Introducing Fractions Through Context with Emphasis on Common Core Progressions

Pre-K – 5 Gallery Workshop

4/11/2014
Bentonville Public Schools

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Jenny brought 3 cookies in her lunch box. She wanted to share them with her friend Anna. How much cookie will they each get?

Note-taking Sheet
Fraction Progression Activity

Grade 1

Grade 2

Grade 3

Grade 4

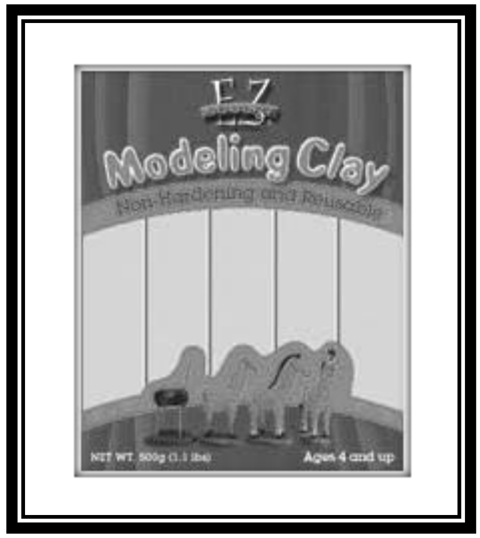
Grade 5

Note-taking Sheet
Video 1

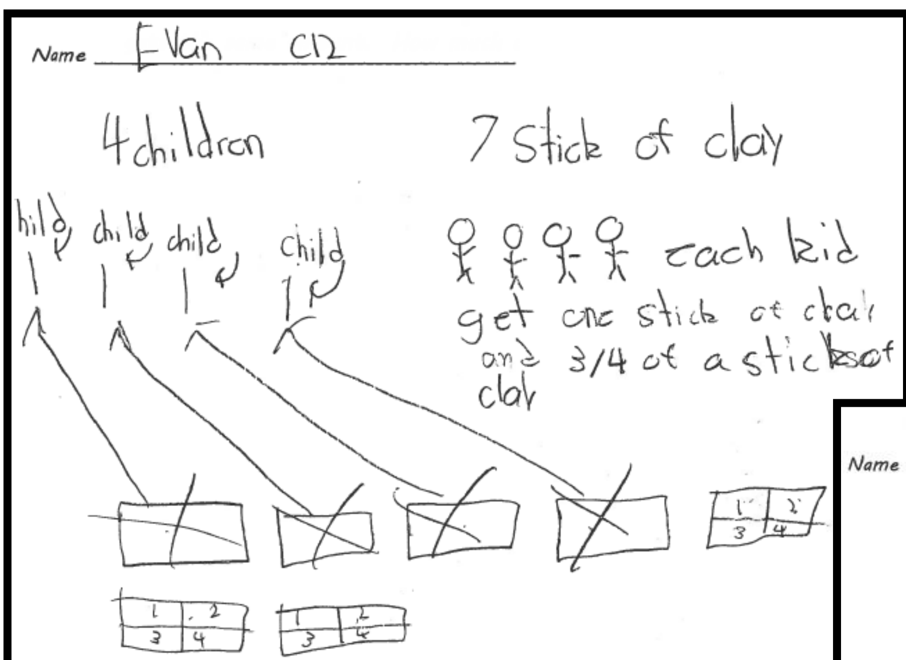
In this video, Mrs. Cleveland takes a group of students through a discussion of their strategies. The students in this class were not taught how to solve problems such as these but instead, were allowed to be creative and develop their own strategies. Therefore, the strategies being discussed are student invented strategies.

