Discovering Math
Historical and Modern Uses of Mathematics
Teacher's Guide

Grade Level: 6-8	**Curriculum Focus:** Mathematics	**Lesson Duration:** Three class periods

Program Description

***Discovering Math: Historical and Modern Uses of Mathematics* —** From the use of mathematics to solve problems to representation of abstract ideas, introduce students to more advanced concepts about the general nature and uses of mathematics.

Lesson Plan

Student Objectives

- Describe the basic properties and operations of numbers.
- Explain how real-world data is represented mathematically.
- Represent data in charts and graphs.
- Design and carry out their own project to represent real-world data.

Materials

- *Discovering Math: Historical and Modern Uses of Mathematics* video
- Computer with Internet access
- Newspapers and magazines that contain data displays
- Calculator
- Graph paper

Procedures

1. Ask students to think about different ways to represent data (graphs, tables, charts, symbols). Have them share and explain their ideas.
    - Have students to look through textbooks, newspapers, or magazines for data represented as a graph, chart, or plot.

- Tell students they will represent the same data in a new way. They can create a formula, equation, draw different chart or graph, use tally marks, Roman numerals, or describe a model.
- Allow time for students to create the new representations. When finished, have them compare the two representations. Ask them to identify advantages and disadvantages of both representations.
- Have students share their representations with the class and explain the advantages and disadvantages of both. As a class decide which display is better and explain why.
- Have students discuss the benefits of representing data in several ways.

2. Have students look through newspapers and magazines to find three different uses of fractions. Ask them to write a sentence describing the way fractions are used in each example and how the applications are similar or different. As a class discuss why fractions are useful in many different contexts.
3. Ask students to consider how many students are in each grade in your school.
    - Have students identify a way to collect the data. Elicit different methods and ask the class to pick an appropriate one to carry out. Ask them to identify the mathematical operations and reasoning skills needed to collect, organize, and interpret the data.
    - Divide the class into pairs or small groups to collect the data.
    - Have each group represent the data in two ways. They should be able to justify their choices, listing the advantages of each representation. Students must use the correct format and labels for their representations.
    - Ask each group present their work to the class and discuss the advantages of each graph, chart, formula, or plot.
    - Have each student write statements about the data based on the representations. They should realize that a variety of statements can be made based on the type of display used to represent the data.

Assessment

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

- **3 points:** Students were highly engaged in class discussions; clearly demonstrated the ability to manipulate numbers; and clearly demonstrated the ability to represent data graphically and formulaically.
- **2 points:** Students participated in class discussions; demonstrated the ability to manipulate numbers at least 80% of the time; and demonstrated the ability to represent data using some graphical and formulaic methods at least 80% of the time.
- **1 point:** Students participated minimally in class discussions; demonstrated the ability to manipulate numbers less than 80% of the time; and demonstrated the ability to represent data using graphical and formulaic methods less than 80% of the time.

Vocabulary

axis

Definition: A line on a graph used as a reference for plotting data

Context: The familiar Cartesian coordinate system is usually represented with two axes, an *x*-axis and a *y*-axis.

bar graph

Definition: A type of graph in which the lengths of bars are used to represent and compare data in categories

Context: Lara surveyed her classmates on their favorite ice cream flavors. She displayed the results in a bar graph in which the lengths of the bars represented the number of classmates who liked each ice cream flavor.

Roman numerals

Definition: A ancient Roman number system using the letters I, V, X, L, C, D, and M

Context: XXVIII is the Roman numeral representation of the number 28.

scale

Definition: A proportion relating a dimension of a graph to some quantity of data represented

Context: Sally represented her basketball team's point totals in a bar graph and used a scale of one inch equals 10 points.

tally marks

Definition: Slashes and crosses used to count data

Context: Jim kept track of the number of license plates he saw from different states on a road trip using tally marks.

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 mathematics has been helpful in practical ways for many centuries.
- Understands that mathematicians often represent real things using abstract ideas like numbers or lines; they then work with these abstractions to learn about the things they represent.

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:

- Understand meanings of operations and how they relate to one another.
- Represent, analyze, and generalize a variety of patterns with tables, graphs, words, and, when possible, symbolic rules.
- Use graphs to analyze the nature of changes in quantities in linear relationships.
- Recognize and use connections among mathematical ideas.
- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
- Recognize and apply mathematics in contexts outside of mathematics.

