race? Because speed is a rate per 1 unit of time, we can multiply the amount of time by the speed to find the distance.

- Car A travels 30 meters ($10 \cdot 3 = 30$), and Car B travels 25 meters from the start line ($10 \cdot 2.5 = 25$). Ten seconds after the start of the race, Car A has traveled 5 meters farther than Car B has traveled.

Student Workbook

Responding To Student Thinking

More Chances
Students will have more opportunities to understand the mathematical ideas addressed here. There is no need to slow down or add additional work to the next lessons.

Cool-down

5 min

Penguin Speed

Student Task Statement

An adult penguin and a baby penguin are standing together. They start walking at the same time and in the same direction.

The adult penguin walks 9 feet in 6 seconds. The baby penguin walks 15 feet in 9 seconds. They both walk for 30 seconds.

At these rates, how far apart will they be when they stop? Explain or show your reasoning.

They will be 5 feet apart.

Sample reasoning:

- The adult penguin walks 45 feet in 30 seconds. The baby penguin walks 50 feet in 30 seconds. $50 - 45 = 5$

time (seconds)	adult penguin (feet)
6	9
30	45

time (seconds)	baby penguin (feet)
9	15
3	5
30	50

- The adult penguin walks $\frac{9}{6}$ or $\frac{3}{2}$ feet per second and $30 \cdot \frac{3}{2} = 45$. The baby penguin walks $\frac{15}{9}$ or $\frac{5}{3}$ feet per second and $30 \cdot \frac{5}{3} = 50$. The difference is 5 feet.

Lesson 9

Practice Problems

6 Problems

Problem 1

A kangaroo hops 2 kilometers in 3 minutes. At this rate:

a. How long does it take the kangaroo to travel 5 kilometers?

7.5 minutes (or equivalent)

b. How far does the kangaroo travel in 2 minutes?

$\frac{4}{3}$ kilometers (or equivalent)

Problem 2

Mai runs around a 400-meter track at a constant speed of 250 meters per minute. How many minutes does it take Mai to complete 4 laps of the track? Explain or show your reasoning.

$\frac{32}{5}$ minutes (or equivalent)

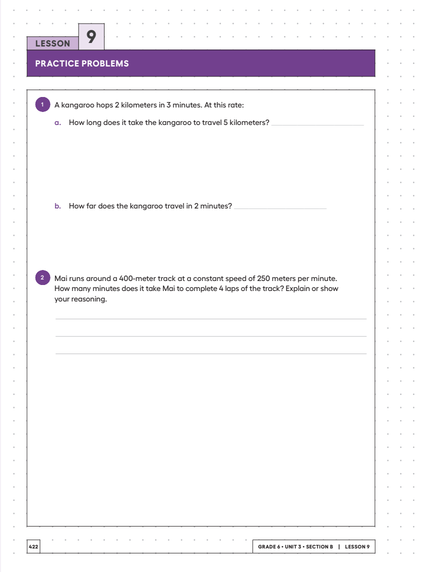
Sample reasoning:

- Using a table:

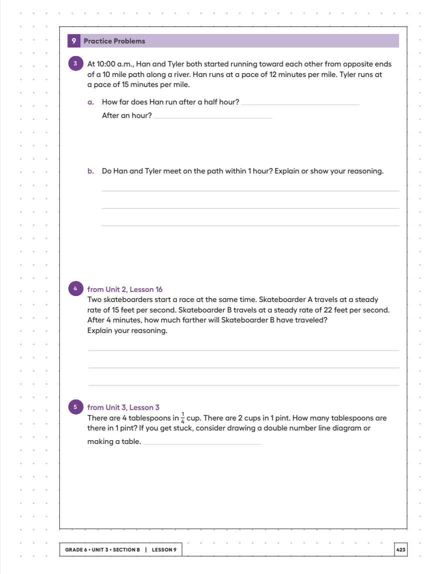
distance (meters)	time (minutes)
250	1
500	2
400	1.6
1,600	6.4

- If each lap is 400 meters, then Mai runs 1,600 meters in 4 laps. Since every 250 meters takes her 1 minute to run, it would take her 1,600 ÷ 250 or 6.4 minutes to run 1,600 meters.

