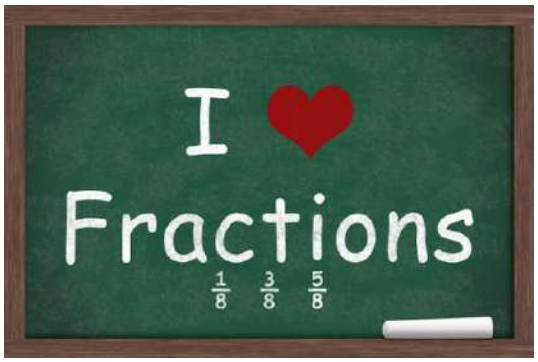
Teaching Fractions

by Amy Porter



I. Introduction to Teaching Fractions

The Scientific American published an article called Fractions: Where It All Goes Wrong which gave a statistic saying that on standard fraction addition, subtraction, multiplication, and division problems 6th and 8th graders tend to answer correctly only about 50% of items. This once again is foundational learning that greatly affects students' ability to do higher level math. In fact, fifth graders' fraction knowledge predicts high school students' algebra learning and overall math achievement. The entire article is a fascinating read about why fractions are so difficult for students and how it affects them later, but to me the question is how can we improve their understanding and ability to compute? How can we improve our teaching of fractions?

The first thing is that students must understand that fractions are numbers and have a place on the number line. Section II will have much more detail on this.

Secondly, as with most math concepts, students as a general rule, even ones who seem to be "getting it," will benefit from much more time with hands on manipulatives and discovering how the numbers work. This is a concept that is best developed in small group where the teacher can guide the students in their play and discovery with the manipulatives.

Some of the best manipulatives you can have for teaching fractions are Cuisenaire rods, fraction tiles, pattern blocks, geoboards, and fraction circles. (Follow the links for posts I have written about using each one.) The commercial game Fraction Formula is another one students love (they call it the scientist game) and that I have found to build solid understanding (link to Fraction Formula Game at Amazon).

There are many other common items you can use for teaching real world applications of fractions, including playdough, Legos, food (Hershey bars and clementine oranges both work very well in addition to the popular examples of pizza and cake,) and money (4 quarters equal $1 because each is 1/4 of $1)

For more specific activity ideas, *You've Got This Math* did a great series on building fraction sense through the use of manipulatives, number lines, visual models and benchmarks. See this article Three Steps For Teaching Numerators and Denominators

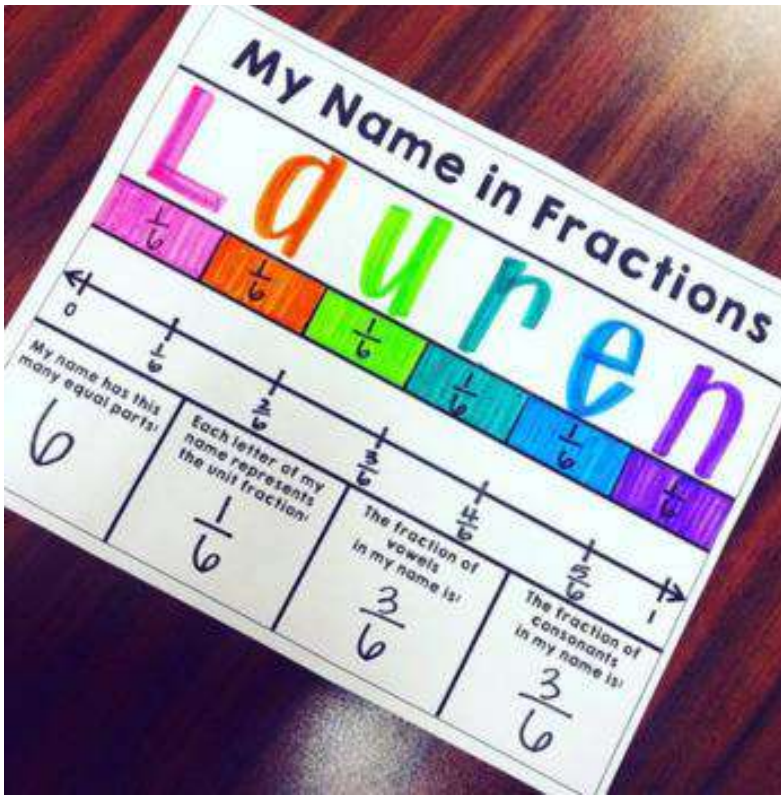
The pdf book Mega Fun Fractions has activities for teaching fractions from 3rd-5th grade including art activities, games, poems, logic puzzles and more!

