Rational Number Project

Fraction Operations and Initial Decimal Ideas

Lesson 10: Overview

Students develop an understanding of thousandths and begin to look at equivalence among tenths, hundredths, and thousandths. Students develop decimal order strategies by identifying the larger of two decimals, by sorting sets of decimals and by finding a decimal between two decimals.

Materials

- Classroom 10 x 10 Grid
- Student Pages A - F
- Orange and yellow crayons, pencils or markers for students.
- Completed Student Page A from Lesson 9

Teaching Actions

Warm Up

Name a decimal close to zero, one close to \(\frac{1}{2}\) and one close to 1. Describe the picture in your mind that helps you find the fraction.

Large Group Introduction

1. Explain: You may have encountered decimals in your science class when you measured volume using graduated cylinders, when you measured differences in mass before and after you added another substance, or when you measured the growth of a plant. Often in science you need a great deal of accuracy in your measurements.

2. Notice that these decimals have more digits to the right of the decimal point than the examples we have examined. \(0.432; 0.003; 0.106\)

3. Let’s consider what they mean.

4. Ask students to take out their 10 x 10 grid (Student Page A from Lesson 9) from last lesson that they 5.

Comments

This is a 2-day lesson.

Language is an important part of understanding decimals. Students struggle keeping track of whether the decimal is read as tenths, hundredths or thousandths. Unfortunately this issue isn’t helped when students name a decimal like .23 as “point 23” instead of 23-hundredths.

Accurate use of decimal language is one indicator of decimal understanding.
Teaching Actions

partitioned into 100 equal parts. Ask: If the large square is our unit, then what is one-tenth? What is 1-hundredth? To show hundredths, what did you do to each tenth?

5. Ask: If I want to shade in 4-thousandths of the grid I need to show thousandths. How can we partition the 10 x 10 grid to show thousandths?

6. After allowing time for students to determine a strategy to partition the grid into thousandths, summarize the steps: Divide one of the small squares into 10 equal parts. Do this on the class grid. Ask: How many parts would a tenth be partitioned into if you did that for each small square in 1-tenth? How do you know that? Now imagine that you did this for each tenth, how many equal parts in the whole grid? (You might want to record this information on the 10 x 10 grid showing that 100-thousandths = 1-tenth; there are 100 in each tenth; there are 1000 equal parts in all)

7. Now show 4-thousandths by dividing one small square into 4 equal parts, shading 4 of them black.

8. Shade 423-thousandths on the class grid. Here we want students to color the grid using 3 colors to emphasize the place value components of the decimal. Explain: Look at the classroom grid and examine the amount I have shaded (0.423). Ask: Describe that amount in terms of the number of tenths, hundredths and thousandths shaded in.

9. Record students’ descriptions using fractions:

\[
\frac{4}{10} + \frac{2}{100} + \frac{3}{1000}
\]

10. Now imagine if each square was divided into 10 equal parts. How many thousandths in the 2 small squares? How many thousandths in the 4 bars?

11. How many thousandths is that in all? \[ \frac{400}{1000} + \frac{20}{1000} + \frac{3}{1000} \] . Record as a single fraction \[ \frac{423}{1000} \]

Comments

This might not be obvious to students. In our experience students first suggested to divide each column in half. One student’s strategy was to partition one square into 4 equal parts then 8 parts and then realized that each small square needed to be divided into 10 equal parts if the total was to be 1000.

Classes have used different ways to “color” 1000ths. Most encourage students to use a pencil to partition 1 small square into 10 equal parts and to shade number of 1000ths needed with pencil. Another class developed their own language for 1000ths: “itty-bitty yellows”. They used the same crayon for 1000ths as 100ths but added the description that it was the “itty-bitty” yellow.

You aren’t going to partition all 100 squares into 10 equal parts. To show .423 shade in 4 tenths as orange; 2 hundredths in yellow. Then partition one of the hundredths into 10 equal parts and shade in 3 of those very small parts using the color black or whatever color your class decides to use.

Here is a sample of student work showing a decimal in thousandths
### Teaching Actions

12. Ask: How can we write that as a decimal? (.423) Help students make connections between the decimal and their initial description using the sum of three fractions and to the single fraction using thousandths.

13. Write these decimals on the board. Direct students to represent each decimal on the 10x10 grid using orange, yellow and a color for thousandths. Under each grid have them record the amount shaded as a sum or 2 or 3 fractions with denominators of 10, 100 and 1000. (Student Pages A and B)

- a. 0.304
- b. 0.034
- c. 0.004
- d. .119
- e. .109
- f. 0.019
- g. 0.82
- h. .012

### Wrap Up

14. As students work on Student Page A and B monitor student work to see that students are interpreting the grid model correctly.
   - Ask students to describe the model
   - Ask students to name the amount shaded using place value language (3 tenths + 0 hundredths and 4 thousandths) and fraction language (304-thousandths).