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 (6 min.)

Numbers in the World: Introduction
People use numbers for many reasons in the real world. Watch doctors and nurses use math to calculate a patient's weight, height, blood pressure, and heart rate.

Example 1: Determining How Many
Use numbers and math to determine different amounts like how many fruits and vegetables to eat each day or how much something weighs.

Example 2: Adding and Subtracting
Use addition and subtraction to calculate the number of apples picked and the number remaining on a tree. Then use estimation to find the amount of apples on two branches.

Example 3: Multiplying and Dividing
Use multiplication and division to calculate how many miles are driven and how to divide a pile of books into two equal groups.

II. Representing Mathematical Ideas (8 min)

Representing Mathematical Ideas: Introduction
See how archaeologists use math skills like adding, graphing, counting, and fractions in their work.

Example 1: Numerical and Concrete Representations
Explore the use of numbers and fractions to keep track of the parts of a whole group.

Example 2: Graphical Representation
See how pictures and graphs describe numbers and concepts and explore the parts of a graph (axis, bars, and scale).

Example 3: Algebraic and Symbolic Representation
Investigate the use of special symbols to show relationships between numbers, such as the < and > symbols that show less than and greater than.

III. Representation and Prediction (9 min.)

Representation and Prediction: Introduction
See how people use math in their jobs. Numbers are used to represent and describe information and that information can be represented in graphs and charts.

Example 1: Numerical and Concrete Representation
Explore the use of tally marks and see how amounts can be represented by models, numerals, or tally marks.

Example 2: Graphical Representation
Investigate bar graphs and see how they are used to display and compare data.

Example 3: Algebraic Representation
Take a look at writing and solving equations and see how math concepts can be represented by symbols, variables, numerals, and fractions. Learn how math facts can help predict future events.

IV. Abstraction of Reality (7 min.)

Abstraction of Reality: Introduction
See how mathematics is used in everyday life to predict weather, explore space, make medical advances, measure heights, count items, and compare quantities.

Example 1: Ancient Math
Investigate the symbols used throughout history to represent numbers, such as Ancient Egyptian symbols and Roman numerals, and see how the Arabic symbols 1–9 are used today to compute numbers.

Example 2: Mathematical Abstraction from Observation
See how patterns and abstractions are made from mathematical observations.

Example 3: Abstraction Reflecting Physical Reality
Take a look at radiocarbon dating and learn how it is based on the mathematical processes of ratios and proportions.

Quiz

I. Numbers in the World

1. If Sue's heart beats 13 times in 10 seconds, how many times does it beat in one minute?
   A. 23
   B. 65
   C. 78
   D. 130

   Answer: C

2. If the recommended daily serving of vegetables is $1\frac{1}{2}$ cup, how many vegetables should you eat in one week?
   A. $7\frac{1}{2}$ cups
   B. $10\frac{1}{2}$ cups
   C. 13 cups
   D. 14 cups

   Answer: B

3. If there are 52 apples on one branch and Tony picks 14 of the apples, how many apples are left on the branch?
   A. 36
   B. 38
   C. 42
   D. 48

   Answer: B

4. Molly took a 138-page book out of the library to read over the weekend. If she wants to read the same number of pages on Saturday and Sunday in order to finish the book, how many pages will Molly read on Saturday?
   A. 69
   B. 64
   C. 52
   D. 46

   Answer: A

II. Representing Mathematical Ideas

1. A group of archaeologists found 24 animal bones, 36 pieces of old plates, and 17 pieces of tools. How many artifacts did they find in all?
   A. 53
   B. 60
   C. 67
   D. 77