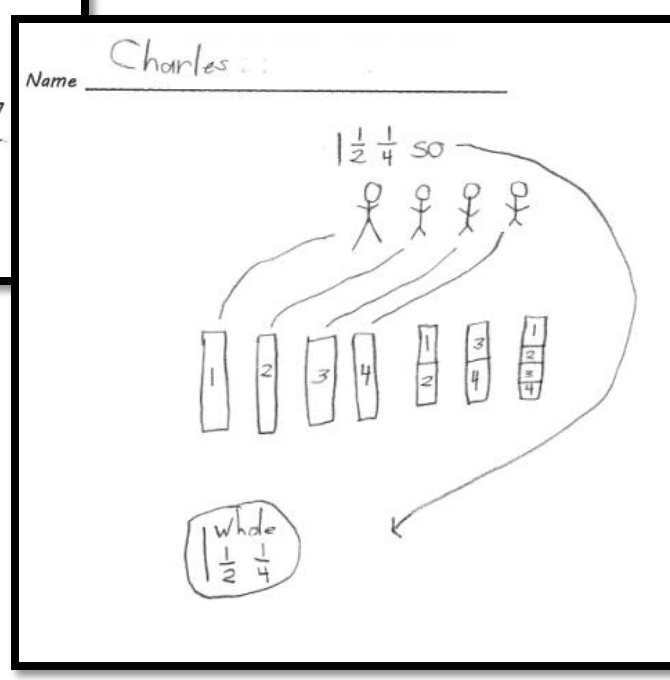
- What do you see as Mrs. Cleveland's learning goal?
- What standards on the progression were addressed by this lesson?
- What else do you see that Mrs. Cleveland could have addressed but chose not to pursue?

Name ____________________________________ Grade _______________



4 children in art class have to share 7 sticks of clay so that everyone gets the same amount. How much clay can each child have?





Playground Fractions

Create this "playground" with your pattern blocks. This will represent one whole playground. Find the pattern blocks that could represent each of the fractions listed below and draw each representation on your paper:

$\frac{1}{2}$ playground

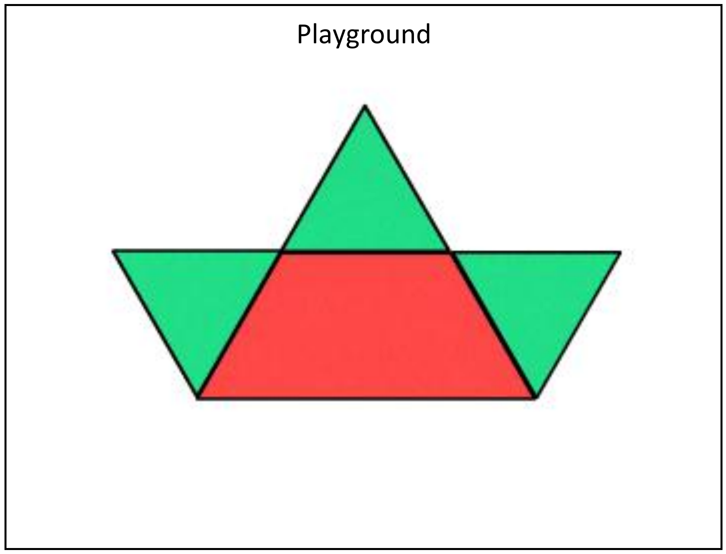
$1\frac{1}{2}$ playground

2 playgrounds

$\frac{1}{3}$ playground

$\frac{2}{2}$ playground

$\frac{4}{3}$ playground



Activity adapted from:

Van de Walle, John A. Elementary and middle school mathematics: Teaching developmentally, 8th ed. Boston: Pearson Education, Inc., 2013

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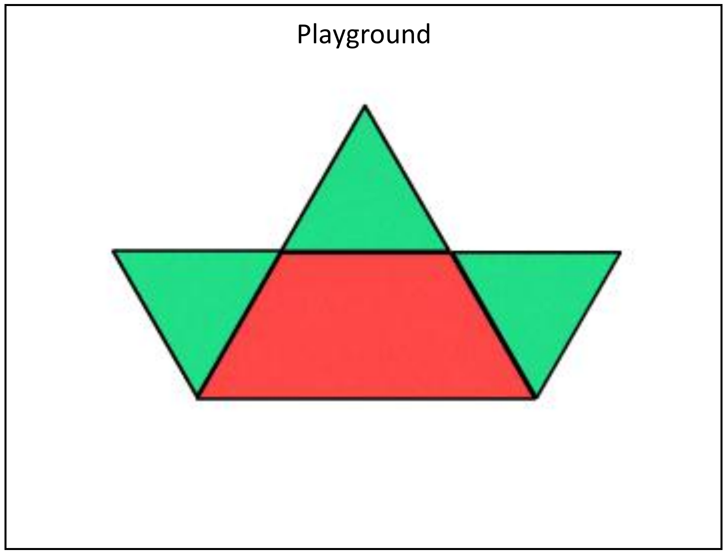

