EXPLORATIONS

Activity 12

Tints and Shades

Concepts/Skills

- Fractions
- Percentages
- Ratios
- Problem-solving

Materials

For each group of 4 students:

- TI–15 calculators
- Four 4-oz. cans of water-base paint (white, black, red, and one other color)
- 15 small paper cups for mixing paint
- 4 medicine syringes showing cubic centimeters or milliliters (one for each color of paint)
- 15 small paint brushes
- White construction paper
- Newspapers (for covering desks)
- Container of water (for washing syringes and brushes)

For the teacher:

- Red, yellow, blue transparency film
- Overhead projector

Overview

Students will work in cooperative groups to solve a problem involving mixing paint colors. Color charts will be used to help students determine the fractional parts and percentages of colors used to create tints and shades.

Background information

- A color chart of tints or shades shows a succession of color samples. A tint color chart shows an increasing amount of color added to white paint. A shade color chart shows an increasing amount of black added to a color. To solve the problem, groups of students will create either a tint chart or a shade chart. To prepare them for this experience, all student groups will create samples of tints and shades using red, white, and black paint. The chart showing the measurements to be used is included on the *Tints and Shades Problem* page.

- To help the students measure the paint accurately, use infant medicine syringes. (These syringes can be found in most grocery and drug stores.) To fill the syringe, push the plunger all the way in, place the open end of the syringe in the paint, and pull the plunger out to the desired amount. Place the syringe in the mixing cup. Push the plunger in and the paint squirts into the cup.

Focus

- Discuss how different colors of paint are made with the students. Use color transparencies on the overhead to "mix" red and yellow, yellow and blue, and blue and red. Discuss the different colors that are made using the transparencies.
- Show the students a color chart from a paint store. Select a chart that shows gradual changes in one color. Have the students make conjectures about how each color could have been made. Record the conjectures.

Presenting the Problem

1. To prepare the students for the problem, have groups of students create a sample color chart using the chart on the *Tints and Shades Problem* page. Help them fill the medicine syringes with an accurate measure of each color. Each color must have its own syringe. Have them mix each color thoroughly in the small cups. Have each student use the brush to paint a small circle (about 1" in diameter) of each color. Each shade or tint should have its own brush.
2. Review the four steps of problem solving with the students:
   - understanding the problem
   - making a plan
   - carrying out the plan
   - evaluating the solution

   Have the students read the *Tints and Shades Problem* page and paraphrase the problem. Make sure the students understand the difference between shade and tint. The problem requires 12 tints or shades while the charts only show 6 tints or shades. Have the students discuss ways to create additional tints or shades.

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3. Have each group plan a process to solve the problem from the *Tints and Shades Problem* page. If students have difficulty, have them use the *Things to Consider* page to guide them.

Evaluating the Results

1. When the groups have completed the task, have them present their results. If all of the groups followed the pattern for mixing colors shown on the chart, the results should be very similar. If students chose a more random approach to the problem, the calculated amounts could be quite different and still correct. Allow groups time to check the calculations on all charts.
2. Discuss questions like:
   - *Did everyone attack the problem in the same way?*
   - *How do you know?*
   - *Did any group have similar results to your results?*
   - *Why do you think that happened?*
3. Have the students find a group whose results were similar to their own.
   - *Why do you suppose your results were similar?*
   - *Did any group have similar numbers but not the same colors?*
   - *Why do you suppose this happened?*
4. Ask students to analyze different ways they used the calculator to solve the problem.

Student Activity

Name _____

Date _____

Activity 12

Tints and Shades

The Problem: How can a particular shade or tint be made when mixing large quantities of paint?

A paint company has asked your team to create a sample color chart to be used for manufacturing paint. You may choose to create either shades or tints. Your team must determine the amount of each color needed to make one batch of each shade or tint you create.

The Facts

- Adding small amounts of black to a color creates shades
- Adding small amounts of color to white creates tints
- A milliliter is equivalent to a cubic centimeter

A color chart shows progressive changes in the shade or tint of a color. Use the chart below to make a color chart of tints and shades of red.

Tints of Red						
White	5 cc	5 cc	5 cc	5 cc	5 cc	5 cc
Red	0 cc	1 cc	2 cc	3 cc	4 cc	5 cc

Shades of Red						
Red	5 cc	5 cc	5 cc	5 cc	5 cc	5 cc
Black	0 cc	1 cc	2 cc	3 cc	4 cc	5 cc

The paint company mixes paint in a large vat. The vat holds 960 liters of paint. One batch of paint equals 960 liters.

