



Central math concepts

By high school, converting units is a proceduralized skill—especially as applied in science coursework and laboratory work. In the elementary and middle grades, however, “converting units” is a thoughtful process of multiplicative reasoning that involves recognizing how many times-as-much a certain unit is than another unit. This reasoning might be fairly abstract or fairly concrete depending on the kind of quantity under consideration, ranging from [base quantities](#) such as length, mass, and time to derived quantities such as area, volume, speed, and force.

Grade 4 problems involve expressing measurements in a larger unit in terms of a smaller unit ([CCSS 4.MD.A.1](#)), within a single system of measurement. In such cases, the larger unit will be a whole-number multiple of the smaller unit. For task 4:11 in particular, weight is measured in both pounds and ounces. As measured by a calibrated scale, 1 pound weighs 16 times as much as 1 ounce. Therefore, a quantity of 45 pounds weighs 45×16 ounces. This is not the application of a remembered rule (“To convert pounds to ounces, multiply by 16”) but rather the application of multiplication thinking to a remembered fact (1 pound is 16 ounces).

Unit thinking is prevalent throughout arithmetic, not just in the measurement domain. The idea of a unit is a coherent and unifying theme in school mathematics.[†] In task 4:11 for example, 6 ounces of cheese could be viewed as a unit, “1 pizza’s worth of cheese.” From this perspective, a final division step solves task 4:11 by measuring the kitchen’s cheese supply in units of pizzas.



Relevant prior knowledge

The following mathematics knowledge may be activated, extended, and deepened while students work on the task: multiplying by a unit fraction; applying ideas of times-as-much in context; and basing multiplicative reasoning on math diagrams.



Extending the task

How might students drive the conversation further?

- Knowing that 45 pounds of cheese will make 120 pizzas with 6 ounces of cheese on each pizza, students could consider such questions as
 - What if the kitchen had 90 pounds of cheese instead of 45 pounds? How many pizzas would that make?
 - What if there were 3 ounces of cheese on each pizza instead of 6 ounces? How many pizzas would 45 pounds of cheese make in that case?
- Intuitive answers to questions like these could be checked by calculation.

4:11 A cook in the school kitchen uses 6 oz of cheese to make a pizza. The kitchen has 45 lb of cheese. How many pizzas will that make?

Answer

120.

[Click here](#) for a student-facing version of the task.

Refer to the Standards

4.MD.A.2, 4.NBT.B.5; MP.1, MP.4. Standards codes refer to www.corestandards.org. One purpose of the codes is that they may allow a task to shed light on the Standards cited for that task. Conversely, reading the cited Standards may suggest opportunities to extend a task or draw out its implications. Finally, Standards codes may also assist with locating relevant sections in curriculum materials, including materials aligned to comparable standards.

Aspect(s) of rigor:

Application

Additional notes on the design of the task

The numbers in the problem are such that they provide opportunities for grade-level procedures such as calculating 45×16 and $720 \div 6$.

Curriculum connection

1. In which unit of your curriculum would you expect to find tasks like 4:11? Locate 2–3 similar tasks in that unit. How are the tasks you found similar to each other, and to 4:11? In what specific ways do they differ from 4:11?
2. Thinking about the curriculum unit you identified, at what point in the unit might a task like 4:11 help students converge toward grade-level thinking about the important mathematics in the task? What factors would you consider in choosing when to use such a task in the unit?*



Related Math Milestones tasks

4:2

4.2 Write the values of the products and quotients. Check the quotients by multiplying.

Mentally	40×20	With pencil and paper
	$30 \div 3$	$6,352 \div 48$
	12×60	$8 \div 32$
	$5 \div 10$	$7 \overline{) 8,722}$
	$480 \div 8$	

(1) Find the three missing lengths and write them on the diagram. Compare answers with a classmate.
 (2) What is the total area of the diagram?
 (3) Look for connections between the diagram and the division problem. What connections can you see?

4:10

4.10 The pickup truck can carry $1\frac{1}{2}$ tons. The super hauler truck can carry 200 tons as much. How many tons can the super hauler truck carry?

4:1

4.1 A tablespoon holds 15 ml of olive oil, which is 3 times as much as a teaspoon holds. How many ml of olive oil does a teaspoon hold?
 Equation model: _____
 Answer: _____

Calculations like those involved in task 4:1 are included from a conceptual point of view in task **4:2 Multi-Digit Division Concepts** and from a procedural point of view in task **4:10 Calculating Products and Quotients**. Task **4:12 Super Hauler Truck** is a word problem involving multiplicative comparison (situation type [Compare with Larger Unknown](#)), and task **4:1 A Tablespoon of Oil** is a word problem involving multiplicative comparison (situation type [Compare with Smaller Unknown](#)) that happens to involve quantities in common use as kitchen measurements.

