# Riding at a Constant Speed, Assessment Variation

Sample task from achievethecore.org
By Illustrative Mathematics and Student Achievement Partners

GRADE LEVEL Sixth

IN THE STANDARDS 6.RP.A.2, 6.RP.A.3

WHAT WE LIKE ABOUT THIS TASK

Mathematically:

- Provides a simply stated, yet mathematically rich task.
- Requires students to think about proportional relationships flexibly and with different units.
- Engages students with precise use of language (MP6) while interpreting ratios mathematically and in the context of the task (MP2).

In the classroom:

- Offers teachers an opportunity to analyze the student work required to answer this task.
- Gives students the opportunity to thoughtfully select the method they will use to solve the task (e.g., table of equivalent ratios, plotting points in the coordinate plane, double number line diagrams, equations) (MP5).
- Allows for both individual and group work, depending on the needs of the class.

This task was designed to include specific features that support access for all students and align to best practice for English Language Learner (ELL) instruction. Go here to learn more about the research behind these supports. This lesson aligns to ELL best practice in the following ways:

- Provides opportunities for students to practice and refine their use of mathematical language.
- Allows for whole class, small group, and paired discussion for the purpose of practicing with mathematical concepts and language.
- Includes a mathematical routine that reflects best practices to supporting ELLs in accessing mathematical concepts.
- Provides students with support in negotiating written word problems through multiple reads and/or multi-modal interactions with the problem.
- Develops meta-awareness of the language used in mathematical questions and problems.

MAKING THE SHIFTS[1]

| | |
|---|---|
| Focus | Belongs to the Major Work[2] of grade 6 |
| Coherence | Provides foundational work for learning about proportional relationships in grade 7 (see Molly's Run) |
| Rigor[3] | Conceptual Understanding: primary in this task |
| | Procedural Skill and Fluency: not targeted in this task |
| | Application: primary in this task |

[1]For more information read Shifts for Mathematics.
[2]For more information, see Focus in Grade Six.
[3]Tasks will often target only one aspect of rigor.

## INSTRUCTIONAL ROUTINE

*The steps in this routine are adapted from the Principles for the Design of Mathematics Curricula: Promoting Language and Content Development.*

Engage students in the Co-Craft Questions and Problems Mathematical Language Routine as they work through this task to allow students to get inside the context before the added pressure of producing answers.

Students will develop meta-awareness of the language used in mathematical questions and problems. Teachers support this by pushing for clarity and revoicing oral responses. Students will need to attend to both ratios (20:150 and 150:20) and both associated unit rates 20/150 and 150/20 in this task.

Co-Craft Questions:

1. Present Situation: Lin rode a bike 20 miles.
2. Students Write: Students write questions that could be answered by doing math (particularly around ratio reasoning). They can also ask questions about the situation. These could include context questions, information that is missing, or important assumptions.
3. Pairs compare: In pairs, students compare their questions.
4. Students Share: Students share their questions and briefly discuss.
5. Reveal: Share that Lin rode 20 miles in 150 minutes at a constant speed. Pause to allow students to determine if that information can help them solve the questions they generated. Finally, share the four questions from the task. Students should then solve the four questions and have an opportunity to discuss their solutions strategies with partners or in a full class discussion

Optional: After solving and discussing, support students as they co-craft problems similar to this task.

Co-Craft Problems:

1. Pairs Create New Problems: With a partner, students co-create problems that are similar to this task.
2. Students Solve their own problems: Students will solve their own problems using solution strategies and representations that make sense to them.
3. Exchange Problems: Student solve the problems created by other pairs. They then share their solutions and methods with the pair who created the problem.
4. Topic Support: If necessary, the class can brainstorm possible contexts of interest before pairing up.

## LANGUAGE DEVELOPMENT

Ensure students have ample opportunities in instruction to read, write, speak, listen, and understand the mathematical concepts that are represented by the following terms and concepts:

- Constant Speed
- Per

Students should engage with these terms and concepts in the context of mathematical learning, not as a separate vocabulary study. Students should have access to multi-modal representations of these terms and concepts, including: pictures, diagrams, written explanations, gestures, and sharing of non-examples. These representations will encourage precise language, while prioritizing students' articulation of concepts. These terms and concepts should be reinforced in teacher instruction, classroom discussion, and student work

ELLs may need support with the following vocabulary words during the classroom discussion:

- Far
- Long
- Fast
- Pace

ADDITIONAL THOUGHTS

As noted in the Commentary below, this task is the second in a set of three tasks. It's interesting to view the two grade six tasks side-by-side, as The Escalator focuses primarily on conceptual understanding of ratios and rates, while this task, Riding at a Constant Speed, focuses primarily on application of ratio and rate reasoning to solve problems. The third task in this set, Molly's Run, illuminates the heightened expectations of this domain for grade 7 (i.e., students work with ratios specified by rational numbers).

