Delivering the Mail, Assessment Variation

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

GRADE LEVEL Eighth

IN THE STANDARDS 8.F.B.4

WHAT WE LIKE ABOUT THIS TASK

Mathematically:

- Requires students to have facility with all the major components of a linear function: initial value, rate of change, and how they relate to the description of a relationship (8.F.B.4).
- Builds on work with variables and equations from seventh grade (see 7.EE.B.4).
- Engages students in specifying units of measure, requiring attention to precision (MP6).

In the classroom:

- Offers opportunity for students to share their developing thinking and understanding of interpreting functions and parts of functions.
- Offers students and teachers an opportunity to see an assessment-type task with the possibility of three different technology-enhanced response types.
- Allows opportunities for extending the task to deepen student understanding. (See Additional Thoughts below.)

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.
- Elicits evidence of student thinking both verbally and in written form.
- 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.

MAKING THE SHIFTS[1]

Focus	Belongs to the Major Work[2] of eighth grade
Coherence	Builds on grade 7 work with expressions and equations; prepares students for more advanced modeling in high school
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 8.
[3] Tasks will often target only one aspect of rigor.

For a direct link, go to: http://www.achievethecore.org/page/881/delivering-the-mail-assessment-variation

INSTRUCTIONAL ROUTINE

Engage students in both the Three Reads and Connecting Representations Instructional Routines for this task.

The Three Reads routine is designed to develop students' ability to make sense of problems by deconstructing the process of reading mathematical situations. Over time, students will internalize this process, thereby creating a heuristic for reading and making sense of mathematical story problems.

Task is read three times each time with a different purpose:

> First read: teacher reads the task to the class and asks students to think about what the task is about. Students offer responses: "This problem is about _____"
>
> Second read: problem is projected. One student reads the task out loud and students follow along thinking about the question being asked. Students turn and talk to their partner and rephrase the question(s) in their own words. Questions are shared in the full group and recorded by the teacher.
>
> Third read: problem is still projected. Students read problem out loud in their partner groups and begin to name the important information. Important information is shared out by students and recorded by the teacher.

Facilitate the discussion of the equation by using the Connecting Representations Instructional Routine. This routine positions students to think structurally as they connect the context of a problem to the terms of an equation.

Display the task equation three times with specific terms highlighted[1] and two statements from part d of the task that refer to the context of the problem:

y = **14**x + 75362
y = 14x + **75362**
y = 14**x** + 75362

The number of miles Joshua drives the truck each day he works.

The mileage at the beginning of Joshua's first day of work.

Ask students to think about the highlighted terms in each equation and the two statements and then share any connections they are beginning to make with a partner. Partners build off one another's thinking and continue to solidify connections between the equation and meaning of its terms.

Partners justify their connection with each other and then with the full class. Assign one student the role of pointer and one student the role of speaker to begin to share and study the connections in the full class. This process encourages the student who is speaking to be precise with language, the student who is pointing to gesture accurately, and the whole class to understand the meaning of the share-out.

Annotate the equations and the statements to highlight the structural connections between the corresponding terms (for example, "14" and "the number of miles Joshua drives the truck each day" can be underlined with the same color marker). Discuss where the miles driven each day appears in the equation, where the total miles driven appears, etc.

After students accurately connect the equation with the highlighted terms to the two statements they represent, there should be one equation remaining. Prompt students to create their own statement to

[1] Other choices to highlight in the third equation may include: y = **14x** + 75362 or y = **14x + 75362** depending on your lesson goal and group of students.

describe what the highlighted element of the remaining equation represents in the context of the problem (think, pair, share). Select one student statement to share, discuss, and annotate with the full class.

Finally, facilitate a reflection process that allows students to identify new mathematical understandings (e.g., identifying the variable and understanding the starting point are strategies to make meaning of the equation). Create a public record of the reflections generated in the room for future reference.

