

Discovering Math: The Nature and Use of Mathematics Teacher's Guide

Grade Level: 3–5

Curriculum Focus: Mathematics

Lesson Duration: Three class periods

Program Description

Discovering Math: The Nature and Use of Mathematics — From describing things in the real world to predicting outcomes to representing problems, introduce elementary students to more advanced concepts about the general nature and use of mathematics.

Lesson Plan

Student Objectives

- Create and use a code for numbers 0–9.
- Use mathematical symbols to compare numbers.
- Use tally marks to represent numbers.
- Count and classify objects.
- Identify fractions of a whole group and write the fraction.
- Create a bar graph.
- Add, subtract, multiply, and divide whole numbers.

Materials

- *Discovering Math: The Nature and Use of Mathematics* video
- Symbol Chart (see below)
- Bag of items (17 counters, 10 rubber bands, 8 pencils, 6 erasers, 5 crayons, 7 straws, 3 paperclips)
- Items in the Bag Chart (see below)
- Graph paper
- Fraction Activity Sheet (see below)
- Number Cards (see below)

Procedures

1. Ask students to identify symbols they are aware of and what those symbols represent. Remind them that symbols are used in math. Ask if they can identify and explain any mathematical symbols.

Tell students that they will create their own symbols to represent numbers and use the symbols to solve problems.

- Display the following:

$$\heartsuit = 3$$

$$\bullet = 5$$

$$\clubsuit = 8$$

$$\text{So, } \heartsuit + \bullet = \clubsuit$$

- Discuss how the symbols represent specific numbers and can be used in mathematical problems.
 - Allow students time to create their own symbols for numbers 0–9. They can record their ideas on the Symbol Chart. Have them write several computation problems using the symbols. Ask them to switch problems and symbol keys with a partner, solve the problems, and return them to author for correcting.
 - Encourage students to try two- and three-digit computation problems using their symbols.
2. Assign each student a partner. Distribute one bag of items to each pair. Tell them that they will be counting, classifying, finding fractions of the whole group, and creating a bar graph using the objects in the bag.
 - Have students classify the objects in the bag, count the number in each group, and record the data on the Items in the Bag Chart. They should record the name of each group, represent the quantity using tally marks, and indicate the number in each group.
 - Distribute the Fraction Activity Sheet. Model how to find the fraction of a whole group. Display four stars, three circles, and two squares. Ask the students what fraction of the group are circles. Elicit responses from students and have them share and explain their answers – $\frac{3}{9}$ of the group is circles. If students are able to reduce the fraction to lowest terms, discuss that $\frac{3}{9} = \frac{1}{3}$
 - Have students create a bar graph to represent the objects in the bag. Display a model bar graph and identify the main features (title, labels, axis, and bars). Tell students they will use the data from the Items in the Bag Chart to create a bar graph.
 - They may need assistance setting up the bar graph. Remind them to use appropriate intervals when labeling the y-axis.

- When they have completed their bar graphs have them share with the class.
3. Ask students to identify the four main operations in math (addition, subtraction, multiplication, and division). Discuss each operation, its purpose, and an example. Assign each student a partner. Distribute a set of Number Cards (0-9) and dice to each pair. Tell them that they will use the cards and the dice to practice addition, subtraction, multiplication, and division.
 - Addition – One student picks one, two, or three cards and makes a one-, two-, or three-digit number. The other student rolls the dice one, two, or three times and makes a one-, two-, or three-digit number. Both students add the numbers to find the sum. They can check their work on a calculator.
 - Subtraction – One student picks one, two, or three cards and makes a one-, two-, or three-digit number. The other student rolls the dice one, two, or three times and makes a one-, two-, or three-digit number. Both students identify the larger number and subtract the smaller number from the larger number to find the difference. They can check their work on a calculator.
 - Multiplication – One student picks one, two, or three cards and makes a one-, two-, or three-digit number. The other student rolls the dice one, two, or three times and makes a one-, two-, or three-digit number. Both students multiply the numbers to find the product. They can check their work on a calculator.
 - Division – One student picks one, two, or three cards and makes a one-, two-, or three-digit number. The other student rolls the dice one or two times and makes a one- or two-digit number. Both students identify the smaller number and divide the larger number by the smaller number to find the quotient. They can check their work on a calculator.
 4. Assign each student a partner. Distribute dice to each pair (2 dice if students are to work with 1 digit numbers, 4 dice if students are to work with 2 digit numbers, 6 dice if students are to work with 3 digit numbers). Have them roll the dice and make two numbers. Then write the numbers in comparative number sentences using the appropriate mathematical symbols (<, >, and =).
 - Have students work in groups of three or four, rolling dice to create numbers and writing three or more numbers in one comparative number sentence (e.g., $438 < 738 < 863$).

Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- **3 points:** Students produced and correctly used symbols for numbers 0-9 in computation problems; demonstrated the ability to count and classify objects; correctly identified and named fractions of a whole group; created a complete bar graph including all components (title, labels, axis, and bars); demonstrated the ability to add, subtract, multiply, and divide whole numbers; demonstrated the ability to compare whole numbers using appropriate mathematical symbols.

- **2 points:** Students produced and used symbols for numbers 0–9 in computation problems 80% of the time; satisfactorily demonstrated the ability to count and classify objects; identified and named fractions of a whole group 80% of the time; created a bar graph including 3 major components (title, labels, axis, and bars); correctly added, subtracted, multiplied, and divided whole numbers 80% of the time; demonstrated the ability to compare whole numbers using appropriate mathematical symbols 80% of the time.
- **1 point:** Students were unable to produce symbols for numbers 0–9 or used symbols in computation problems less than 80% of the time; did not demonstrate the ability to count and classify objects; identified and named fractions of a whole group less than 80% of the time; created a bar graph including only 1–2 major components (title, labels, axis, and bars); correctly added, subtracted, multiplied, and divided whole numbers less than 80% of the time; demonstrated the ability to compare whole numbers using appropriate mathematical symbols less than 80% of the time.

Vocabulary

bar graph

Definition: a graph that uses bars to show and compare data

Context: The students created a bar to represent the number of people who read 0, 5, 10, or 15 books during summer vacation.

difference

Definition: the answer to a subtraction problem

Context: The teacher asked the students to find the difference between 7 and 4. $7 - 4 = 3$, so the difference is 3.

fraction

Definition: a number that names a part of a whole or part of a group

Context: There are 10 students in the class and 9 of them completed the project. The fraction of students that completed the project is $\frac{9}{10}$.

product

Definition: the answer to a multiplication problem

Context: The product in the multiplication problem $5 \times 6 = 30$ is 30.

quotient

Definition: the answer to a division problem

Context: The quotient in the division problem $32 \div 8 = 4$ is 4.

sum

Definition: the answer in an addition problem

Context: The sum in the addition problem $5 + 4 = 9$ is 9.

symbol

Definition: a character used to represent something

Context: The + sign is the mathematical symbol that represents addition.

Academic Standards

Mid-continent Research for Education and Learning (McREL)

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit

<http://www.mcrel.org/compendium/browse.asp>.

This lesson plan addresses the following benchmarks:

- Understands that numbers and the operations performed on them can be used to describe things in the world and predict what might occur.
- Understands that mathematical ideas and concepts can be represented concretely, graphically, and symbolically.

National Council of Teachers of Mathematics (NCTM)

The National Council of Teachers of Mathematics (NCTM) has developed national standards to provide guidelines for teaching mathematics. To view the standards online, go to

<http://standards.nctm.org>.

This lesson plan addresses the following standards:

- Develop understanding of fractions as parts of unit wholes, as parts of a collection, as locations on number lines, and as divisions of whole numbers.
- Develop fluency in adding, subtracting, multiplying, and dividing whole numbers.
- Understand various meanings of multiplication and division.
- Understand the effects of multiplying and dividing whole numbers.
- Develop fluency in adding, subtracting, multiplying, and dividing whole numbers.
- Model problem situations with objects and use representations such as graphs, tables, and equations to draw conclusions.
- Represent data using tables and graphs such as line plots, bar graphs, and line graphs.
- Create and use representations to organize, record, and communicate mathematical ideas.

Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- <http://school.discovery.com/teachingtools/teachingtools.html>
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DVD Content

This program is available in an interactive DVD format. The following information and activities are specific to the DVD version.

How to Use the DVD

The DVD starting screen has the following options:

Play Video – This plays the video from start to finish. There are no programmed stops, except by using a remote control. With a computer, depending on the particular software player, a pause button is included with the other video controls.

Video Index – Here the video is divided into chapters indicated by title. Each chapter is then divided into four sections indicated by video thumbnail icons; brief descriptions are noted for each section. To play a particular segment, press Enter on the remote for TV playback; on a computer, click once to highlight a thumbnail and read the accompanying text description and click again to start the video.

