

A Visual Approach to Learning Math
Fractions

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Problem Statement

Teaching third grade, I have witnessed first hand the struggles students have with math. Many students have anxiety about math and numbers. They lack the conceptual knowledge about content and how numbers work. They rely on memorizing steps, basic facts or strategies and have less knowledge about why they are doing these concepts and how these concepts are connected to other topics in math. I believe that conceptual learning is very important if we want to truly have student successes in math. When students have to apply math knowledge to fractions, the background knowledge and content necessary to understand fractions is also a challenge. It has been stated in Predictive Factors in Student Mathematics Achievement Decline between Third and Fifth grade, a doctoral study written by Jean E. Salters that “Positive social change will occur when all elementary teachers are able to facilitate students' learning of mathematics and the students successfully master math concepts.” (Salters) Therefore, a shift in the teaching and learning of mathematics is necessary in order to facilitate such change.

Knowing that students on the elementary level learn best by visuals and having time to build their conceptual knowledge with lots of practice to develop and master concepts is the bases for this curriculum unit and why the course “A visual approach to learning math” became such an important tool in my educational career as an elementary educator.

Fractions and how they are part of a whole, is a hard concept for third grade students. And while there may be a lot of visual worksheets and aids that have been developed, focusing on developing a unit curriculum that will include portioning fractions, fraction number lines, comparing fractions and equivalent fractions was important. These are topics within the content area for fractions that have been the most difficult for the students over the years, and also the areas that tend to need a lot more visual aids to help students understand.

Researching about fractions an article “Using models to build fractions understanding” mentioned how unit partitioning, paper folding, number lines, fraction order, and fraction circles provide great models for students to gain a deeper understanding of fractions. It stated, “When students use multiple models to represent a fraction their understanding of the role of the unit and portioning evolves as they interact with different models.” Monson, Gramer, and Ahrendt (pg.118) Thus, this unit will attempt to encompass this giving students a chance to model using fraction circles, portioning through folding paper, recognize fractional order and equivalency with the use of number lines.

Within this article many important points were noted. One point was that fraction circles are the familiar shape used when fractions are taught. The article made strong points that although fraction circles are an important starting point for teachers to use, it shouldn't be the only means of modeling fractions. It also stated “colorful fractions circles to be uniquely effective as a model because they helped students create strong mental images for fractions.” Monson, Gramer, and Ahrendt (pg.118) these mental images are necessary for students to use when studying other concepts within the fraction unit. It was also noted in this particular study, that students used fractional circles for reasoning more than any other model. Stating “fraction circles provide students with the opportunity to develop a flexible interpretation of what a unit can be, which is important when students are asked to order 2 fractions,” Monson, Gramer, and Ahrendt (pg.119)

The course “A visual approach to learning mathematics” taught me that visual aids in math have to not only look aesthetically well but also it has to be meaningful. The viewer should be able to gain information while enjoying the way that it looks. It was discussed and shown that information should be clean, clear, colorful without being distracting, and easy to view by the

viewing audience. Through out this course we have learned about color, correct fonts and font size, animation and transition techniques. It is my goal to use these techniques to create slides that will help third grade students understand fractions.

Background

PSSA test scores for grade 3 show that students at William Rowen Elementary School scored well below the state. However, when compared to the city of Philadelphia, scored slightly above. In 2019, students scored **24.2** percent on the math PSSA test this score was nearly half of the score that third graders in the state scored which was **56.0** percent. Results from last year shows great improvement compared to the last four years. Data from as early as 2015, show third graders performing only **4.1** percent on the state math test. Scores gradually increased with the biggest jump in 2016 to **22.3** percent. (www.PDE.org)

The need for a visually aligned, concept driven and student independent work developed unit is critical to help keep the trend moving upward but also for student growth and attainment. Students in my school struggle with math concepts I believe due to lack of efficient independent practice time, a pacing guide that doesn't allow time for mastery of required content and a curriculum that doesn't give enough problems for students to practice the content before moving to other subject matter. Therefore, one of the goals of this unit will be to ensure that students are given enough practice with fractions to allow mastery of the required eligible content. Making them more prepared for the state test and following grades where they have to build on these concepts taught and demonstrate mastery.