To explore the idea of equivalent fractions, see Section III.

After you have built understanding of fractions, there are other great strategies to deepen and extend knowledge, including:

- physical activities such as fraction hopscotch
- games such as cover/uncover
- hands on art activities and projects (origami is my favorite.).
- Here is a great source for fraction anchor charts.
- This is a great article from Math Minds about incorporating fractions into number talks in upper elementary

Pizza Fractions from 4th Grade Frolics



My Name in Fractions freebie from Sass in the Class

Click here to watch a video, Fraction Museums by Bob Krech from Scholastic Instructor Magazine.

Online Games for Teaching Fractions

Math Playground Fraction Games

Fraction Fling on abcya – matching fractions to models

Illuminations Fraction Game – combining and comparing fractions, can be played from 3rd-8th grade level

Greg Tang Satisfraction – Four levels of difficulty from identifying fractions to multiplying/dividing fractions

More Resources for Intervention

Fraction Face Off tutoring plan for 4th grade

Intensive Intervention: Fractions As Numbers

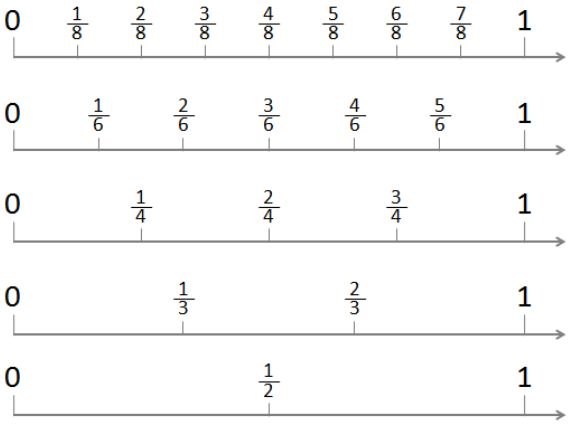
More Resources for Enrichment

Fractions Unpacked from NRICH – activities to deepen conceptual understanding of fractions

Books for Teaching Fractions

- Whole-y Cow Fractions Are Fun
- Fraction Action
- Give Me Half
- The Wishing Club: A Story About Fractions
- Jump Kangaroo Jump
- Hershey Fractions
- Full House: An Introduction to Fractions
- Pizza Counting
- Piece=Part=Portion
- The Lion's Share
- Polar Bear Math
- Apple Fractions
- Go Fractions
- Multiplying Menace: The Revenge of Rumpelstiltskin
- Fractions in Disguise
- A Fraction's Goal- Parts of a Whole
- My Half Day
- Fractions in Trouble
- Mary Clare Likes to Share
- Funny and Fabulous Fraction Stories

II. Fractions on the Number Line



According to an article in The Wall Street Journal, placing fractions on a number line in the correct order in third grade is a more important predictor of fourth-grade math performance than calculation skills, working memory, or even the ability to pay attention. The article also states that while a student's ability to understand fractions in fifth grade is a predictor of long-term math achievement in high school, half of eighth graders can't put three fractions in order by size.

Using a number line is incredibly helpful as foundation for all operations with fractions, particularly when students will need to understand division of fractions. It helps students see the relationships between fractions and to understand them as numbers, not just divisions of physical objects.

Necessary Background Knowledge

To teach kids to place fractions on a number line requires two things. First, the kids need to understand what a number line really is. Here is a great resource from Math Learning Center called *Learning How To Think Mathematically With the Number Line.* In order for them to fully understand the number line, I teach them from the beginning of when I work with them in math that a line goes infinitely in both directions (I will add a post later on teaching this concept). Kids love the concept of infinity.

I have found that when I teach them this, I can easily teach them that when we draw a number line we are drawing only a piece of the number line and that EVERY NUMBER IN THE WORLD has a place on the line. Then we practice putting numbers using different intervals. So when they learn about fractions, the kids understand that, since they are numbers, they have a place on the line.

