

LESSON 13

How Many Ways?

Algebra and Function

Objectives . . . Students will be able to:

- ◆ Recognize, describe, extend, and create a wide variety of patterns.
- ◆ Represent and describe mathematical relationships.
- ◆ Explore the use of variables and open sentences to express relationships.

NCTM Standards and NAEP Strand

Concepts learned and applied in Lesson 13 correlate to NCTM Standards 1, 2, 3, 4, 6, 7, 8, 12, and 13; and NAEP Strand 5 (Algebra and Functions).

Materials List

Each Group

- A 100 Chart.
- Base ten blocks.
- Various counting objects, such as bottle caps, tokens, chips.

Each Student

- A copy of BLMs 13-A and 13-B for the “You Try It at Home” activities.

To Prepare Your Students

Introduce today’s video topic and ask questions designed to ascertain if the students are familiar with the Student Prerequisites and Key Words and Terms. Present some simple examples of the type of problem to be explored—e.g., What does “equal” mean? Can anyone show me a number sentence that uses “equal”? When I say I am using a “strategy” to solve a problem, what do I mean? Is it true to say that five nickels equal one quarter? . . .

Video Overview

In the opening sequence of the video, a child uses a calculator to investigate a problem; two students are using construction paper shapes to make new shapes; a peg-and-string board is used to make a geometrical shape. How many ways are there of solving the same mathematical problem?

Video Lesson

The Vending Machine Problem

A boy at a vending machine wants to buy some juice and he has many different coins. How many different combinations of coins can he use to buy juice for 50 cents?

Student Prerequisites

- ◆ Understand coin values for nickels, dimes, and quarters.
- ◆ Basic computation strategies such as counting on, counting back, counting by fives, tens, etc.

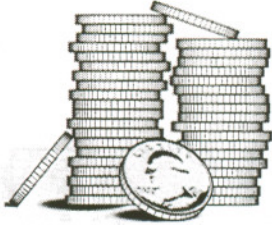
Key Words and Terms

number sentence equality
strategy
equal



YOUR CLASS MAY WANT TO TALK ABOUT THIS NOW.

Use the following questions to help your students explore and record possible coin combinations which equal 50 cents.



What coins can you use?

How many combinations do you think you might find?

Can you develop a strategy for keeping track of these combinations?

Give your students time to discuss and select a strategy; for instance, an organized list: Could you use only nickels? only dimes? only quarters?

Allow students time to report and compare findings.

Play

Jumping Rope

Sue Gehn of Nichols Elementary has a special problem. She jumped rope for charity last year and jumped 173 times. Her goal this year is to jump 200 times. How many more jumps does she need to make 200? Is there more than one way to find out?



YOUR CLASS MAY WANT TO TRY THIS NOW.

Introduce the counting materials available for this activity. Reiterate the problem (She jumped 173 times last year. Her goal this year is 200. How many more jumps does she need?) and remind students to find multiple strategies for solving the problem.



As the groups work on their strategies, encourage them to use their counting objects. If they need help in finding additional strategies, you may want to use the following questions:

Can you write a number sentence to represent your solution?

Can you explain your reasoning?

Will using a different counting object change your number sentence?

Is there a way to solve this using addition? subtraction? multiplication?

After they have worked out the problem, but before they present their solutions, play the video showing how other kids solved the problem.

Play

Watch the ways the children on the video solve the problem. The video then asks:

IS THIS SOLUTION LIKE YOURS?

Note: Question is on-screen but there is no stop sign. Teachers should pause at this point and ask each group to present its solution. Encourage your class to think about all the solutions and remind them that there are many possible solutions.

Play

Class Attendance

How many students are present in class today? Are there other ways the girl can count to check attendance?



YOUR CLASS MAY WANT TO TALK ABOUT THIS NOW.

Use the following questions to help your class identify different strategies of solution.

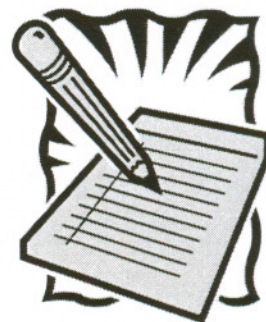
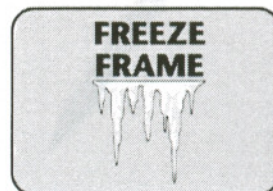
How many strategies can you think of to solve this problem?

What number sentence could you write for this problem?

After the students have found two strategies to solve the problem, you may want to have them write number sentences that match each strategy. How many number sentences are possible?

In the final segment, the video imagines that there is a little person inside of a machine that makes change. How many ways are there to make change for a dollar? The video suggests . . .

YOU TRY IT!



EXTENDED ACTIVITIES

These activities are designed to extend the mathematics learning introduced in this lesson.

Set up a station with three kinds of shapes: hexagons, squares, and equilateral triangles (use pattern blocks or make your own shapes from construction paper). Assign hexagons a value of 6, squares a value of 4, and triangles a value of 3, to match the number of sides.

1. Have your students make different combinations using the shapes and calculate their values. (They can record their answers in number sentences.)
2. Have your students find different combinations of shapes that are equivalent. Record these equations as number sentences.

Example: 2 hexagons + 1 square = 4 squares.

$$6 + 6 + 4 = 4 + 4 + 4 + 4 \text{ or } 2(6) + 1(4) = 4(4)$$

3. Have your class play the "What's Missing?" Game. One child makes a combination of shapes, determines the total number of sides, then takes away some of the shapes. Another child tries to determine which shapes are missing.

Example: A child makes a combination of 2 triangles and 1 hexagon, which has a sum of 12. The child removes the hexagon and challenges the partner to find the missing shape(s).

Cross-curricular Activity

Pose the following problem to your class: It is early spring and you have some flower seeds you want to plant. It is too cold now, as the average daily temperature at this time of year is only 28° . The directions say to wait until the average daily temperature is 52° . The daily temperature rises by 3° a week. How many weeks until you can plant? Can you come up with three different ways to get your answer?

Writing Activity

Have students write a number riddle giving several clues about their secret number, then have classmates try to guess the number. (This would make a nice class bulletin board, with the secret numbers hidden under a flap.) Write your answer down and how you found out what the secret number was.

Example: I'm a multiple of 8.

If I drove this fast through town I would be speeding.

My value can be found using only dimes.

I am greater than 3 twelves, but less than 4 twelves.

(Secret number is 40.)

You Try It At Home

Two handout masters, numbered 13-A and 13-B, are provided in a booklet accompanying the Teacher's Guide; reproduce as many of these as you need. Reduced examples are also provided at the end of this lesson. These activities are designed to

extend and reinforce concepts taught in the lesson, and to enable parents or other caregivers to become more involved with students' mathematics learning.

Assessment and Criteria for Scoring

The following four proficiency categories may be used to evaluate student performance in response to Lesson 13. You may use these evaluation categories to assess student classroom performance and extended activity performance.

The problem: Students are given the problem of devising multiple strategies for determining how many more jumps their teacher will need to make this year.

Advanced Response: Student completely and correctly mathematically presents and explains more than three strategies for solving the problem.

Proficient Response: Student completely and correctly mathematically presents and explains three strategies for solving the problem.

Partially Proficient Response: Student completely and correctly mathematically presents and explains two strategies for solving the problem.

Minimal Response: Student completely and correctly mathematically presents and explains one strategy for solving the problem.

Attempted Response: Student presents at least one strategy for solving the problem, but there are some flaws in the mathematics of the presentation or explanation.

References And Resources

National Council of Teachers of Mathematics (1989) Curriculum and Evaluation Standards for School Mathematics. Reston, VA: The Council.

Standard 1 : Mathematics as Problem Solving.

Standard 2 : Mathematics as Communication.

Standard 3 : Mathematics as Reasoning.

Standard 4 : Mathematical Connections.

Standard 6 : Number Sense and Numeration.

Standard 7 : Concepts of Whole Number Operations.

Standard 8 : Whole Number Computation.

Standard 12 : Fractions and Decimals.

Standard 13 : Patterns and Relationships.

NAEP Strand 5 (Algebra and Functions).



Suggested Children's Literature

Mannis Charosh, *Number Ideas through Pictures*

Robert Froman, *A Game of Functions*

Cyril Hayes and Dymphna Hayes, *Number Mysteries*

Masaicharo Anno and Mitsumasa Anno, *Anno's Mysterious Multiplying Jar*

David Birch, *The King's Chessboard*

You Try It At Home 1 and 2

Making Change

Ask an adult at home or other care-giver to help you with the following project.

1. How many ways can you make \$1.00 using half-dollars, quarters, dimes, and nickels? Record your solution in the space below.

I Wonder . . .

Can you solve these? Write a number sentence that represents your solution for each of the following situations. Ask an adult at home or other care-giver to help you with the following project.

1. When the Chicago Bulls played the L.A. Lakers, Michael Jordan of the Bulls scored 41 points. The Lakers' Magic Johnson scored 29 points. If the Bulls' final score was 115, how many points did the rest of the Bulls team score? How do you know?
2. Althea feeds her dog, Buddy, 2 cups of dry food once a day. She buys dog food in a large bag which contains 64 cups. She started with a full bag of dog food on Monday. How much is left in the bag the following Monday?
3. You got \$20 for your birthday from Aunt Sadie. You bought your favorite CD for \$14.89, which includes tax. How much change did you get?
4. Write a story problem that matches this number sentence.
 $45 + \underline{\quad} = 60$
5. Write your own story problem and solve it. Don't forget to write the number sentence.