Content Objectives

The following objectives in this unit will allow students the opportunity to explore fractions.

(CC.2.1.3.C.1) Explore and develop an understanding of fractions as numbers.

(CC.2.3.3.A.1) Use the understanding of fractions to partition shapes into parts with equal areas and express the area of each part as a unit fraction of the whole.

(CC.2.3.3.A.2) Understand a fraction as a number on the number line; represent fractions on a number line diagram.

(CC.2.3.3.A.3) Explain equivalence of fractions in special cases, and compare fractions by reasoning about their size.

The following PA standards will be addressed in these lessons:

3.NF.1-Understand a fraction $\frac{1}{b}$ as the quantity formed by 1 part when a whole is partitioned into b equal parts; understand a fraction $\frac{a}{b}$ as the quantity formed by a parts of size $\frac{1}{b}$.

3.NF.2-Understand a fraction as a number on the number line; represent fractions on a number line diagram.

A. Represent a fraction $1/b$ on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into b equal parts. Recognize that each part has size $1/b$ and that the endpoint of the part based at 0 locates the number $1/b$ on the number line.

B. Represent a fraction a/b on a number line diagram by marking off a lengths $1/b$ from 0. Recognize that the resulting interval has size a/b and that its endpoint locates the number a/b on the number line.

3.NF.3- Explain equivalence of fractions in special cases, and compare fractions by reasoning about their size.

A. Understand two fractions as equivalent (equal) if they are the same size, or the same point on a number line.

B. Recognize and generate simple equivalent fractions, e.g., $1/2 = 2/4$, $4/6 = 2/3$. Explain why the fractions are equivalent, e.g., by using a visual fraction model.

C. Express whole numbers as fractions, and recognize fractions that are equivalent to whole numbers. *Examples: Express 3 in the form $3 = 3/1$; recognize that $6/1 = 6$; locate $4/4$ and 1 at the same point of a number line diagram.*

D. Compare two fractions with the same numerator or the same denominator by reasoning about their size. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with the symbols $>$, $=$, or $<$, and justify the conclusions, e.g., by using a visual fraction model.

Teaching Strategies

This unit will use grade appropriate activities to develop conceptual learning and understanding using some of the following strategies:

- ~Whole group learning with the use of developed Power Point
- ~Small group learning with the use of the developed Power Point
- ~Differentiated learning
- ~Shared, partner and independent work with the use of district material
- ~Hands on activities (modeling fraction circles, fractional number lines and equivalencies)
- ~Fraction math craft (optional; if time in the schedule allows)
- ~ Exit tickets, quizzes and assessments
- ~Online school required math program (Zearn.org)

Classroom Activities

Lesson 1 What's a Fraction?

Objective: SWBAT divide shapes into parts with equal areas. IOT explore and develop an understanding of fractions as numbers.

Duration: 2-45 minutes class periods

Materials:

- Pre-cut Fraction circles
- Crayons or color pencils
- Interactive math notebook
- Pictures of equally portioned fraction shapes. (Not all circles to show how most shapes can be used as fractions)

Teaching Procedure

Hook: Teacher and student will play a quick game of what is equal. Teacher will display on Smart Board through (5) slides or pictures, shapes that are portioned equally and not equally. SW call-out equal or not equal, SW have an opportunity to discuss what made the shapes portioned equal or not equal through think-pair-share.

Vocabulary introduction: Fraction, Numerator, Denominator.

Lesson: Discuss how fractions can be modeled and how one way that they are modeled is with a circle similar to a pie or pizza. How the model has to be portioned equally like in the examples of the hook.

TW show fraction circle and model how to portion a circle to model a fraction. **TW** model portioning the fraction circle into $\frac{1}{2}$ and then the **SW** portion with the teacher how to fold the fraction circle into $\frac{1}{2}$. Modeling will be done for $\frac{1}{4}$ and $\frac{1}{8}$.