Secondly the kids need to really understand fractions as parts of a whole. It is really easy for teachers of upper grades to move too quickly through the concrete stage with

manipulatives. Many think their kids are "getting it" and don't need the manipulatives. However, by using fraction tiles, pattern blocks, and cuisenaire rods students will develop a deeper understanding of how fractions work and be able to apply this knowledge. In the first section I wrote about the research on how kids are lacking fraction knowledge and hands on strategies for teaching fractions.

Introducing Fractions on a Number Line

There are several great options for introducing fractions on a number line depending on your students' learning styles and what manipulatives you have available.

- Here, from Marilyn Burns, is my favorite lesson I have found for introducing the concept of fractions on a number line .
- How To Develop Fraction Sense Using Number Lines from You've Got This Math
- Here is a great 5 minute video from ETA hand2mind about how to use fraction tower cubes and an open number line to teach fractions on a number line.
- Mr. Elementary Math uses fraction bars to build number lines.
- The Owl Teacher uses colored paper clips to introduce fractions on a number line.
- Making a pipe cleaner number line and sliding a bead along it is another way to get kinesthetic practice. Again this would be done in a small group setting. Here's a video to demonstrate this method.

Here is a link to the Fraction Tower Activity Set on Amazon.

Here is a link to Rainbow Fraction Tiles on Amazon.

Student Practice

- These free printables from Math Tech Connections are designed to be used in a small group using fraction bars as a manipulative. One (with three levels of differentiation) has students color in bar diagrams to partition the number line. The other is a math sort activity to match fraction, bar model, and number line.
- This activity from The Owl Teacher uses a clothesline as the number line and has students place t-shirts with fractions on them in the correct place. She includes differentiation options as well.
- Here is a fractions on the number line Teamwork Challenge for grades 3-5 that is free on TPT. I love this one because it incorporates problem solving and logic along with fraction skills. Students use their skill with fractions on a number line to build bridges.
- Make a human number line! Students are put in groups of 4-6 and each given a different fraction piece. Then, each team creates a human number line.

Additional Resources

- Fractions on a number line song from Number Rocks
- Fractions on a number line video from Khan Academy
- Puzzle Pics online game on Math Playground- match a fraction with its picture or location on the number line.
- Animal Rescue online game on Sheppard Software- find and free the animals by placing fractions on the number line.
- Battleship Numberline game on Brainpop

Intervention Resources

- Intensive Intervention Guide: Fractions As Numbers
- Common Student Misconceptions Equivalent Fractions
  Free Intervention Lesson Downloads

III. Teaching Equivalent Fractions

In the previous sections I have discussed the statistics of how poorly most students understand fractions, and some of the ways we can teach for better understanding. In this post I want to specifically address teaching equivalent fractions.

This free resource from MSTAR has a fabulous chart of common misconceptions about equivalent fractions and how to prevent or correct these. Interestingly, most of the suggestions come down once again to more use of the number line and more use of manipulatives. Remember our goal is for students to understand and be able to visualize fractions, not just use "tricks" to get an answer.

Using Manipulatives to Teach Equivalent Fractions

To introduce equivalent fractions the best activity I have found is this free one from Math Coach's Corner. She developed it for 3rd grade teachers to have their students explore the concepts and develop meaning on their own. The activity uses fraction tiles and can be found at this link- Concrete Learning For Equivalent Fractions

