A Picture's Worth

Summary

Students will work in small groups to analyze, record, and demonstrate the concepts of fractions.

Main Core Tie

Mathematics Grade 4

Strand: NUMBER AND OPERATIONS - FRACTIONS (4.NF) Standard 4.NF.3

Additional Core Ties

Mathematics Grade 4

Strand: NUMBER AND OPERATIONS - FRACTIONS (4.NF) Standard 4.NF.2

Materials

- Overhead pattern blocks

For each group:

- Yin Yang symbol

For each student:

- 3" x 5" index card
- Colored pencils
- Colored pencils/markers
- Construction paper pattern block pieces or pattern block stickers
- Large chart paper/student journals

For each pair:

- Tub of several pattern blocks
- 5" x 8" index card

Background for Teachers

One of the foundational steps in working with fractions is to understand the concept of the unit whole. If the unit whole is divided into four equal sized pieces, then each piece is 1/4 of the unit whole. A common misunderstanding that can occur is that the fractional piece always remains the same, when in fact, there is a direct relationship and if the unit whole changes, the fractional piece changes as well. In order for students to gain a working knowledge of this abstract concept, they must first begin with concrete lessons, and bridge to the abstract with pictorial representations. This is especially true for English Language Learners. For some students, it is helpful to think of fractions as equal portions, or fair share/fair trade. After students gain a mastery of the concept of the unit whole and its component parts, they will then be ready to tackle addition and subtraction operations with fractions. Components of the unit whole objective include an understanding of equivalency as well as an understanding of key vocabulary terms, including mixed number, improper fraction, and proper fraction. Just like a foreign language, for students to master the language of mathematics, they must be given numerous opportunities to practice using it in context. Students need to develop an appreciation of the need for precise definitions and for the communicative power of conventional mathematical terms by first communicating in their own words. Allowing students to grapple with their ideas and develop their own informal means of expressing the information can be an effective way to foster engagement and ownership. In this light, all students are MLL (math language learners) and should be combined together in pairs or small groups to analyze, record, and demonstrate the concepts of fractions. As they work together, they will be forced to use the mathematical language.

Student Prior Knowledge

Understand a fraction 1/b as the quantity formed by 1 part when a whole is partitioned into b equal parts; understand a fraction a/b as the quantity formed by a parts of size 1/b.

Intended Learning Outcomes

1. Demonstrate a positive learning attitude toward mathematics.
4. Communicate mathematically.
6. Represent mathematical situations.

Instructional Procedures

Invitation to Learn

Provide each small group a copy of the yin yang symbol. This example has 1/2 of the circle in black and 1/2 of the circle in white. Ask each student to take a 3" x 5" card and have them select a colored pencil. They are to color exactly 1/2 of their card, but the challenge is to do it in an interesting and creative way. At the conclusion of the activity, display all the cards and draw attention to the many different ways the objective was demonstrated.

Instructional Procedures

Have each pair of students select one larger pattern block piece (yellow or red) and several smaller pieces that are all the same color and that will cover the larger pattern block piece. Continue selecting and covering pieces until a number of relationships between pieces is discovered.

Using the markers and large chart paper, have each pair record these relationships and write the fraction that corresponds with it. It is suggested that you demonstrate with the first relationship using the overhead pattern blocks and provide a model for the students to follow.

Example: How many green equilateral triangles are in one yellow hexagon?

The students can then go on and discover how many triangles are in the red trapezoid, how many blue parallelograms are in the yellow hexagon, etc. You may even have a student discover that they can put two green equilateral triangles in a blue. As new relationships are found, stress the equivalency by noting and writing comments such as "3 blue parallelograms are in 1 yellow hexagon, so 3 parallelograms equal 1 yellow hexagon. 3/3 =1."

Have students express the mathematical relationships in their journals using colored pencils. Assign the yellow hexagon the value of 1. This makes it the "unit whole." Express the value of the other pieces in fractional form, in relation to the yellow hexagon (unit whole).

Example: If the yellow hexagon is the unit whole, then 1 red trapezoid equals 1/2."

Go over the pieces several times until the students are very familiar with the value of each piece when yellow is the unit whole. Make sure you include the phrase, "if 1 yellow hexagon equals the unit whole, then…" After the students have mastered the relationships, pick up one purple right triangle and ask them the value. They will probably say 1/12, but let them know that they must add the relationship to the unit whole. In other words, the correct answer is "if the unit whole equals 1 yellow hexagon, then the purple right triangle equals 1/12." Otherwise, they should have responded, "What is the unit whole?"

Once the students are comfortable with pieces and their relationship to the unit whole being the

yellow hexagon, select a new piece as the unit whole and express the revised values of the remaining pieces.

Example: If the red trapezoid equals the unit whole, what is the value of the green equilateral triangle? (1/3)

If the red trapezoid is the unit whole, what is the value of the yellow hexagon? (2)
Again using the yellow hexagon as the unit whole, select several pieces of the same color and determine the fractional value.

Example: 5 red trapezoids = 5/2. But we can combine them together to equal 2 1/2. This shows that 5/2 = 2 1/2.

Use explicit instruction to introduce the math vocabulary terms
- Equivalent Fractions (5/2 = 2 1/2)
- Improper Fraction (5/2)
- Mixed number (2 1/2)

Have students work with their tables to find other relationships between pattern block pieces that are greater than 1. Show both the improper and the mixed number. Once they have found their own relationships, have them find pieces that match your specifics, such as "How can you demonstrate 2 and 1/3 using just one kind of fraction piece?" Or, "What piece would you need to use to equal 2 1/2 and uses 10 of the same color?"

Distribute a 5" x 8" index card to each pair. Have them create a design using the construction paper pattern blocks or pattern block stickers that equals a specific total, with the yellow hexagon representing the unit whole.

Example: "If this yellow hexagon equals the unit whole, I would like you to select pieces that would total 3 1/2 and lay them on your paper. Write the value of each piece in relation to the unit whole, then write the corresponding mathematical equation, which should equal 3 1/2. Demonstrate that if you took 1 yellow hexagon, it would equal 1. If you took 3 red trapezoids, that would equal 1/2 + 1/2 + 1/2 or 1 1/2, and if you had 6 green equilateral triangles, it would equal 1/6 + 1/6 + 1/6 + 1/6 + 1/6 + 1/6 = 6/6 or 1. So our equation would be 1 + 1/2 + 1/2 + 1/2 + 1/6 + 1/6 + 1/6 + 1/6 + 1/6 + 1/6 = 3 1/2."

Extensions

To add a challenge for accelerated learners, you might require that they use an odd number of pieces, or at least three different colors, or at least seven pieces. Have them write a math sentence on their card that proves their total.

For students who struggle with this activity, you could adapt it by having them select all their pieces of the same color. For example the red trapezoid. They would then find out that the relationship to the hexagon equals 1/2. They could place three yellow hexagons on their desk, cover them with six red trapezoid pieces, and then add one more. They could then count the seven trapezoid pieces and express them as the improper fraction 7/2 = 3 1/2.

Have early finishers use the pattern block pieces to solve algebraic equations such as, "If 1 yellow hexagon + 1 blue parallelogram equals the unit whole, then what is the value of a green equilateral triangle?" Or, "If 1 yellow hexagon + 1 green equilateral triangle equal 1, then what is the value of the red trapezoid?" For an even more challenging activity: "If 1 green equilateral triangle and 1 red trapezoid = 2/3, then what equals 1?" Or, "If 1 yellow hexagon -- 1 blue parallelogram equals 1 1/3, then what equals 2/3?"

Materials

For each student:

Construction paper pattern block pieces or pattern block stickers

Black construction paper 3 1/2" x 5"

Glue sticks

Art Integration

Distribute a 3" x 5" piece of black construction paper to each student.

Have four students work together on one card to create a design using the pattern block pieces. (For better coverage, use combinations of red, brown, purple, and yellow...or blue, green, purple, and yellow.)

Once the initial pattern piece has been designed, replicate it on each of the other three black papers and then join them together to form a large design, similar to a quilt block.

Calculate the total of the large quilt block if the yellow hexagon equals the unit whole.

Music Integration

Have a variety of different types of sheet music available. Look specifically for different time signatures.

Duplicate a piece of sheet music for each student. With a quarter note representing the unit whole, what is the value of each measure?

Compare your findings with a variety of different selections. What generalizations can be observed?

Discover a variety of different ways that whole, half, quarter and eighth notes can be rearranged to equal the four beats in a measure.

Family Connections

Find items at home that are equivalent.

Example: 2 juice glasses equals 1 water glass; 2 sessions of piano practicing equals 1 T.V. news program.

Assessment Plan

With the students using the pattern blocks and teacher using the overhead pattern blocks, ask the students to respond by drawing the answer to questions similar to the following:

If 1 red trapezoid equals 1 unit, then the yellow hexagon equals _____

If the red trapezoid equals 1 unit, then the blue parallelogram equals _____

If the green triangle equals 1/2 of the unit whole, then draw the unit whole

_____

If the green triangle is 1/2 of the unit whole, then draw 2 1/2 units _____

If the blue parallelogram equals 2, then draw 1 unit _____

If the yellow hexagon equals 3 units, then the blue parallelogram equals

_____

If the red trapezoid equals 1/2, then draw 1 unit

_____

Students could also be assessed by responding in writing to:

Explain how you know that 1 unit whole = 6/6.

Write an equation showing a fraction that is equivalent to 1 1/2.

Draw three pictures showing an improper fraction.

Explain why pattern block pieces have different values in different equations.

Create a design and ask the students to find the value of the total if the unit whole equals 1 red trapezoid. Or find the value if the unit whole equals 1 green triangle.

Bibliography

Research Basis

National Council of Teachers of Mathematics. (2000) *Principles and standards for school mathematics*. Reston, VA.
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Texas Education Agency. (2000) *The Texas Successful Schools Study: Quality Education for Limited English Proficient Students*. ERIC Document Reproduction Service No. ED479 179
A study by the Texas Education Agency examined the variables contributing to the academic success of economically disadvantaged and language minority students. Data was collected from seven highachieving elementary schools with high poverty rates and high percentages of Limited English Proficient (LEP) students.

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