Making Green Paint

With the Proportion Playground Simulation

Warm Up - click here
Instructions to Project - click here
Activity Sheet - click here

Overview

BACKGROUND

This activity addresses two of the most important types of reasoning in proportional reasoning: the ability to analyze change in both absolute and relative terms. Students demonstrate absolute reasoning when they focus on changes that occur independent and unrelated to anything else. When using absolute reasoning, students focus on actual growth (i.e. how much is added in the change situation). For example, if a student is 4 feet tall at the end of 3rd grade and is 5 feet tall at the end of 5th grade, a student reasoning absolutely would say that they student grew 1 foot. Absolute thinking is additive thinking.

On the other hand, a student who is reasoning using relative thinking would think about the change in terms of multiplicative thinking. In relative thinking, the change is thought of in terms of how one quantity changes in relation to another. Thus, students are focusing on relative growth. For example, if the same student is 4 feet tall at the end of 3rd grade and is 5 feet tall at the end of 5th grade, a student reasoning relatively would say that they student grew 1/4th of her third grade height. Relative thinking is multiplicative thinking.

In proportional reasoning, it is very important that students move beyond absolute thinking and be able to apply relative thinking when analyzing proportional situations. Relative thinking is also extremely important in initial fraction instruction.

PRIOR KNOWLEDGE

Students should:

- Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (CCSS: 6.RP.1)

LEARNING GOALS

- Students will use relative thinking to solve mixing problems using a paint mixing simulation.
- Students will contrast absolute (additive) thinking and relative (multiplicative) thinking when reflecting on the activity during partner and whole group discussion.

Common Core Standards	**Common Core Practices**
Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. (CCSS: 6.RP.3)	MP.1 Make sense of problems and persevere in solving them MP.3 Construct viable arguments and critique the reasoning of others. MP.6 Attend to precision MP.7 Look for and make use of structure MP.8 Look for and express regularity in repeated reasoning.

MATERIALS
• PhET *Proportion Playground* simulation: https://phet.colorado.edu/sims/html/proportion-playground/latest/proportion-playground_en.html • Computers/tablets for each student or pairs of students. • Activity Sheet: Making Green Paint with Proportion Playground (one for each student) • Instructions: Making Green Paint with Proportion Playground (to project and/or handout)
Lesson Cycle
WARM-UP *5 minutes*
Practice the language of ratios by having students complete the Warm Up. You can choose to provide a copy to each student or project the Warm Up for the whole class. Launch the Warm Up by having a quick discussion of the rabbits and pigs example. Invite as many students as possible to describe each image using ratio language.

INTRODUCTION *7 minutes*	
Teacher will…	*Students will…*
Project the instructions for Step #1. **Give** students time to explore the simulation.	**Follow** instructions for **Step #1** and explore Proportion Playground.

Lead a whole class discussion about what students figured out about how to use the sim and interesting things that they discovered. If it doesn't come up, specifically point out the yellow eye  in the "Predict" screen will be an important button in the activities. Tell students that the instructions will tell them when to push the blue eye. Emphasize that the activities will work best if they don't push it too soon.	**Participate** in a whole class discussion about what they discovered.
GUIDED EXPLORATION	
Teacher will…	*Students will…*
Project or hand out the instructions for Step #2 and #3. **Review** the instructions for Step #2 and #3. Make sure students know that they will be working in the "Predict" screen. **Ask students to begin working**. **Circulate around the room** to make sure students are working in the "Predict" screen. Challenge students to find more than one way to make the greenest paint. Remind students to stop when they finish Step #3.	Open the **Predict** screen and select the paint scene. **Work** through Step #2 and #3

Lead a discussion about how students made the greenest paint and any patterns they noticed. Make sure to encourage students to use the *ratio language* that was practiced in the Warm Up. Model the language as necessary.	
DISCUSSION	*15 minutes*
Teacher will…	*Students will…*
● **Prepare the class** for a summary discussion of the big ideas: o Equivalent fractions are fractions that represent the same amount and can have different numerators and denominators. o Equivalent fractions are those fractions whose numerator and denominator are in the same ratio as that of the original fraction. ● **Remind** students to close their laptops or turn around so that the sim does not distract them from listening. Use an established teaching strategy such as popcorn discussion (one student answers, calls on the next student to talk), think-pair-share (pose question, allow time to think, turn and talk to partner), or group discussions (print out questions and have groups talk to each other and write down consensus to share aloud with class). ● **Begin** by discussing students' answers to Question #2b,c,d (Note: you may consider recording students' work using the table the table that was created earlier showing the	**Participate** in the whole class summary discussion

variety of students' representations for #2a). Questions might include: 1. In question #2, were there some representations that confused you? What are they? What is confusing about them for you? 2. What relationships do you notice between the numerators and denominators of all the fractions in each column? (question #2c on activity sheet) 3. How do we know __ and __ are equivalent from their visual representations? 4. How do we know __ and __ are equivalent by just looking at their values? 5. How would you explain to another student why __ and __ are equivalent? 6. What are some other fractions and/or visual representations that are equivalent to __ and (ask several students and generate a long list to include fractions that don't appear in the sim). 7. What are some fractions that are equivalent to __? (make a long list). What relationships between the numerator and denominator are we using to make this list? *(start the discussion with this question if you feel students can jump write to it)* 8. How many different ways can we write __ using equivalent fractions? ● **Continue** the discussion by having students share their answers to #4,5,6.	
SUMMARY	

Teacher will… ● **Summarize** the discussion by asking more general questions such as: 1. What questions do you still have? 2. Did anyone *not* answer another question? Share out and call on someone who can answer it. 3. Who can explain how they know when fractions are equivalent? 4. What is your strategy for writing equivalent fractions? For example, if I ask you to write fractions equivalent to ⅘, how would you do it.	*Students will…* **Participate** in the summary discussion.
EXIT TICKET	
Teacher will… ● **Ask** students to draw at least two different fraction representations that are equivalent to each other and label each representation with the fraction it represents. ● **Alternatively,** you might choose to specify a specific fraction and ask students to draw and label two or more representations of fractions that are equivalent to the given fraction.	*Students will…* **Complete** and hand in the exit ticket.