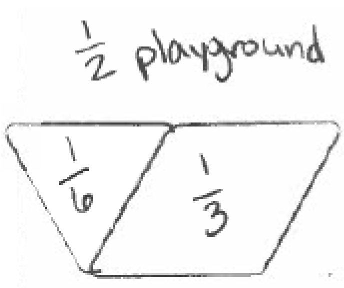

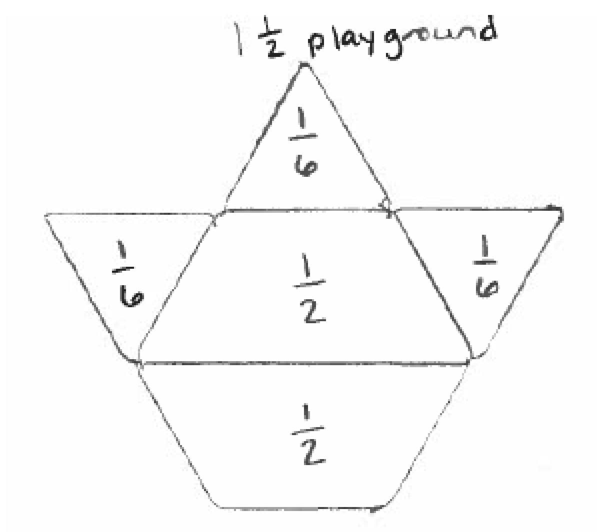

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Who's Winning?

The friends below are playing "Red Light, Green Light" and the fractions next to their names represent how far they are from the start line. Who do you think is winning? Can you place these friends on a line to show where they are between start and finish?

Emma $\frac{3}{4}$ Meredith $\frac{1}{2}$ Jack $\frac{5}{6}$

Han $\frac{5}{8}$ Miguel $\frac{5}{9}$ Angelika $\frac{2}{3}$

Activity adapted from:

Van de Walle, John A. Elementary and middle school mathematics: Teaching developmentally, 8th ed. Boston: Pearson Education, Inc., 2013

Note-taking Sheet
Video 2

In this video, Mrs. Drewry is questioning some student's on the strategies they used to complete the "Who's Winning" task.

- What do you see as the learning goal for this activity?
- What specifically about this activity lent itself to that learning goal?
- What standards on the progression were addressed by this activity?

Equal sharing – A tool for developing deep conceptual understanding of fractions

Arkansas Council of Teachers of Teachers of Mathematics Journal, April 2014

Included in this article is some discussion of traditional fraction instruction as compared to introducing fractions through context using equal share problems.

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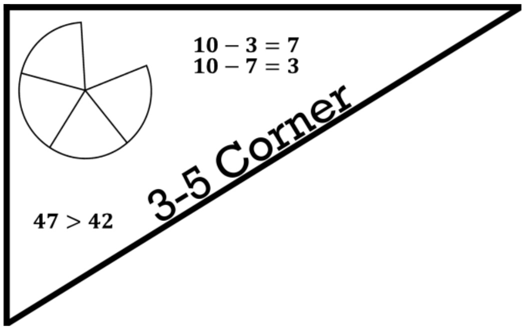

Equal Sharing – A tool for building deep conceptual understanding of fractions

Submitted by Leandra Cleveland
Bentonville Public Schools

A class of fourth graders was engaged in a discussion about fractions. The classroom teacher, Mr. E, was attempting to uncover what understandings the students had brought from previous years. Mr. E told a story of a boy named Jay who had cut himself a piece of pizza (Figure 1), and then began asking questions.

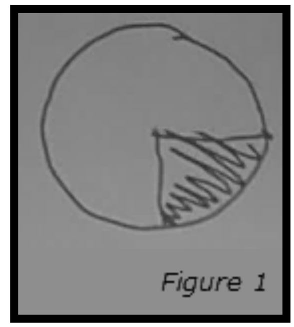

Figure 1

Mr. E: So how much of the pizza did he have?

Chris: One-fourth

Mr. E: One-fourth? How do you know?

Chris: Because if you look at it, it's one-fourth. Because even if you don't cut it all the way through, it's still only one part of it, the other three-fourths are there, just it's not cut.

Mr. E: But don't you have to have the cuts? … What do you think Talen?

Talen: I disagree because, if that's like that, it could still be 1/8…you could still cut it into eighths, because it's just one piece and then the rest, so you won't know the fraction, you'll just know that he has one, not what the fraction's out of.

Mr. E: So you're saying without having the pieces cut, it's impossible to know exactly what that fraction is?