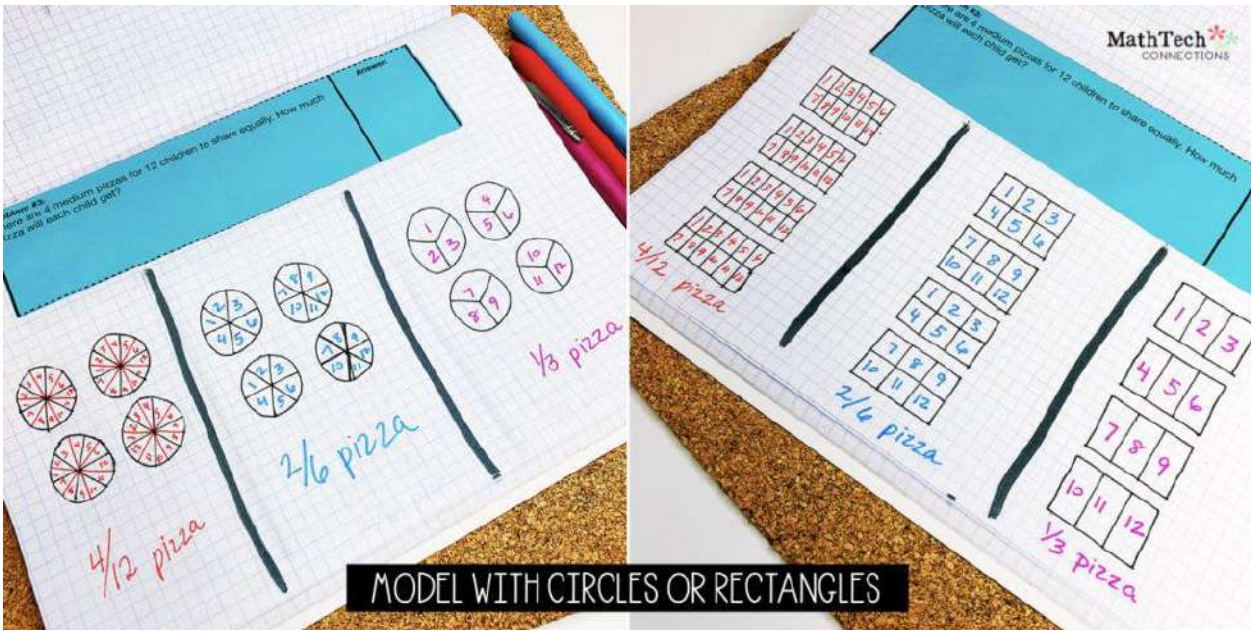
Besides fraction tiles, another fun and effective manipulative for exploring equivalent fractions is pattern blocks. Go here for free equivalent fraction task cards using pattern blocks. As with the previous activity these encourage students to explore and make their own discoveries.

Using Number Lines to Teach Equivalent Fractions

Math Coach's Corner also has a great article on Drawing Number Lines to Visualize Equivalent Fractions

Using Models to Teach Equivalent Fractions

Introducing Equivalent Fractions Using Equal Sharing Problems from Math Tech Connections



Here is a link to a Khan Academy video on Introduction to Equivalent Fractions.

Free Printable Practice Task from the Georgia Department of Education

Using a Multiplication Chart to Find Equivalent Fractions

This article from Simply Teaching explains how to teach students to use a multiplication chart to find equivalent fractions (and the importance of students being able to quickly write their own multiplication chart.) While this may seem like a "trick," if taught properly it will develop number sense of how we use multiplication and division to determine equivalent fractions.

Online Games for Practice

Equivalent Fractions Bingo at ABCYA

Triplets at Math Playground

Physical Games for Practice

Here is a free printable equivalent fractions Triomino game for 4th/5th grade.

Intervention

Free Tier 2 intervention lessons from MSTAR for teaching equivalent fractions

Lesson using visual models from Math Interventions

Intensive Intervention Fractions As Numbers has a section on equivalent fractions

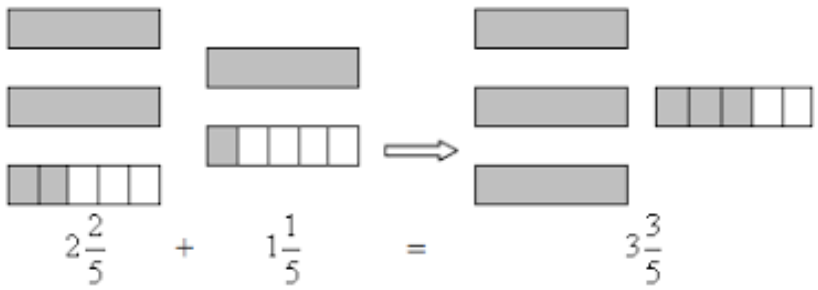
Enrichment

Slice My Pizza Enrichment Lesson for Third Grade

Nicholas' Game from Marilyn Burns In this game students are asked to identify fractions that are less than, equal to, and greater than a particular starting fraction. The lesson doesn't rely on any contextual setting or use of concrete materials but rather draws on students' reasoning abilities.

