5:12 Rain Measurements

Teacher Notes

Math Milestones™

Central math concepts

Students' data work in the upper-elementary grades concentrates on measurement data displayed in line plots.[†] In a line plot like the one shown in task 5:12, the "x" symbols are the individual data points.[‡]

The number line diagram in a line plot corresponds to the scale on the measurement tool that was used to generate the data. In task 5:12, the measurements are liquid volumes in liters, but if the measurements had been masses, for example, then the units on the scale would be kilograms or another unit of mass.

As for the vertical scale on a line plot, a vertical scale isn't shown on the line plot in task 5:12, but if a vertical scale had been shown, then it would be a count scale, meaning that the tick marks on the vertical scale would be the numbers 0, 1, 2, 3, and so on, indicating the number of observations above each tick mark.

Interpreting a line plot involves grasping the correspondence between an "x" symbol or dot, its horizontal position on the measurement scale, and what fact about the situation is being thereby recorded. For example, the leftmost "x" symbol records the fact that one of the baking pans set out by the teacher collected $\frac{5}{8}$ of a liter of water.

From the individual data points (the "x" symbols), students can count to find the total number of observations, 6, which is one numerical summary of the data—and also the number of pans set out by the teacher.

There are close connections in every elementary grade between students' data work and their expanding use of numbers and operations in context; see Table 1, p. 4 of the relevant *Progression* document for a list of these connections in grades K–5. Students' work in representing and analyzing measurement data connects directly to their growing number sense of fractions and to their increasing ability to operate with fractions to solve problems in context. In task 5:12, students use a number line diagram marked in eighths. They use addition to determine the total volume of water collected, in liters. And they use division to determine the answer to the unknown factor problem 6 × ? = 6, where the factor on the left-hand side corresponds to the number of baking pans, the result on the right corresponds to the number of liters in all, and the unknown factor is the number of liters in one pan.

As the *Guidelines for Assessment and Instruction in Statistics Education Report* notes, "data are not just numbers, they are numbers with a context. In mathematics, context obscures structure. In data analysis, context provides meaning."[§] Thus as the *Progression* document notes, "students should work with data in the context of science, social science, health, and other subjects, always interpreting data plots in terms of the context they represent" (p. 3).

5:12 Before it rained, the teacher went outside and placed identical baking pans on the ground. After it rained, the teacher brought the pans inside, and students measured how much water was collected in each pan.

If all the water collected were shared equally among the pans, how much water would be in each pan?

Answer

1 liter.

Click here for a student-facing version of the task.

Refer to the Standards

5.MD.B; MP.2, 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 answer to task 5:12, 1 liter, may draw attention to the fact that half of the observations have that exact value, while two values are slightly greater and another value is substantially less, so that 1 liter is a plausible "balance point" of the data; this prefigures work with the mean as a measure of center in grade 6.
- In an idealized rain shower, one might expect every baking pan to contain the same amount of water. However, there can also be variability in the rain collection and in the measurement process.

Relevant prior knowledge

The following mathematics knowledge may be activated, extended, and deepened while students work on the task: thinking about capacity in units of liters; using number lines with fractions; calculating sums of mixed numbers with equal denominators; and using addition and division to solve problems in context.

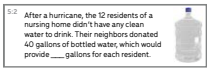
Extending the task

How might students drive the conversation further?

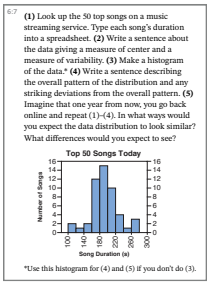
- Students could consider what would have happened if the rain shower had lasted twice as long. What might the line plot have looked like?
- Students could use websites such as weather.gov to research the measurement of rain in weather research.

Related Math Milestones tasks

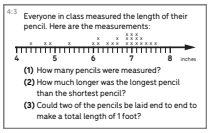
5:2



6:7



4:3



Like task 5:12, task **5:2 Water Relief** involves a division of an amount of a continuous measurement quantity by a whole number.

In later grades, measures of center are part of task **6:7 Song Length Distribution** (note that task 5:12 involves equally redistributing the water in the baking pans, which prefigures the statistical mean).

In earlier grades, task **4:3 Pencil Data** involves contextual problem solving based on interpreting data represented on a line plot.

Curriculum connection

1. In which unit of your curriculum would you expect to find tasks like 5:12? Locate 2–3 similar tasks in that unit. How are the tasks you found similar to each other, and to 5:12? In what specific ways do they differ from 5:12?
2. Thinking about the curriculum unit you identified, at what point in the unit might a task like 5:12 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?*

† Common Core Standards Writing Team. (2011, June 20). *Progressions for the Common Core State Standards in Mathematics (draft): K–3, Categorical Data; Grades 2–5, Measurement Data.* Tucson, AZ: Institute for Mathematics and Education, University of Arizona.

‡ In line plots generated by technology, data points are often marked by small filled circles, or "dots." Apart from that cosmetic feature, the terms *line plot* and *dot plot* are synonymous.

§ The *Guidelines for Assessment and Instruction in Statistics Education Report* was published in 2007 by the American Statistical Association, http://www.amstat.org/education/gaise.

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

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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?