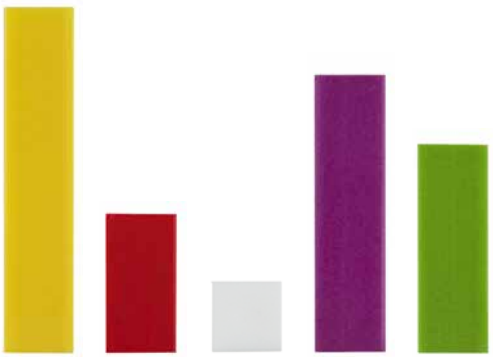
Julie James



Jesse's train

The February 2014 problem task gives students the chance to explore the magnitude of fractions in comparison with different sizes of wholes. To access the full-size activity sheet, go to **www.nctm.org/tcm**, Back Issues.

Fourth graders at J. C. Sommer Elementary School in Grove City, Ohio, were introduced to a new mathematical tool. By exploring Cuisenaire® Rods, they were able to apply relationships that they noticed to the Jesse's Train problem.

Setting the stage

Before introducing the problem, fourth-grade teacher Deb Belcastro and math coach Gina Fill asked their students to do some research: Explore the set of Cuisenaire Rods to discover relationships. Because the class had been studying fractions for the past week, these teachers had high expectations for the relationships that students would discover.

Belcastro and Fill presented students with one question: "What relationships can you find when you explore the Cuisenaire Rods?"

Asking such a broad, open-ended question required students to communicate about what they noticed. In turn, the teachers had to listen closely for students' reasoning about the relationships that they noted. The adults noticed students engaging in different strategies to compare the pieces in the set of Cuisenaire Rods. Some students lined up rods to create equal lengths; other students organized the rods by placing them in order from shortest to longest.

As Belcastro and Fill circulated around the room, they noticed that several students were able to find halves and thirds, with different rods representing the whole. This is interesting because the idea of comparing parts of different-size wholes had not been discussed in class. As students shared their discoveries, the teachers encouraged them to use precise mathematical language so that their reasoning was clear to other students. One student stated, "I was just playing with the rods and then realized that it is

problem solvers activity sheet

Jesse's Train Clue Card Template

Jesse's train Use your clue and your Cuisenaire Rods to help your group build Jesse's train. Jesse used four different colored rods to build a train.	**Jesse's train** Use your clue and your Cuisenaire Rods to help your group build Jesse's train. One rod in Jesse's train represents one-half of one other rod in the train.
Jesse's train Use your clue and your Cuisenaire Rods to help your group build Jesse's train. Two rods in Jesse's train can be placed end-to-end to represent half of the entire train.	**Jesse's train** Use your clue and your Cuisenaire Rods to help your group build Jesse's train. Jesse did not use the white rod in his train.
Jesse's train Use your clue and your Cuisenaire Rods to help your group build Jesse's train. ***EXTRA CLUE*** One rod in Jesse's train represents one-third of another rod in Jesse's train.	**Jesse's train** Use your clue and your Cuisenaire Rods to help your group build Jesse's train. ***EXTRA CLUE*** Jesse did not use the purple rod.

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like fractions. For example, this one [the yellow rod] is half of the orange rod, and two of them together make the whole."

Introducing the problem

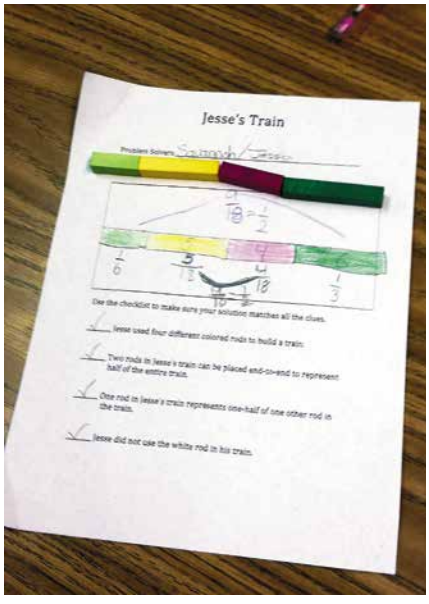
Belcastro and Fill found that the Jesse's Train problem engaged their students in the first and third Standards for Mathematical Practice (SMP) that the Common Core State Standards for Mathematics (CCSSM) describe specifically: *Make sense of problems and persevere in solving them* and *Construct viable arguments and critique the reasoning of others* (CCSSI 2010, p. 6). To introduce the problem, the teachers instructed students that they could read their clue to the group and that all clues must be used to build the train.

Group work

The teachers noticed that several groups began their problem-solving process by randomly selecting four different colored rods, placing them end-to-end, and then rereading the clues to see if the collection of rods fit all the clues. To move students beyond this guess-and-check strategy, Belcastro and Fill asked the groups to describe their plan for solving the problem. Having students reflect on their strategy focused them on particular relationships among the rods. For example, students identified rods that represented half of another rod. With those two rods selected, they then had to determine how they could build the other half of the train. By using this approach, students were able to find many other solutions.

FIGURE 1

Jessica and Savannah's solution showed how 1/6 and 1/3 represents half the train and 5/18 and 4/18 represents the other half.



GINA L. FILL

Critiquing others' reasoning

The teachers allowed several groups to come forward to share their solutions. When Deven and Caleb came up to share their train—consisting of two orange rods, two yellow rods, one pink rod, and one dark green rod—the teacher addressed the class to see if anyone had any questions.

Student 1: Are you allowed to use more than one piece of one color?
Student 2: It doesn't say you can't. You just have to have four colors, not four pieces.

From the discussion of this group's unique solution, the class came to a consensus that using any number of pieces is possible as long as four different colors are present.

Extending student thinking

Students received recording sheets to document their solutions. On the sheets, they were asked to write an equation using fractions to represent the parts of the whole. To determine the part each rod represented, many students used the white rod as the smallest fractional part to decide how many parts would make up the whole train.

Jessica and Savannah (see **fig. 1**) shared their train, which consisted of one light green rod, one yellow rod, one pink rod, and one dark green rod. They labeled each part of the train with a number corresponding to its length in white rods. Because the entire train was eighteen white rods in length, the girls used this information to determine the fractional part of the train represented by each rod. When asked to explain their reasoning, Jessica stated, "Since I know that three times six is eighteen, and there are six cubes in this [dark green] part of the train, I know that this part is one of three parts, or one-third of the train."

Using this reasoning, the girls labeled the light green rod as one-sixth. Because five and four are not factors of the entire length, Jessica and Savannah were unable to apply this reasoning to the yellow or pink rods, so they labeled these using a denominator of eighteen. Jessica continued to check their work by showing in the recorded solution how one-sixth and one-third represented half the train and five-eighteenths and four-eighteenths represented the other half.

Extending teacher thinking

Although Belcastro and Fill presented this task to their students to extend their thinking

about fractions, the teachers felt that their own thinking was extended as well. They realized that by providing students plenty of time to explore Cuisenaire Rods ahead of the task, they were able to create a collaborative work environment and promote an understanding of fractional parts. Additionally, they learned that the Cuisenaire Rods offer much greater opportunities for inquiry and understanding than fraction sets that have only one whole.

Special thanks to teacher Deb Belcastro and math coach Gina Fill, who presented the problem to Belcastro's fourth-grade class at J. C. Sommer Elementary School in Grove City, Ohio.

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REFERENCE

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