SWBAT shade one portion of the folded circle with teacher modeling. **TW** explain that the shading of one portion of the circle is called the **numerator**. **TW** refer to the vocabulary. **SW** recite the meaning of numerator while shading the portioned fraction circle. **TW** ask students what they think the denominator is looking at the fraction circles that they portioned and how they know. **TW** review what a denominator is if needed. **TW** allow students to independently work on the remaining fraction circles. Shading and labeling the remaining benchmark fraction.

SW show and share their fraction circles and then complete an exit ticket identifying portioned fraction circles and identifying numerators and denominators.

Lesson 2 Fractions on a number line

Objective: **SWBAT** Understand a fraction as a number on the number line IOT represent fractions on a number line diagram.

Duration: 2-45 minutes class periods

Materials & Resources:

- Rectangular strips of paper
- <https://www.youtube.com/watch?v=d30xOClj6RA> (Fraction number line video)
- Fractions Power point presentation
- Exit Ticket

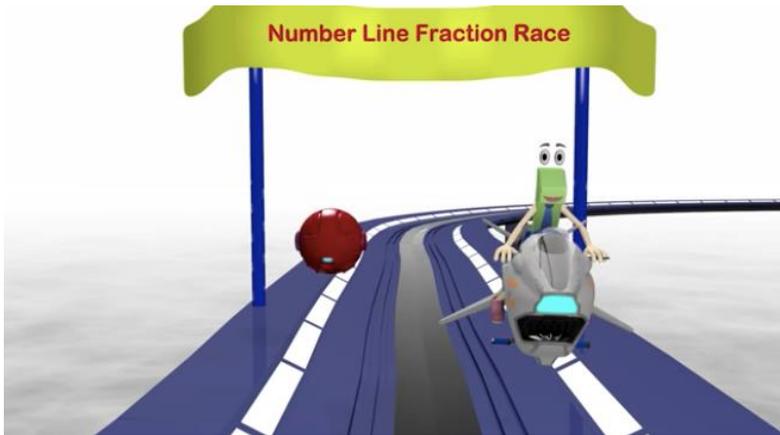
Teaching Procedure

Hook/Warm-up:

Review Vocabulary- SW demonstrate what a fraction, numerator, denominator looks like on dry erase boards. TW recall benchmark fractions and SW model those benchmark fractions on dry erase boards.

Discuss how fractions were modeled using a circle but that is just one way that they can be represented. Show an empty number line. Model how a number line has portions like the piece of the shapes that students modeled the previous day.

Show Video: <https://www.youtube.com/watch?v=d30xOClj6RA>



Lesson: TW model making a fraction number line to demonstrate how fractions can be represented without using a shape, TW use a rectangular strip of paper and fold making portions of benchmark fractions. SW then each get a rectangular strip of paper and will model portions of the benchmark fractions.

*** Flexibility- this part of the lesson, the video can be saved for review the next day, used as a small group intervention tool or refresher for students having difficulty with the concept.

TW introduce fraction power point and show slides of vocabulary words and fractions demonstrated on the number line. SW work with empty number lines, fill out the empty number lines along with the Power Point using it as a reference guide and discuss how folding the paper and then creating the number line helps in their understanding of fractions on a number line.

SW complete exit ticket that will have them explain how folding the paper and then creating the number line helps understanding how fractions can look on a number line.

Lesson 3 Equivalent Fractions

Objective: SWBAT Explain equivalence of fractions IOT compare fractions by reasoning about their size.

Duration: 2-45 minutes class periods

Materials:

- Students Pre-cut Fraction circles from lesson 1
- Crayons or color pencils
- Interactive math notebook
- Pre-cut fraction circles set 2
- Empty Fraction number line

Teaching Procedure

Hook 2-5 mins: Teacher and student will review power point slides from the previous lesson to show fractions on a number line. TW discuss how two fractions can look alike but have a different numerator and denominator. Power point slide will be used to show benchmark fractions that are equivalent.