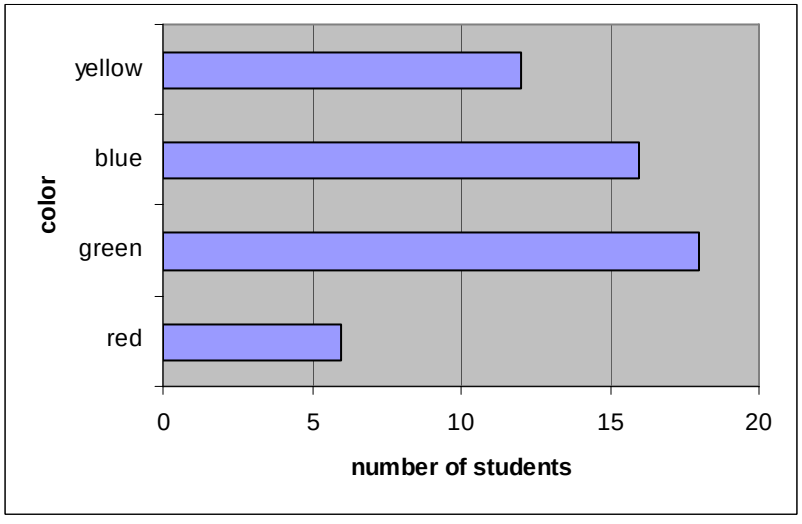
   Answer: D

2. There are 25 red cubes, 17 blue cubes, 40 green cubes, and 13 yellow cubes in a bag. What fraction of the cubes are either red or green?
   A. $\frac{5}{19}$
   B. $\frac{6}{19}$
   C. $\frac{8}{19}$
   D. $\frac{13}{19}$

   Answer: D

3. Mrs. Smith gathered data about her students' favorite colors and displayed the results in a bar graph. How many students prefer the colors blue and red?
   A. 18
   B. 21
   C. 22
   D. 28

   Answer: C

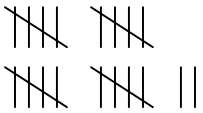


4. Identify the number sentence that correctly compares 467 and 647.
   A. 467 > 647
   B. 647 > 467
   C. 647 < 467
   D. 647 = 467

   Answer: B

III. Representation and Prediction

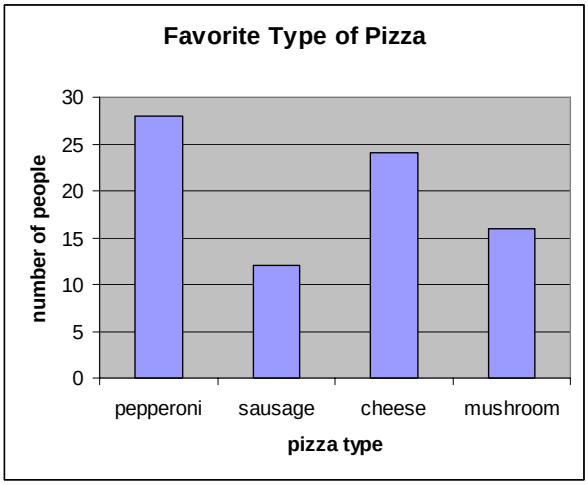
1. What number do the tally marks represent?
   A. 6
   B. 17
   C. 22
   D. 27



   Answer: C

2. Use the information in the bar graph to identify the true statement.
   A. More people prefer cheese than pepperoni.
   B. Less people prefer sausage than pepperoni.
   C. Less people prefer mushroom than sausage.
   D. More people prefer sausage than cheese.

   Answer: B



3. During the past two hours Old Faithful erupted 5 times for a total of 23 minutes. Which equation can you use to calculate the average length of each eruption?
   A. 1,380 seconds ÷ 5 = 4 minutes 36 seconds
   B. 23 minutes ÷ 5 = 4 minutes 3 seconds
   C. 1,380 seconds ÷ 5 = 276 minutes
   D. 23 minutes x 5 = 115 seconds

   Answer: A

IV. Abstraction of Reality

1. Kiera counted nine students on the playground and represented the number by writing IX. What type of symbols did she use to represent the number of students on the playground?
   A. Arabic symbols
   B. Roman numerals
   C. cardinal numbers
   D. Egyptian numerals

   Answer: B

2. Identify the mathematical system scientists use to estimate the age of artifacts they discover.
   A. radiocarbon dating
   B. ratio carbon dating
   C. carbon-nitrogen dating
   D. carbon proportional dating

   Answer: A

3. Which statement is true?
   A. A mathematical pattern provides little or no information to scientists.
   B. Patterns and abstractions can be made from mathematical observations.
   C. Patterns and abstractions can never be made from mathematical observations.
   D. The Law of Gravitation is based on one mathematical observation made by Newton.

   Answer: B