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:

- Mail truck travels
- Not used
- Mileage
- Express
- Linear Function
- Appears
- Interpretation
- Each
- Beginning

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.

ADDITIONAL THOUGHTS

As noted in the Commentary below, this task is the first in a set of two tasks. It's interesting to view the two tasks side-by-side, as this task addresses a relationship that is linear while US Airports addresses statistical data that can be approximated to a linear relationship through the use of a model.

There are many ways this task could be extended to deepen students' understanding of functions. Teachers may want to ask students to relate this function to the equation $y = mx + b$ and discuss how the slope and y intercept are interpreted in the context of this task (8.F.A.3). Students could also graph the function and describe various points that lie on the graph, again in the context of the task (8.F.B). Teachers could also give students an additional function (represented in a different way) and have the students compare the properties of that function to the function represented in this task (8.F.A.2).

For more insight on the expectations for functions in grade 8, read pages 5 and 6 of the progression document*, Grade 8, High School, Functions*, available at www.achievethecore.org/progressions.

For more insight on the distinctions between equations and functions, read pages 2 and 3 of the progression document, *High School, Algebra*, available at www.achievethecore.org/progressions.

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

8.F Delivering the Mail, Assessment Variation

Task

Joshua's mail truck travels 14 miles every day he works, and is not used at all on days he does not work. At the end of his 100th day of work the mail truck shows a mileage of 76,762.

a. Fill in the blanks to express the mileage y as a linear function of the number of days x that Joshua has worked:

$$y = [\text{blank } 1]x + [\text{blank } 2].$$

b. What are the units of the number [the number the student typed into in blank 1] that appears in your equation?

c. What are the units of the number [the number the student typed into in blank 2] that appears in your equation?

d. Which of the following is a correct interpretation of the number [the number the student typed into in blank 1] that appears in your equation? (Select all that apply.)

i. The mileage at the end of Joshua's first day of work.

ii. The number of miles Joshua drives the truck each day he works.

iii. The mileage at the beginning of Joshua's first day of work.

iv. The number of days Joshua works for each mile he drives.

v. The number of miles Joshua drives at work over 100 days.

e. In this context, which of the following is a correct interpretation of the number [the

number the student typed into in blank 2] that appears in your equation? (Select all that apply.)

i. The mileage at the end of Joshua's first day of work.

ii. The number of miles Joshua drives the truck each day he works.

iii. The mileage at the beginning of Joshua's first day of work.

iv. The number of days Joshua works for each mile he drives.

v. The number of miles Joshua drives at work over 100 days.

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.

Purpose

This is one of two assessment tasks illustrating the similarities and differences between the 8th grade standards in Functions and in Statistics and Probability. The first, 8.F Mail Truck, involves a situation that can be modeled exactly with a linear function. The second, 8.SP US Airports, uses a linear function to model a relationship between two quantities that show statistical variation and do not have an exact linear relationship.

In 8.SP US Airports, each additional person in the state does not directly correspond to a portion of an airport, but the relationship can be modeled using a linear association, and the model can be used to make predictions about the number of airports in states with a given population. In 8.F Mail Truck, each additional day of driving does correspond to exactly the same increase in the number of miles put onto the truck each day.

Cognitive Complexity

Mathematical Content

This task involves constructing a linear function and interpreting its parameters in a context. Thus, this task has a medium level of complexity.

Mathematical Practice

The task asks students to reason abstractly and quantitatively (MP 2) and directly assesses component skills related to mathematical modeling (MP 4), namely, interpreting mathematical objects in contexts.

Linguistic Demand

This context in this task requires students to interpret the mathematics in this context, so has a high level of linguistic complexity.

Stimulus Material

The stimulus material is not complex.

Response Mode

The interface is not complex.

Solution: 1

a. $y = 14x + 75{,}362$.

b. miles/day

c. miles

d. (ii)

e. (iii)

This is a 2-point item: 1 point for parts (a)-(c) and 1 point for parts (d) and (e).