Vocabulary introduction: Fraction number line, equivalent fraction

Discuss how equivalent means “equal” and fractions can be modeled to show that they are equal but have different denominators and numerators. SW use previous fraction circles and create new fraction circles that are equivalent.

Lesson: TW show one fraction circle and model how to portion a new circle to model an equivalent fraction. **SWBAT** work with the teacher modeling an equivalent fraction.

TW allow students to independently work on the remaining fraction circles. Shading and labeling the remaining benchmark equivalent fraction.

SW show and share their fraction circles and then complete an exit ticket identifying equivalent fraction.

Lesson 4 Comparing Fractions

Objective: **SWBAT** compare fractions **IOT** reason about their likeness and differences according to size.

Duration: 2-45 minute class periods

Materials:

- Student fraction strip template
- Fraction circles/student drawings
- Color pencils or crayons
- Interactive notebook
- Power point presentation

Teaching Procedure

Hook 5-7 min.: TW lead students in something called “Show what you know”. TW have students recall what they know about comparing numbers using greater than, less than and equal symbols. This is a previously learned skill from first and second grade and students should be secure and familiar with this skill. SW mention two numbers to the teacher who will then model

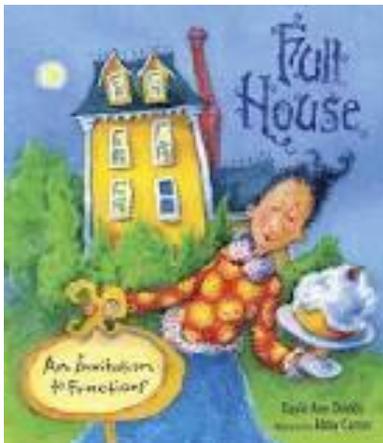
how to compare the two said numbers. **TW** draw a model of two fractions. **TW** ask student how can we compare these fractions to see which is greater, less or are they equal in size? **TW** inform students that comparing fractions is necessary and used in baking when you want to know if you are using the correct amount, and carpentry when you want to make sure that you are using the correct size. Based on the modeled drawing, **TW** have students turn and talk to others at their tables to discuss how the fraction is being compared. **SW** share their thoughts and answers.

Lesson: **TW** show power point section of comparing fractions and allow time for student feedback and discussion. **SW** work with partners and compare fractions, drawing models to help them see the pictorial versions of the fraction. This will continue to build on the knowledge being built about fractions. **SW** use anchor chart and power point information to help guided them through out the lesson as they complete the worksheet for comparing fractions.

Additional Lessons to Consider

Objective: **SWBAT** model fractions **IOT** demonstrate understanding of fractions as numbers through listening to a Math Read-a loud – Full house-an invitation to fractions by Dayle Ann Dodds.

This book can be read at the beginning of the unit to have students inquire about fractions or it can be read after a few lessons to check for understanding. I created a worksheet that can be used if you choose to use it **after** some lessons have been taught about fractions. I love this activity because it allows students to hear a book being read during math. It's always great to see the students' reaction to hearing a math story. Students who need extra help or those students who work at a slower pace can use the video version of the book being read to them on YouTube. This can be done during math workshop.