The Task

1. Your team will choose to make either tints or shades. Your team will create a chart showing the following information:
   - Samples of at least 12 different tints or shades of one color
   - The measured amount of each color of paint for each tint or shade
   - The fractional amount of each color of paint for each tint or shade

- The percentage of each color of paint for each tint or shade
- The number of liters needed of each color of paint to make a batch of each tint or shade

2. Each person on the team will write an explanation of the team's solution. This explanation will answer these questions:
   - How did you determine the fractional parts of each tint or shade?
   - How did you calculate the percentage of each color of paint for each tint or shade?
   - How did you calculate the amount of each color needed to make one batch of paint?
   - How do you know that the batch of paint will match your sample of paint?

Things to Consider

Understanding the Problem

Read the *Tints and Shades Problem* page, and then answer these questions.

- What paints do you mix to make a tint? When making a color chart of a tint, what color should be first? What do you do next to make another tint? If you want to keep samples of each tint, what should you do?
- What paints do you mix to make a shade? When making a color chart of shades, what color should be first? What do you do next to make another shade? If you want to keep samples of each shade, what should you do?
- Look at the mixing chart for tints. If you wanted to make 5 liters of one of the tints, what would you do? How do you know?

Making a Plan

Before you make your plan, answer these questions.

- Look at the mixing chart for tints. For the first tint, 5 cc of white was used and 0 cc of red. How much paint was used in all? What fractional part of that amount was white? What fractional part was red? How do you know? Look at the second tint. How much paint was used in all? What fractional part of the paint was white? What fractional part was red? How do you know?
- If you know the fractional part, how can you calculate the percentage? Calculate the percentages for the first two tints from the chart *on Tints and Shades Problem* page.
- Your color chart needs to show how to make a large quantity of paint. How can the fractions and percentages help you figure how much of each color you will need? How do you know?

Carrying Out the Plan

Before you begin your chart, answer these questions.

- What does your chart need to show? Do you have all of the necessary information? What other calculations do you need to make?
- How will you display your information on the chart? Where will your color samples go? What kind of chart could display the rest of the information? What additional information will you show on your chart? What other information do you know that might make your chart more informative?
- How can you make your chart clear and understandable to the class? Are the letters large enough? Is it easy to read?

Evaluating the Solution

- Did you answer the question on the *Tints and Shades Problem* page? How do you know?
- Does your answer make sense? Is the total amount of paint used for each batch the same? Should it be? How do you know?
- Did everyone in the group write an explanation?
- How did you use the calculator in your investigation? Did anyone use it in a different way? How did your results compare?

Using the Calculator

Name _____

Date _____

Tints and Shades: Converting fractions to percents

Try this problem with the calculator:

1. Mr. Garcia's class has 23 students. Fourteen of the students are boys and nine of the students are girls. What fraction of the class is boys? What percent of the class are boys? What fraction of the class are girls? What percent of the class are girls?

   The total number of students is the denominator of the fraction. The number of boys (or girls) is the numerator.

Press:	The display shows:
14 [n] 23 [d] [Enter]	

This is the fraction of the class that is boys.

Press:	The display shows:
[F↔D]	

This is the decimal equivalent of the fraction.

Press:	The display shows:
[▶%] [Enter]	

This is the percent of boys in Mr. Garcia's class.

Press:	The display shows:
9 [n] 23 [d] [Enter]	

This is the fraction of the class that is girls.

Press:	The display shows:
[F↔D]	

This is the decimal equivalent of the fraction.

Press:	The display shows:
▶% Enter	

This is the percent of girls in Mr. Garcia's class.

2. On last week's mathematics test, Tabitha got 38 of the 43 problems correct. What percent of the test did she complete correctly?

   Another way to find percent is to divide the numerator (the number correct) by the denominator (total number of questions). What number would be the numerator? What number would be the denominator?

Press:	The display shows:
38 ÷ 43 Enter	

This gives the decimal equivalent of the fraction. To change the decimal fraction to a percent, multiply the decimal fraction by 100.

Press:	The display shows:
× 100 Enter	

This gives the percent of the test Tabitha got correct. Note: Use the Fix 0.01 to round to the nearest hundredths place.