15. During class discussion to wrap up the lesson, make public any errors you see in the model. Purposefully select students who do model the decimals correctly and can use accurate language to describe their work to others.

### Day 2 of Lesson 10

**Small Group/Partner work**

1. Explain that this lesson is a day to practice their decimal work. As they solve the problems, students are asked to informally order decimals based on the grids to show decimals and to order decimals. As with fractions,
### Teaching Actions

1. Have students mark the decimal pairs on the 10 x 10 grid.
2. As students work on Student Pages C–F, ask them to explain how the model is used to solve the tasks.
3. Look to see if students can explain how they ordered decimals. Do they break the decimal into its components and compare? (See student thinking in the comments section)

### Wrap up

4. Present these decimal pairs to the class. Ask students to imagine each decimal on the 10 x 10 grid. From that mental image: Which is the larger decimal?

<p>| | |</p>
<table>
<thead>
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<tbody>
<tr>
<td>0.3</td>
<td>.025</td>
</tr>
<tr>
<td>.05</td>
<td>.09</td>
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<tr>
<td>.15</td>
<td>.015</td>
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<td>.8</td>
<td>.80</td>
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### Comments

Order ideas are important part of understanding the relative size of decimals. Students without mental images for decimals will bring whole number thinking to decimal order tasks. When ordering 0.75 and 0.9, a student might say .75 is bigger because as whole numbers 75>9. Below see how two students reasoned through this order task using mental images of 10 x 10 grid:

- 75-hundredths and 9-tenths. Seven rows and 5 hundredths. Nine rows. 9-tenths is bigger.
- 9-tenths would be greater than 75-hundredths. I see 9 orange bars and 7 orange bars and 5 yellow squares.

Consider the role of the 10 x 10 grid in these students’ explanations.

- Which is bigger .5 or .055? I see 5 hundredths and half of a square since there are 10 thousandths in each square and 5 is half of it. And I picture \( \frac{1}{2} \) of a whole square, the grid. .5 is bigger.
- Which is bigger .9 or .009? 9 tenths. I picture that there are 100 boxes and 90 of them are full. With 9 thousandths it would be almost one little box. 9 tenths is bigger.

In this next example, the teacher helped the student overcome a misunderstanding by asking her to think of the 10 x 10 grid and to describe what she saw in her mind. Initially when ordering .245, .025, .249, .3 the student said .3 was the smallest even though she ordered the other three decimals correctly.

T: I was wondering about 3-tenths. Do you think the 3-tenths is the
<table>
<thead>
<tr>
<th>Teaching Actions</th>
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<tr>
<td>smallest? How many tenths are in .245? S: 2 tenths T: Can you picture that decimal on the grid? How many orange strips would this be? S: There would be 2 oranges, 4 yellows and ½ of a square. T: And how many oranges for .3 S: 3. 3 tenths is the biggest.</td>
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Modeling many decimals with the 10 x 10 grid enabled these students and others to overcome any whole number thinking most students bring to decimal tasks.

**Translations:**
- Symbols to pictures to verbal
- Symbols to pictures to symbols
Name a decimal close to zero, one close to $\frac{1}{2}$ and one close to 1.

Describe the picture in your mind that helps you find the fraction.
Naming Tenths, Hundredths and Thousandths on a 10 x 10 Grid

Show each decimal that your teacher lists on the board on a 10 x 10 grid. Use orange for 10ths, yellow for 100ths and whatever color your class decided upon for 1000ths. Then record the amount shaded as a sum of 2 or more fractions.
Decimals

Be ready to explain your work to the class.

1) Use the grid below to find three numbers between 0.07 and 0.08. Explain how you know the numbers are between these two.

![Grid](image)

2) Circle the smaller number: 0.025 0.03. Explain how to use the grids below to support your answer.

![Grid](image)
3) Determine if the sentences are true or false. Use the grids to support each answer.

0.40 = 0.4

.880 = .8
.098 = .980

.234 = .24
Imagine each decimal on a 10 x 10 grid. Describe each decimal. Then order each set from greatest to least:

| 2.32 | 3.082 | 2.157 |

Name three decimals less than one but greater than $\frac{1}{2}$. Describe what they would look like on a 10 x 10 grid. How do you know that they are greater than $\frac{1}{2}$?

Name three decimals equal to $\frac{1}{2}$. Describe what they would look like on a 10 x 10 grid. How do you know that they are equal to $\frac{1}{2}$?

| 0.625 | 0.25  | 0.675 | 0.8   |
Post Lesson Reflection

Lesson_________________

1) Number of class periods allocated to this lesson: ______________

2) Student Pages used: ______________

3) Adaptations made to lesson: (For example: added extra examples, eliminated certain problems, changed fractions used)

4) Adaptations made on Student Pages:

5) To improve the lesson I suggest: