Discovering Math: Introduction to Problem Solving
Teacher's Guide

Grade Level: K–2	**Curriculum Focus:** Mathematics	**Lesson Duration:** Three class periods

Program Description

Discovering Math: Introduction to Problem Solving — From representative pictures to organized lists to whole number models, introduce young students to basic strategies for solving problems.

Lesson Plan

Student Objectives

- Follow a process for cooperative planning in designing and building a model or product.
- Draw a picture of a structure prior to building it.
- Participate in and contribute to a group problem-solving process.
- Explain the advantages of drawing a design before building a structure.
- Explain how testing a design may result in changes to a structure.
- Use a problem-solving process to create a tool to move marbles.

Materials

- *Discovering Math: Introduction to Problem Solving* video
- Bag of large building blocks
- Drawing paper
- Markers or crayons
- For each group, one bag containing the following items: 6 straws, modeling clay, 5-inch square of cardboard, 4 rubber bands, 4 pipe cleaners, tissue paper, and 12-inch string
- Organizing charts 1–3 (see below)

Procedures

1. Give each group a bag of large building blocks, and ask them to think about a building they could create. Instruct students to draw a picture of it. Older students can draw a diagram and label the parts of the building and the blocks they use. Have students create their buildings using the drawings as a guide. Have students compare the final products to their original drawings and share their buildings with the class. Hold a class discussion about the benefits of using drawings to create ideas and guide the building process.

   Depending on class makeup and grade, the activity could be done in pairs or in small groups. In either case, working together is the goal.

2. Tell students they will work together to solve this problem: Use some or all of the objects in a bag to create a tool that will move six marbles from one side of the classroom to the other. Give each group a bag containing the items listed above ("Materials"). Tell students to follow the problem-solving process in the video.

   - Discuss — Students discuss the problem and brainstorm solutions.
   - Draw or Diagram — Students create drawings or diagrams of tools that could move six marbles from one side of the classroom to the other.
   - Explain Solutions — Students discuss pros and cons of each solution with team members and determine the best solution.
   - Organize Information — Students record their ideas in a chart (see below). Once a solution is chosen, they make a list of materials needed, persons responsible for each job, and a schedule to complete the project. (Younger students may write their name next to one job.)
   - Model — Students work as a team to create a model of their tool. Students share their final products and original diagrams with the class, comparing the two.
   - Reflect — The students review how they followed the problem-solving process.

   This activity could be differentiated based on class makeup and grade level. Lower grade levels may have simpler materials and problems to solve. As enrichment, the students could choose the materials and the product to be made and switch with other teams.

Assessment

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

- **3 points:** Students produced complete drawings or diagrams, including all the requested information; clearly demonstrated the ability to work together as a team to solve a problem; final building project and tool for moving marbles were products of effective teamwork and were clearly explained and modeled.

- **2 points:** Students produced adequate drawings or diagrams, including most of the requested information; satisfactorily demonstrated the ability to work together as a team to solve a problem; final building project and tool for moving marbles were products of satisfactory teamwork and were somewhat explained and modeled.
- **1 point:** Students produced incomplete drawings or diagrams, including little or none of the requested information; were not able to demonstrate the ability to work together as a team to solve a problem; final building project and tool for moving marbles were ineffective due to lack of teamwork and were not clearly explained or modeled.

Vocabulary

diagram
Definition: A drawing or plan that outlines and explains the parts or operation of something
Context: Students draw diagrams before creating a block building.

model
Definition: A representation to show the structure of or serve as a copy of an object
Context: Students create a model of their tool to show classmates what their final product will look like**.**

problem solving
Definition: A systematic process for finding a solution to a problem
Context: Students use problem solving to create a tool for moving six marbles from one side of the classroom to the other.

teamwork
Definition: Cooperative or coordinated effort by a group of persons acting together as a team
Context: The students used teamwork to solve the problem.

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:

- Mathematics: Uses a variety of strategies in the problem-solving process.

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:

- Apply and adapt a variety of appropriate strategies to solve problems.

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. Picture This: Drawing Pictures to Represent Problems (6 min.)

Drawing Pictures: Introduction
Architects and engineers draw diagrams to represent and solve problems with buildings and bridges before the problems become real.

Example 1: Drawing the Colosseum
Scientists used drawings and diagrams to reconstruct how the Roman Colosseum looked when it was first built and functioning, based on evidence from its ruins.

Example 2: Drawing Bridges
Engineers use drawings and diagrams to help design bridges to solve problems of strength and stability before building the structures.

Example 3: Drawing Skyscrapers
Architects and engineers use drawings and diagrams to solve problems of appearance, function, strength, and stability before the problems become real.

II. That's Discussing: Dialogue to Understand Problems (5 min.)

Dialogue: Introduction
Students competing on teams to solve problems in the Discovery Channel Young Scientist Challenge gain understanding by dialogue.

Example 1: Discussing Lasers
Team Jolly Green Giant gains understanding through discussion, helping it succeed to get a laser beam to its target through a series of obstacles.

Example 2: Discussing Music
A team of students discusses the problem of recreating part of Beethoven's Fifth Symphony using unconventional sound makers and instruments. The result can be recognized.

Example 3: Discussing Force
A team of students conducts "skateboard science," using discussion among themselves and with skateboarders experiencing the forces to determine where in the skating path the force is greatest.

III. Make Sense: Explaining Solutions to Problems (7 min.)

Explaining Solutions: Introduction
Young scientists in the Discovery Channel Young Scientist Challenge explain their solutions to problems. Winner Shannon McClintock explains how she investigated traction of wheels on wet railroad tracks.

Example 1: Fire Ant Control
Blake Thompson explains his investigation into fire ant control using pesticides.

Example 2: Explaining a Plane
A member of a team of young scientists explains how they solved the problem of flying a model plane accurately on course.

Example 3: Rocket Car Thrust
Members of a team of young scientists explain how they solved the problem of using fuel efficiently to power a rocket car to go far.

IV. Get It Together: Organizing Information (5 min.)

Organizing Information: Introduction
Thinking about what you want and need on a trip to an amusement park allows you to be prepared and have a good time.

Example 1: Packing List
Anita makes a list of what to take on a trip so she won't forget anything important.

Example 2: Airline Schedule
A flight schedule tells you when your flight leaves one place and arrives at another. This information helps you get to the airport on time and figure out the length of your flight.

Example 3: Activity List
A list of activities you want to do at an amusement park and a map of the park help you organize your time well and enjoy yourself while you're there.

V. Model Much (6 min.)

Whole Number Models: Introduction
A model can be anything that helps you see how something works.

Example 1: How Many Chairs?
Counters serve as whole-number models for the number of chairs to add around a table to have enough for all the guests. The associated number sentence is displayed.

Example 2: Enough Dog Food
Counters serve as whole-number models for the number of scoops needed to feed five dogs when the dogs get different amounts. Associated number sentences are displayed.

Example 3: Tiling Pentominoes?
Students arrange pentominos to fill a piece of poster board; then they calculate the number used.

Quiz

I. Picture This: Drawing Pictures to Represent Problems

1. What is the first thing architects and engineers do to prepare to build a building or bridge?
   A. take pictures
   B. start building
   C. draw a diagram
   D. buy the material

   Answer: C

2. Why did the scientists draw a diagram of the Roman Colosseum?
   A. to make a game
   B. to build another colosseum
   C. to see what it looked like in the past
   D. to see what it will look like in the future

   Answer: C

3. Bridge builders draw diagrams to make bridges safe for traffic. What two parts of a bridge help make it safe?
   A. towers and water
   B. cables and fences
   C. towers and cables
   D. fences and towers

   Answer: C

4. Very tall buildings are useful in places where many people live. What are very tall buildings called?
   A. blocks
   B. skyscrapers
   C. tall scrapers
   D. round buildings

   Answer: B

II. That's Discussing: Dialogue to Understand Problems

1. The young scientists have problems to solve. What strategy do they use to begin to solve the problem?
   A. work separately
   B. talk to their parents
   C. discuss the problem
   D. write the problem down

   Answer: C

2. The Jolly Green Giants used discussion to solve the problem of hitting a target. What object did they hope to hit the target with?
   A. ball
   B. water
   C. long tube
   D. laser beam

   Answer: D

3. The young scientists worked together to create music. What word describes working and talking together to solve a problem and reach a goal?
   A. playing
   B. goal work
   C. teamwork
   D. team spirit

   Answer: C

4. If you were studying skateboarding, who would be the best person to talk to for information about that sport?
   A. a doctor
   B. a scientist
   C. a skateboarder
   D. a student who watches skateboarding

   Answer: C

III. Make Sense: Explaining Solutions to Problems

1. How can you share what you learned from solving a problem?
   A. draw a picture
   B. keep the solution to yourself
   C. clearly explain how you solved the problem
   D. give only some information about the problem

   Answer: C

2. What problem was Blake trying to solve in his backyard?
   A. how to get rid of mice
   B. how to get rid of beetles
   C. how to get rid of crickets
   D. how to get rid of fire ants

   Answer: D

3. What did Jeffrey and his team decide to do with the model airplanes to get the highest number of points?
   A. throw the plane low
   B. throw the plane hard
   C. throw the plane fast
   D. throw the plane as high as they could

   Answer: A

4. The scientists explained how they made their rocket car go the farthest. When did the rocket car get the most fuel?
   A. at the end of the ride
   B. in the middle of the ride
   C. at the beginning of the ride
   D. the power was the same for the whole ride

   Answer: C

IV. Get It Together: Organizing Information

1. What did Anita do so she would not forget anything important for her trip?
   A. made a list
   B. talked to her sister
   C. read a book about taking a trip
   D. drew pictures of everything she was taking

   Answer: A

2. Sue is taking a trip on an airplane. What tells her what time the plane is leaving?
   A. map
   B. clock
   C. airplane picture
   D. airplane schedule

   Answer: D

3. You are going to the amusement park with your family for six hours. You know that it takes one hour to do each activity. How many activities can you do at the amusement park?
   A. 2
   B. 4
   C. 6
   D. 8

   Answer: C

V. Model Much: Whole Number Models

1. What can you build to help you see how something works or to solve a problem?
   A. a train
   B. a model
   C. a picture
   D. a toy car

   Answer: B

2. There are 8 seats at the table. John needs to seat 10 people. How many more seats does he need?
   A. 1
   B. 2
   C. 3
   D. 4

   Answer: B

3. Sara has three big dogs. Each dog eats two scoops of food for dinner. How many scoops of food will Sara need to feed all her dogs dinner?
   A. 1
   B. 5
   C. 6
   D. 10

   Answer: C

4. The students put two L-shaped pentominoes together on the poster board. What shape did the two L-shaped pentominoes make?
   A. circle
   B. triangle
   C. diamond
   D. rectangle

   Answer: D

Chart 1

Possible Solutions

Solution	Pros	Cons

Chart 2

Materials

Material	Purpose

Chart 3

Jobs

Team Member	Job/ Responsibility