For more insight into the expectations for ratio and rate reasoning in grade six, read pages 5–7 of the progression document, *6–7, Ratios and Proportional Relationships*, available at www.achievethecore.org/progressions.

For more analysis on this task from an assessment perspective, please read the Cognitive Complexity section on the Illustrative Mathematics site.

# 6.RP Riding at a Constant Speed, Assessment Variation

## Task

Lin rode a bike 20 miles in 150 minutes. If she rode at a constant speed,

a. How far did she ride in 15 minutes?

b. How long did it take her to ride 6 miles?

c. How fast did she ride in miles per hour?

d. What was her pace in minutes per mile?

## Commentary

This task is part of a joint project between Student Achievement Partners and Illustrative Mathematics to develop prototype machine-scorable assessment items that test a range of mathematical knowledge and skills described in the CCSSM and begin to signal the focus and coherence of the standards.

## Task Purpose

This task is part of a set of three assessment tasks that address various aspects of 6.RP domain and help distinguish between 6th and 7th grade expectations.

While simply constructed, 6.RP The Escalator addresses aspects of both 6.RP.1 "Understand the concept of a ratio" and 6.RP.2 "Understand the concept of a unit rate a/b associated with a ratio a:b with b≠0, and use rate language in the context of a ratio relationship." The simple extension of a traditional multiple choice item to a "choose all that apply" allows us to ask questions about the same context from the different perspectives afforded by the different RP standards in 6th grade.

6.RP Riding at a Constant Speed addresses aspects of 6.RP.2 "Understand the concept of a unit rate a/b associated with a ratio a:b" and 6.RP.3 "Use ratio and rate reasoning to solve real-world and mathematical problems." The numbers are chosen so that it would be easy to implement this task as a fill-in-the-blank item.

On the other hand, 7.RP Molly's Run is meant to contrast directly with "6.RP Riding at a Constant Speed" as it is the natural extension of the work that students do related to 6.RP.2. In sixth grade, the standards are clear that ratios need to have whole numbers for a and b. With the introduction of rational number arithmetic in 7.NS, the standards place an emphasis on ratios that have fractions within a given ratio; 7.RP.1 requires students to "compute unit rates associated with ratios of fractions."

## Cognitive Complexity

**Mathematical Content**

The mathematics in "6.RP The Escalator" is more complex than it appears. The distractors are placed in a particular order. Students might choose (c) after (correctly) choosing (a) because they look similar. The three correct answers are purposefully interrupted by an incorrect choice, and (e) is included for students who subtract rather than divide.

"6.RP Riding at a Constant Speed" requires students to attend to both ratios (20:150) and (150:20) and both associated unit rates $\frac{20}{150}$ and $\frac{150}{20}$ that are implicit in the given context. Thus, this task is complex for 6th grade.

"7.RP Molly's Run" is a straight-forward extension of the work that students do in 6th grade. The only difference is that students now work with ratios defined by fractions rather than just whole numbers. Thus, this task is not mathematically complex except for students who are still struggling with fractions.

**Mathematical Practice**

Especially in 6th grade, the cognitive load associated with making sense of units in proportional relationships is heavy; the first two tasks in this set engage MP6, Attend to precision.

The third task does not engage any of the MPs any more than they are present in the day-to-day mathematical work of students.

**Linguistic Demand**

The linguistic demand for all three tasks is low.

**Stimulus Material**

The stimulus material for all three tasks is not complex.

**Response Mode**

The response mode for all three tasks is not complex.

## Solutions

Solution: 1

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| Number of Minutes | 150 | 15 | 7.5 | 30 | 45 | 60 |
| Number of Miles | 20 | 2 | 1 | 4 | 6 | 8 |

The values in column B were found by dividing both values in column A by 10. The values in column C were found by dividing both values in column B by 2. The other columns contain multiples of the values in column B.

a. If we look in column B, we can see that she could ride 2 miles in 15 minutes.

b. If we look in column E, we can see that it would take her 45 minutes to ride 6 miles.

c. If we look in column F, we can see that she is riding 8 miles every 60 minutes (which is 1 hour), so she is riding her bike at a rate of 8 miles per hour.

d. If we look in column C, we can see that her pace is 7.5 minutes per mile.

This is a four-point item.

Solution: 2

a. She could ride 1 mile in 7.5 minutes and 2 miles (1 + 1) in 15 minutes (7.5 + 7.5).

b. She rides 150/20 minutes per mile which is 7.5 minutes per mile. So it would take her 45 minutes to ride 6 miles because 6 × 7.5 = 45.

c. If she rides 2 miles in 15 minutes, then she can ride 4 miles in 30 minutes and 8 miles per hour. d. She rides 7.5 minutes per mile.