5:3

5.3 A neighborhood garden will have 6 wooden planting boxes. Every box will have the same shape (see diagram). Soil can be bought by the truckload; a truckload is 54 ft³ of soil. How many truckloads of soil will fill all of the boxes?

6:4

6.4 My car drives 570 mi with 15 gal of gas.
 (1) *Mental math/Pencil and paper* (a) If I drive 57 mi, I'll use ___ gal. (b) If I drive 5,700 mi, I'll use ___ gal. (c) If I have 9 gal left, I can drive ___ more mi. (d) I can drive ___ mi with 30 gal. (2) *Calculator* Calculate both unit rates for the proportional relationships. (3) (a) If I drive 532 mi, I'll use ___ gal. (b) If I have 1 gal left, I can drive ___ more mi. (4) Make a two-column table using your answers to (1a), (1c), (1d), (3a), and (3b). Then use graph paper to plot the values in the table. Label the axes of your plot.

7:6

7.6 Car A and Car B were moving at constant speed, as shown in the graphs.

Car A and Car B were moving at constant speed, as shown in the graphs. (1) At the end of the first minute, how many miles had each car moved? (2) Which car was moving faster? (3) For the faster car, write a formula for the number of miles moved in n minutes. (4) How many miles does the faster car move in 10 minutes?

7:7

7.7 If the speed limit in Canada is 100 km/hr and you are driving 65 mph, are you over or under the limit? By how much?

In later grades, task **5:3 Neighborhood Garden** involves two different units of measure for volume, with the larger unit being more convenient for solving the problem. Proportional relationships in tasks such as **6:4 Gas Mileage** involve derived quantities, and rates are compared in tasks **7:6 Car A and Car B** and **7:7 Speed Limit**.

3:1

3.1 There are five teams in the volleyball league. Every team has six players. How many players are in the volleyball league?
 Equation model: _____
 Answer: _____

3:2

3.2 The picture shows a dog sleeping on a rug. The rug design is a rectangular array of squares with a dot in each square.

Below are four expressions. One expression equals the total number of dots in the rug design. Which expression equals the total number of dots in the rug design? Tell how you decided.
 12×14 , 11×14 , 12×15 , 11×15

3:4

3.4 Jasmine bought 45 corn seeds. She arranged the seeds into piles of 9 seeds each. How many piles were there?
 Equation model: _____
 Answer: _____

3:9

3.9 Our class painted pictures. The teacher will hang the pictures on 4 bulletin boards. The teacher will hang the same number of pictures on each board. How many pictures will be on each board? There are 32 pictures to hang.

In earlier grades, tasks such as **3:1 Volleyball Players**, **3:2 Hidden Rug Design**, **3:4 Corn Seeds**, and **3:9 Bulletin Board Pictures** focus on the equal-groups concept of multiplication that is the precursor of times-as-much thinking.


† See Zimba (2013), "Units, a Unifying Theme in Measurement, Fractions, and Base Ten."

* Math Milestones™ tasks are not designed for summative assessment. Used formatively, the tasks can reveal and promote student thinking.



Anticipating and responding to student thinking about the task

Imagine how students might think about the task, and what you might see and hear while they work.

On this page, you can write your thoughts on the following questions. 

Solution Paths

- What solution paths might you expect to see?
- What representations might you see? What correspondences between those representations might be noticed by students (or be worth pointing out to students) and discussed by them?
- What misconceptions or partial understandings might be revealed as students work on the task? How could you respond to these positively and productively?

Language

- What might you expect to hear from students engaged with the task? What does that language reveal about their mathematical thinking, and how might you respond to different ways of thinking?
- If students are using early English or using multiple languages in an integrated communication system, how might you help their classmates see those mathematical ideas as valuable?
- Even when using nascent language, students are thinking and communicating their thinking. What might it look like to respond positively and productively to the mathematics in their thinking before giving feedback on the language used?

Identity, Agency, and Belonging

- How can you engage students' interests, experiences, or funds of knowledge?
- How can you build students' self-confidence as learners, thinkers, and doers of mathematics?
- What choices are there for a student to make in the task? How can you build students' agency to the point where they notice and make these choices to solve problems?
- How might one use feedback to build student agency? Where might there be opportunities to build students' self-confidence?