3:5 Playground Cleanup

Teacher Notes

Central math concepts

In grade 2, students drew picture graphs in which each picture represents one object, and they drew bar graphs with a single-unit scale. In grade 3, as explained in the relevant *Progression* document,†

> the most important development in data representation for categorical data is that students now draw picture graphs in which each picture represents more than one object, and they draw bar graphs in which the height of a given bar in tick marks must be multiplied by the scale factor in order to yield the number of objects in the given category. (p. 7)

The *Progression* document also notes that "[t]hese developments connect with the emphasis on multiplication in this grade" (p. 7). More generally, 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 for a list of these connections in grades K–5.

Constructing a picture graph or a bar graph involves identifying quantities in the situation, specifying units of measure, and attending to precision. To support students in creating picture graphs and bar graphs, grid paper is useful. As noted in the *Progression* document (p. 7), "When drawing picture graphs on grid paper, the pictures representing the objects should be drawn in the squares of the grid paper." For bar graphs, "the tick marks on the count scale should be drawn at intersections of the gridlines. The tops of the bars should reach the respective gridlines of the appropriate tick marks." For both kinds of graphs, as suggested in the *Progression* document (p. 3), "a template can be superimposed on the grid paper, with blanks provided for the student to write in the graph title, scale labels, category labels, legend, and so on."

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 (p. 3), "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." That said, "students do not have to generate the data every time they work on making bar graphs and picture graphs. That would be too time-consuming. After some experiences in generating the data, most work in producing bar graphs and picture graphs can be done by providing students with data sets" (p. 7).

Relevant prior knowledge

The following mathematics knowledge may be activated, extended, and deepened while students work on the task: finding a total number for groups of 5 or 10 using Level 2 count-by strategy; and using known single-digit products involving factors of 5.

3:5 Our class picked up litter on the playground. One student wrote tally marks to record the things we picked up.

Paper 𝍸 𝍸 𝍸 𝍸

Plastic 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸

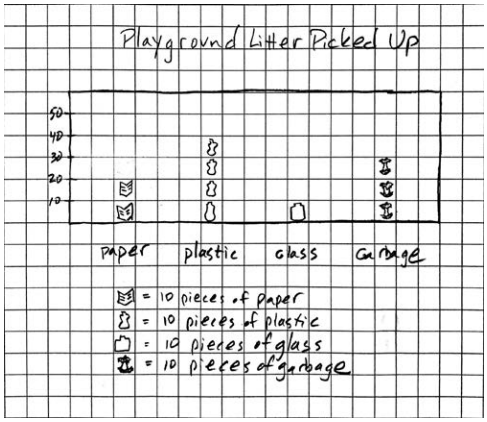
Glass 𝍸 𝍸

Garbage 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸

Show the data another way by drawing a scaled picture graph in which 1 picture stands for 10 things picked up.

Answer

See example. The graph should include a title, category labels, and a legend. Ticks on the vertical count scale are optional. The order of the categories doesn't matter. The spacing between the category bars doesn't matter. The graph may be oriented horizontally or vertically. Pictures representing the categories need not be representational (for example, they could be stars, diamonds, circles, and X's). Wording may vary for the title and the legend, but precision is desirable in naming quantities in the legend.



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

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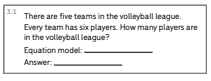
Extending the task

How might students drive the conversation further?

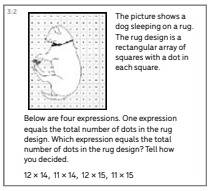
- Students could discuss how the scale for the picture graph communicates what happened during the playground cleanup. Would the graph better communicate the volume of effort if 1 picture stood for 5 things picked up? What would be the advantages and disadvantages of a scale in which 1 picture stands for 1 thing picked up?
- Students could create a bar graph of the same data and compare the way it represents the data to the way the picture graph represents the data. Are there advantages to each?
- Students could recategorize the data in two categories, Recyclable items and Garbage items, treating Paper, Plastic, and Glass as recyclable. How many items are in the Recyclable category? What would the bar graph look like for the categories of Recyclable and Garbage, compared to the one with categories of Paper, Plastic, Glass, and Garbage?

Related Math Milestones tasks

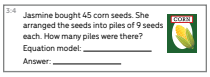
3:1



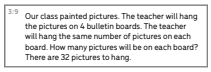
3:2



3:4

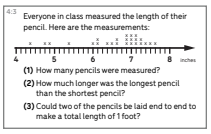


3:9

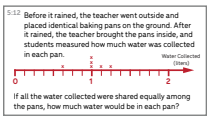


Tasks **3:1 Volleyball Players**, **3:2 Hidden Rug Design**, **3:4 Corn Seeds**, and **3:9 Bulletin Board Pictures** involve multiplication and division contexts.

4:3

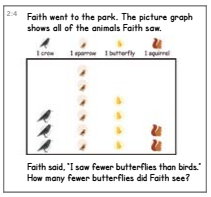


5:12

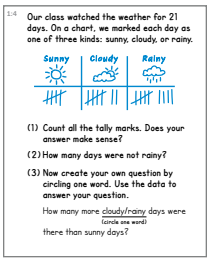


In later grades, tasks **4:3 Pencil Data** and **5:12 Rain Measurements** involve problem solving based on measurement data displayed in line plots.

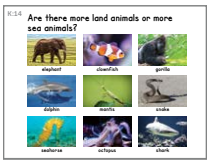
2:4



1:4



K:14



In earlier grades, tasks **2:4 Animals in the Park**, **1:4 Analyzing Weather Data**, and **K:14 Animals from Land and Sea** involve problem solving based on categorical data.

Refer to the Standards

3.MD.B.3; MP.2, MP.4, MP.6. 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 tally marks in task 3:5 are shown in groups of 5, and the bar graph is requested in units of 10, so as to provide connections with multiplication and division work in this grade.
- Three of the four categories refer to materials that are often recyclable (paper, plastic, and glass).

Curriculum connection

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

‡ 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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Teacher Notes

Math Milestones™

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?

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