Talen: Because you just know that he takes one piece, you don't know if you're going to cut it into fourths or eighths.

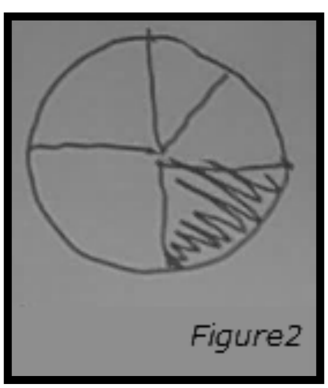

Figure2

After a few more minutes of discussion, the students were presented with a new representation of how the pizza might have been sliced (figure 2). They were then asked, "How much pizza did Jay have, if this is how the other kids cut it?"

Talen: Now he has one-fifth.

What's the misconception here? What does Talen believe to be true about fractions? What does he not understand?

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Talen has a very basic definition of the numerator and denominator of a fraction. He believes the numerator means "how many parts we have" and the denominator means "how many parts are in the whole." This definition may be technically correct, but it's also misleading. It leads students to think that the numerator and denominator are separate values. In thinking of the numbers separately, Talen is just counting parts. He fails to understand the importance of equal-sized parts or that the denominator actually identifies the size of the parts.

Talen was not alone in his misconception. When asked to discuss Talen's response, approximately half of the class agreed that the amount of pizza represented was one-fifth.

The following day, the same fourth graders were asked to solve this problem: Kassidy ate $\frac{3}{6}$ of a chocolate bar on Monday. She ate $\frac{3}{6}$ of a chocolate bar on Tuesday. How much chocolate did she eat in all?

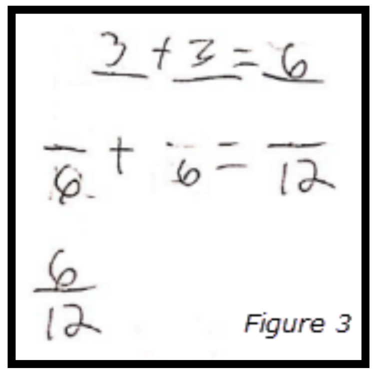

Figure 3

Talen's work (figure 3) is further evidence of his belief that the numerator and denominator are two separate values. His misconception is not uncommon. In fact, after solving the problem, the students were surveyed and 10 out of 20 of the fourth graders believed $\frac{6}{12}$ of a chocolate bar to be the correct answer.

Talen and his classmates were likely exposed to a typical amount of traditional fraction instruction throughout their elementary careers. Starting in kindergarten, these students would have been engaged in fraction tasks such as those seen in most textbooks or resources found on the web (figure 4). In tasks such as these, the shapes used are often already partitioned for the students, making it easy to see fraction identification tasks as simply counting