Free Fractions Magic Square Puzzle

IV. Operations with Mixed Numbers



The resources in this section will cover:

- introducing and developing understanding of the relationship between improper fractions and mixed numbers,
- the 4th grade standard of adding and subtracting mixed numbers with like denominators,
- the 5th grade standards of adding and subtracting mixed numbers with unlike denominators
- multiplying mixed numbers.

Using Fraction Circles

The best way I have found to help children understand the relationship between improper fractions and mixed numbers, and to be able to solve operations with mixed numbers, is to use hands on manipulatives. For this concept I believe fraction circles are the most helpful as the students can easily tell when the circle is complete.

Since I teach students that math is all about patterns, we make a growing pattern with the fraction circles. For example if we are using fourths we'll show 1/4, 2/4, 3/4, 4/4- what happens when we have 5/4? The kids are easily able to see that they have one complete circle and 1/4 of another one.

Here's a video example of that method using virtual manipulatives.

While you can use the virtual manipulatives to model, it is important for most kids to work with physical manipulatives to really understand this. You can use plastic or magnetic ones or print them from this free download.

Here is a link to the Fraction Circles on Amazon.

Here is a link to Magnetic Rainbow Fraction Tiles on Amazon.

Using Unifix Cubes, Pattern Blocks, and Cuisenaire Rods

Of course fraction circles are not the only manipulative you can use. Here's a free 4th grade lesson called All Hands In for Improper Fractions where students use unifix cubes to convert mixed numbers to improper fractions.

In this 4th grade lesson Modeling Adding and Subtracting Mixed Numbers students use pattern blocks.

Video on Adding Mixed Numbers Using Pattern Blocks.

Video for Fifth grade lesson using Cuisenaire Rods

Using Area Model for Unlike Denominators

Video for Adding Mixed Numbers

Video for Subtracting Mixed Numbers

Multiplying Mixed Numbers Using Area Model

Video for Multiplying Mixed Numbers

Free Printables for Instruction

Math Doodle Foldable for Adding/Subtracting Mixed Numbers With Regrouping

5th Grade Flowchart/graphic organizer for interactive notebook

5th grade adding/subtracting mixed numbers notes

Online Videos for Students to Watch

Maths With Lego: Improper Fractions to Mixed Numbers

Math Antics: Mixed Numbers

Math Antics: Adding Mixed Numbers

Math Antics: Subtracting Mixed Numbers

Super Easy Math: Adding and Subtracting Mixed Numbers

Brain Pop: Mixed Numbers

Khan Academy Multiply Mixed Numbers

Online Resources and Games for Practice

Study Jams: Add and Subtract Mixed Numbers. Step by step guided practice through word problems.

Adding Mixed Numbers Unlike Denominators Smart Notebook lesson

Math Man (Pacman) game from Sheppard Software to practicing converting improper fractions to mixed numbers

Math Playground game to convert mixed numbers to improper fractions

Clara Fraction's Ice Cream Shop game to convert improper fractions to mixed numbers

Free Printable Activities and Games for Practice

Mixed Numbers and Improper Fractions Spiral Card Game (4th grade and up)

Subtracting Mixed Numbers Printable Board Game from Math Geek Mama

Adding/Subtracting Mixed Numbers War game (5th grade)

Matching Activity: Improper fraction, mixed number, and picture

4th grade adding/subtracting mixed numbers practice problems and self evaluation

4th grade Adding and Subtracting Mixed Numbers cards for centers or scavenger hunt.

Springing Up Mixed Numbers: students solve problems, then sort the answers and glue to create flowers.

One more that isn't free, but is really cool and is well worth the $2.50, is these Mixed Number and Improper Fraction Mazes from Idea Galaxy on TPT.

Intervention Resources

Converting a Mixed Number to an Improper Fraction from the National Center on Intensive Intervention. This lesson uses fraction tile manipulatives.

Adding and Subtracting Mixed Numbers- A Looong Journey by Surfing to Success

Enrichment

Adding and Subtracting Mixed Numbers Printable Tarsia Puzzle