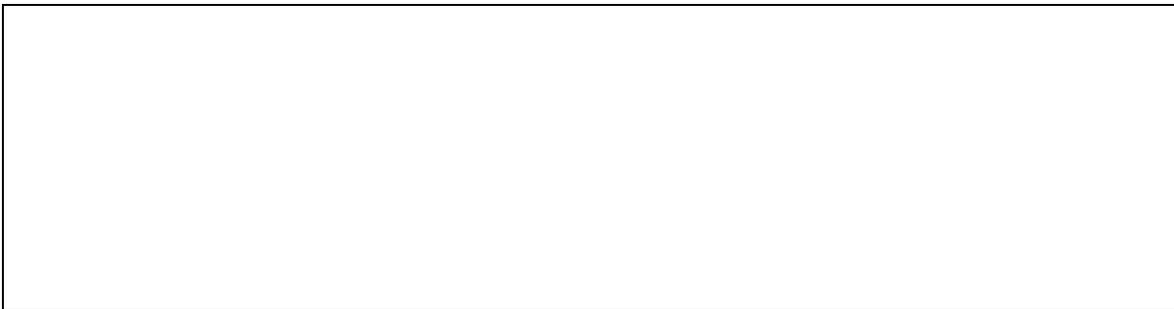


Date _____

Name _____

Full House- an invitation to Fractions

Directions: As the story is being read, fill in the shape below that would represent the fraction amount of the rooms that are being used. Color each section a different color. Then, answer the questions about how many rooms are left.



1. What is the fraction of the rooms left after the first guest arrives?

2. What is the fraction of the rooms left after the second guest arrives?

3. What is the fraction of the rooms left after the third guest arrives?

4. What is the fraction of the rooms left after the fourth guest arrives?

5. What is the fraction of the rooms left after the fifth guest arrives?

6. What is the fraction of the rooms left after the sixth guest arrives?

Show What You Know:

Create a Fraction Number line to show 2 of your favorite parts of the Full House Story.

1)

2)

Fraction Skittles- This additional lesson will show the connection fractions have to a group or

set. It has the students using a scaffold skill of graphing.

Objective: **SWBAT** classify fractions **IOT** know that fractions can be shown as part of a set of items.

Lesson: **TW** supply a fun size bag of skittles candy. (You can also use M&M's non-peanut variety.) **SW** sort the bag of candies according to color and graph the candies accordingly. After graphing students will write the colors graphed as a fraction. **SW** use the graph as an anchor chart to help guide their answers. **SW** explain how they were able to write each color as a fraction. Teacher should observe that students should be able to explain that they were able to write the fractions because the total number of skittles in the bag is the denominator. That the numerator is the total number of the different colors represented in their bag. **TW** remind students that the answer their partner may have will be different then the number they have because every bag of skittles has a different amount and different color amounts.

Color of Skittle	Number of Skittles	Fractional Representation of Color Out of the Whole
Red		
Orange		
Yellow		
Purple		
Green		
Total		

1. What is the total number of skittles?

2. Out of all the skittles in your bag, how many of them are red?

Write this number in a fractional form. _____

3. Out of all the skittles in your bag, how many of them are orange?

Write this number in a fractional form. _____

4. Out of all the skittles in your bag, how many of them are yellow?

Write this number in a fractional form. _____

5. Out of all the skittles in your bag, how many of them are purple?

Write this number in a fractional form. _____

6. 4. Out of all the skittles in your bag, how many of them are green?

Write this number in a fractional form. _____

Fraction Pizza Challenge- As a culminating activity to fractions, students can create a fraction pizza. This activity takes time. It can be started before the end of the unit to allow for students to have time to work on it a little everyday. You may need at least two to three weeks of class time for students to complete in class or it could be assigned as a at home assignment and returned within a week. Students will be given an actual small pizza box and asked to create a pizza inside the box.

Objective: SWBAT create a pizza model **IOT** demonstrate how fractions are modeled using a pizza. **SW** construct a pizza using construction paper, cutting out pizza toppings, sauce, cheese, and other pizza related items. The students will show the correct fractional pieces that a pizza can be cut into. Students will create a math key to show the fraction of pizza toppings that they used. If they put pepperoni over all the pizza for instance it could have a fraction of $\frac{8}{8}=1$ or if it's on half of the pizza it could have a fraction of $\frac{4}{8}=\frac{1}{2}$.

Citations

Monson, Debra, et al. *Justification as an Equity Practice*. Vol. 113, *Mathematics Teacher Learning*, 2020.

Salters, Jean E. "Predictive Factors of Student Mathematics Achievement Decline Between Third and Fifth Grade." *Walden University*, 2019.

"Schools." *Department of Education*, www.education.pa.gov/Schools/Pages/default.aspx.