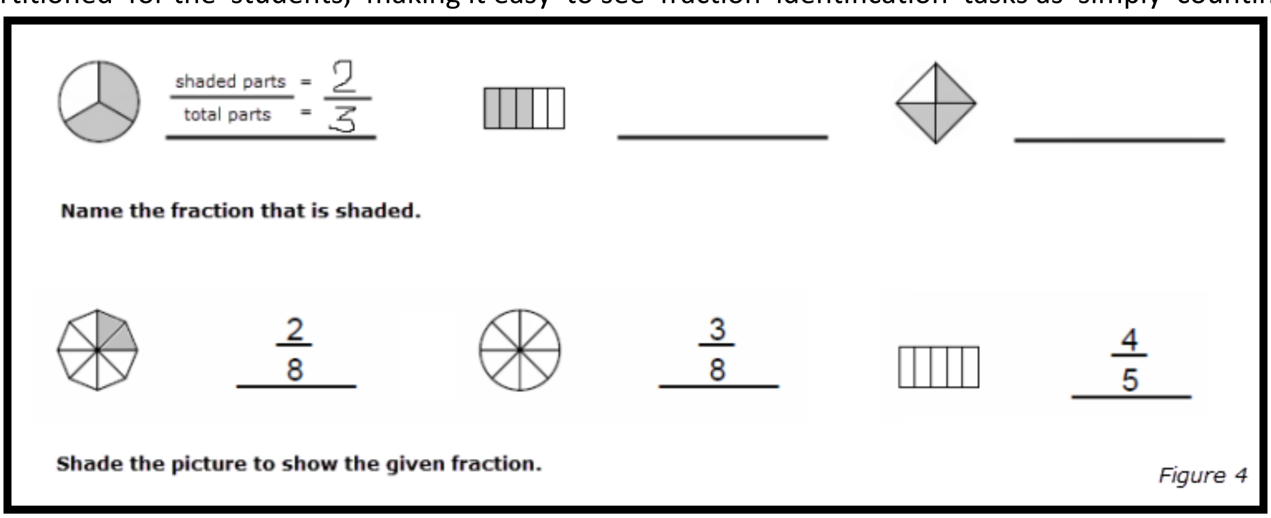

Figure 4

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tasks. Along with these tasks, fractions are often referred to using phrases like, "three out of four" or "three over four," further reinforcing the idea that the numerator and denominator are separate values.

In a report completed by the Institute of Educational Sciences (IES), the researchers prepared recommendations for supporting the learning of fractions. The first recommendation states: "Build on students' informal understanding of sharing and proportionality to develop initial fraction concepts" (Siegler et al., 2010, p.1). Specifically, they suggest the use of equal sharing activities to develop understanding of fractions. Equal Sharing problems use countable quantities that can be cut, split, or divided such as candy bars, pancakes, bottles of water, sticks of clay, jars of paint, bags of sand, and so on. These quantities can be shared by people or distributed into other groupings, such as onto plates or into packages (Empson & Levi, 2011). Figure 5 includes examples of Equal Sharing problems that could be used to introduce and develop fractions. Problems such as these provide students with the opportunity to make sense of fractions in a context which they can relate to.

Equal Sharing

4 children want to share 10 sticks of clay so that everyone gets the same amount. How much clay can each child have?

4 children want to share 3 cookies so that everyone gets the same amount. How much cookie can each child have?

Figure 5

The Common Core State Standards call for partitioning circles and rectangles into equal shares in first and second grade. Therefore, it would make sense that equal sharing problems are a part of the instruction in primary grade levels. However, it's just as important to use Equal Sharing problems with older students to refine and deepen their understanding of fractions (Empson & Levi, 2011).

Mr. E's fourth graders were presented another problem: *Dylan wants to share 4 bottles of apple juice with his friends. If there are 3 total kids, and they each get the same amount, how much apple juice will each friend get?*

Not only did this problem present a context in which Talen could begin to resolve his misconceptions surrounding fractions, but it also elicited strategies (figure 6) that were used to generate a discussion about the repeated addition and multiplication of fractions.

Connecting Carter's strategy to Darla's strategy creates the opportunity to discuss many different concepts. Including but not limited to the following:

- $\frac{1}{3}+\frac{1}{3}+\frac{1}{3}+\frac{1}{3}=\frac{4}{3}$
- $4 \times \frac{1}{3}=\frac{4}{3}$
- $1\frac{1}{3}=\frac{4}{3}$

Carter's Strategy

Darla's Strategy

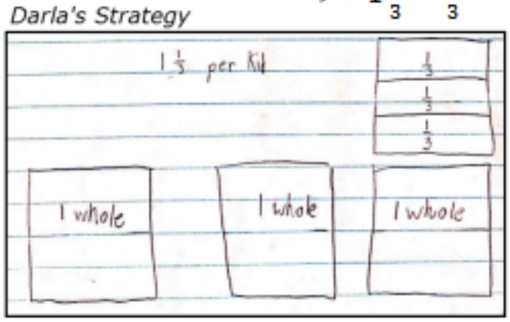

Figure 6

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Equal Sharing problems allow students to connect what they already know about solving problems with whole numbers to the concept of fractions. They can be used to discuss a range of fraction concepts from the very foundation of fraction understanding to more complex ideas such as multiplying fractions and fraction equivalence.

When using Equal Sharing problems with your class, it is recommended that you pose the problem without providing instruction on how to solve it. The variety of strategies that your students bring to the table will provide for rich discussions that will develop a deep understanding of fractions and how they operate. **§**

References:

Siegler, R. S., Carpenter, T., Fennell, F., Greary, D., Lewis, J., Okamoto, Y., … Wray, J. (2010). *Developing effective fractions instruction for kindergarten through 8th grade: A practice guide* (NCEE 2010-4039). Retrieved from www.whatworks.ed.gov/publications/practiceguides

Empson, S. B. & Levi, L. (2011). *Extending children's mathematics fractions and decimals: innovations in cognitively guided instruction*. Portsmouth, NH: Heinemann.

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