Quiz – Each chapter has four interactive quiz questions correlated to each of the chapter's four sections.

Standards Link – Selecting this option displays a single screen that lists the national academic standards the video addresses.

Teacher Resources – This screen gives the technical support number and Web site address.

Video Index

I. Numbers in the World (7 min.)

Numbers in the World: Introduction

People use numbers and math for many reasons. See how doctors and nurses calculate a patient's heart rate.

Example 1: Determining How Many

People use numbers and math every day to determine different amounts, such as how many fruits fit in a bag or how much something weighs.

Example 2: Adding and Subtracting

Addition and subtraction are used to calculate the number of apples picked and the number remaining on the tree. Estimation is used to find the number of apples on two branches.

Example 3: Multiplying and Dividing

Multiplication and division are used to calculate the number of miles driven and how to split a pile of books into two equal groups.

II. Representing Mathematical Ideas (8 min.)

Representing Mathematical Ideas: Introduction

See how archaeologists use adding, graphing, counting, and fractions in their research.

Example 1: Numerical Representation

Numbers and fractions help keep track of the parts of a whole group.

Example 2: Graphical Representation

Pictures and graphs describe numbers and concepts. A bar graph represents how many girls like to wear different colored leotards.

Example 3 Algebraic Representations

Symbols are used in math to show relationships between numbers, such as $<$ for less than and $>$ for greater than.

III. Representation and Prediction (8 min.)

Representation and Prediction: Introduction

Many people use math in their job; numbers can represent and describe information, which can be represented in graphs and charts, and data can help make predictions.

Example 1: Numerical Representation

Amounts can be represented by models, numerals, or tally marks. The use of tally marks is explained and modeled.

Example 2: Graphical Representation

A bar graph can be used to display and compare data.

Example 3: Algebraic Representation

Equations help us solve problems. Math concepts can be represented by symbols, variables, numerals, and fractions. Understanding math facts can help predict future events.

Quiz

I. Numbers in the World

1. Sue's heart beats 11 times in 10 seconds. How many times does Sue's heart beat in one minute?
 - A. 21
 - B. 60
 - C. 66
 - D. 110

Answer: C

2. Paula sleeps eight hours every night. How long does Paula sleep in four nights?
- A. 4 hours
 - B. 12 hours
 - C. 24 hours
 - D. 32 hours

Answer: D

3. There are 23 apples on one branch. Chad picks 15 apples. How many apples are left on the branch?
- A. 8
 - B. 12
 - C. 22
 - D. 38

Answer: A

4. Madison checked out a library book to read over the weekend. The book has 38 pages. If she wants to read the same number of pages on Saturday and Sunday, how many pages must she read each day?
- A. 14
 - B. 16
 - C. 18
 - D. 19

Answer: D

II. Representing Mathematical Ideas

1. An archaeologist found some artifacts: 24 animal bones, 36 pieces of old plates, and 17 tools. How many artifacts did the archaeologist find in all?
- A. 53
 - B. 60
 - C. 67
 - D. 77

Answer: D

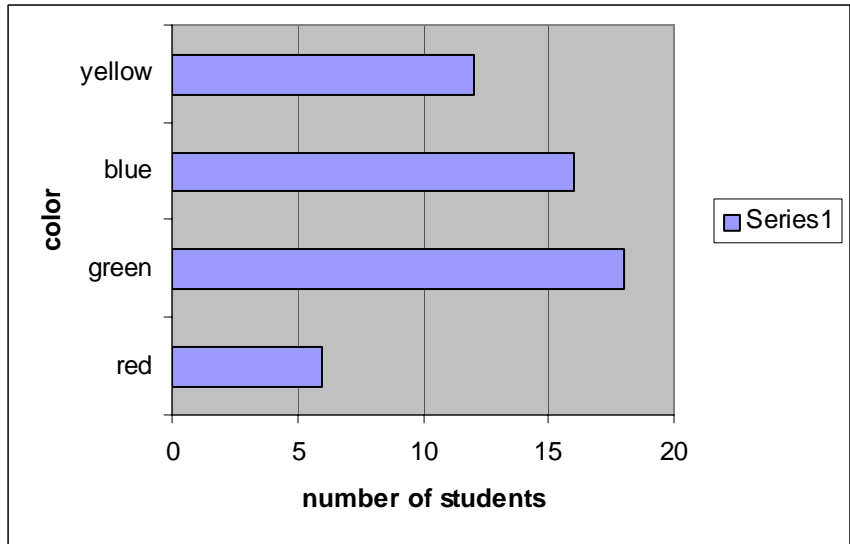
2. George has a bag of marbles. There are four green marbles, eight red marbles, and three blue marbles. What fraction of the marbles is red?
- A. $\frac{7}{8}$
 - B. $\frac{8}{15}$
 - C. $\frac{7}{15}$
 - D. $\frac{8}{12}$