Student Workbook


LESSON 9
PRACTICE PROBLEMS
1 A kangaroo hops 2 kilometers in 3 minutes. At this rate:
a. How long does it take the kangaroo to travel 5 kilometers?
b. How far does the kangaroo travel in 2 minutes?
2 Mai runs around a 400-meter track at a constant speed of 250 meters per minute. How many minutes does it take Mai to complete 4 laps of the track? Explain or show your reasoning.

Student Workbook



Problem 3

At 10:00 a.m., Han and Tyler both started running toward each other from opposite ends of a 10-mile path along a river. Han runs at a pace of 12 minutes per mile. Tyler runs at a pace of 15 minutes per mile.

a. How far does Han run after a half hour? After an hour?

Han runs $2\frac{1}{2}$ miles in a half hour and 5 miles in an hour.

Sample reasoning:

time (minutes)	distance (miles)
12	1
1	$\frac{1}{12}$
30	$2\frac{1}{2}$
60	5

b. Do Han and Tyler meet on the path within 1 hour? Explain or show your reasoning.

No

Sample reasoning: Tyler travels 1 mile every 15 minutes, so he travels 4 miles in 60 minutes. Because Han travels 5 miles and Tyler travels 4 miles, and they are 10 miles apart, they are one mile apart after 1 hour.

Problem 4

from Unit 2, Lesson 16

Two skateboarders start a race at the same time. Skateboarder A travels at a steady rate of 15 feet per second. Skateboarder B travels at a steady rate of 22 feet per second. After 4 minutes, how much farther will Skateboarder B have traveled? Explain your reasoning.

Skateboarder B will have traveled 1,680 feet farther. Sample reasoning: There are 240 seconds in 4 minutes, because $4 \cdot 60 = 240$. Skateboarder A travels 240 times 15, or 3,600 feet in 4 minutes. Skateboarder B travels 240 times 22, or 5,280 feet in 4 minutes. $5{,}280 - 3{,}600 = 1{,}680$.

Problem 5

from Unit 3, Lesson 3

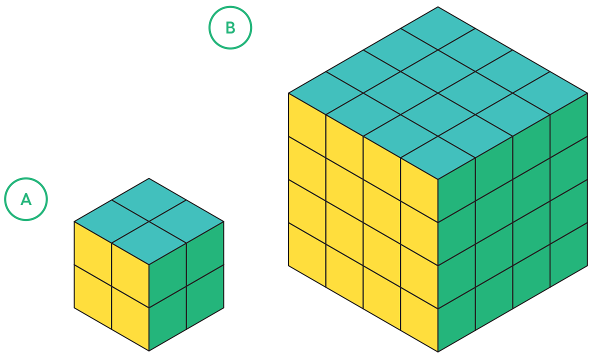
There are 4 tablespoons in $\frac{1}{4}$ cup. There are 2 cups in 1 pint. How many tablespoons are there in 1 pint? If you get stuck, consider drawing a double number line diagram or making a table.

32 tablespoons

Problem 6

from Unit 1, Lesson 12

Two larger cubes are made out of unit cubes. Cube A is 2 by 2 by 2. Cube B is 4 by 4 by 4. The side length of Cube B is twice that of Cube A.



a. Is the surface area of Cube B also twice that of Cube A? Explain or show your reasoning.

No

Sample reasoning: The surface area of Cube A is $6 \cdot (2 \cdot 2)$ or 24 square units. The surface area of Cube B is $6 \cdot (4 \cdot 4)$ or 96 square units. The surface area of B is 4 times that of A.

b. Is the volume of Cube B also twice that of Cube A? Explain or show your reasoning.

No

Sample reasoning: The volume of Cube B is 64 cubic units because $4^3 = 64$. The volume of Cube A is 8 cubic units because $2^3 = 8$. When compared, 64 is not twice as much as 8.

Student Workbook