Answer: B

3. Mr. Conti gathered information about his students' favorite colors and summarized the data in a bar graph. How many students like yellow?

- A. 12
- B. 18
- C. 2
- D. 6

Answer: A



4. Identify the number sentence that correctly compares 234 and 625.

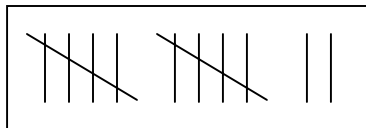
- A. $234 > 625$
- B. $234 < 625$
- C. $625 < 234$
- D. $625 = 234$

Answer: B

III. Representation and Prediction

1. What number do the tally marks represent?

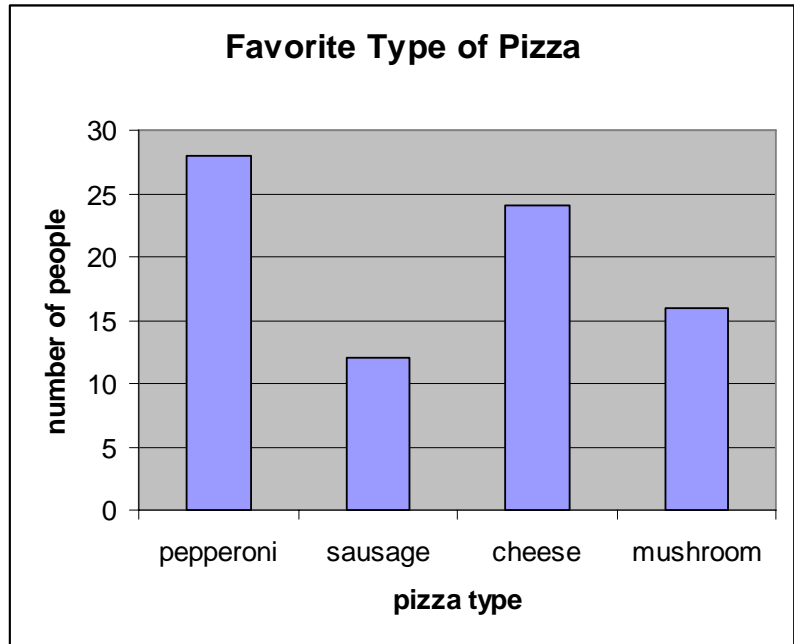
- A. 7
- B. 10
- C. 12
- D. 17



Answer: C

2. Use the bar graph to answer the question. What is the least favorite type of pizza?
- A. cheese
 - B. sausage
 - C. pepperoni
 - D. mushroom

Answer: B



3. During the past two hours, Old Faithful erupted for 23 minutes. What equation can you use to find out how many minutes Old Faithful was **not** erupting during the past two hours?
- A. $23 - 2 = 21$
 - B. $60 - 23 = 37$
 - C. $120 - 23 = 97$
 - D. $120 + 23 = 143$

Answer: C

Symbol Chart

Number	Symbol
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	

Items in the Bag Chart

Item	Tally	Number

Fraction Activity Sheet

Question	Fraction
What fraction of the objects are counters?	
What fraction of the objects are rubber bands?	
What fraction of the objects are pencils?	
What fraction of the objects are erasers?	
What fraction of the objects are crayons?	
What fraction of the objects are straws?	
What fraction of the objects are paperclips?	
What fraction of the objects can be used for writing?	
What fraction of the objects can be used to hold papers together?	
What fraction of the objects can be used to make an art project?	
What fraction of the objects are rubber bands and erasers?	
What fraction of the objects are straws and pencils?	
What fraction of the objects are crayons and paperclips?	
What fraction of the objects are rubber bands, crayons, and paperclips?	
What fraction of the objects are counters, erasers, and straws?	

Number Cards

0	1	2
3	4	5
6	7	8
9		