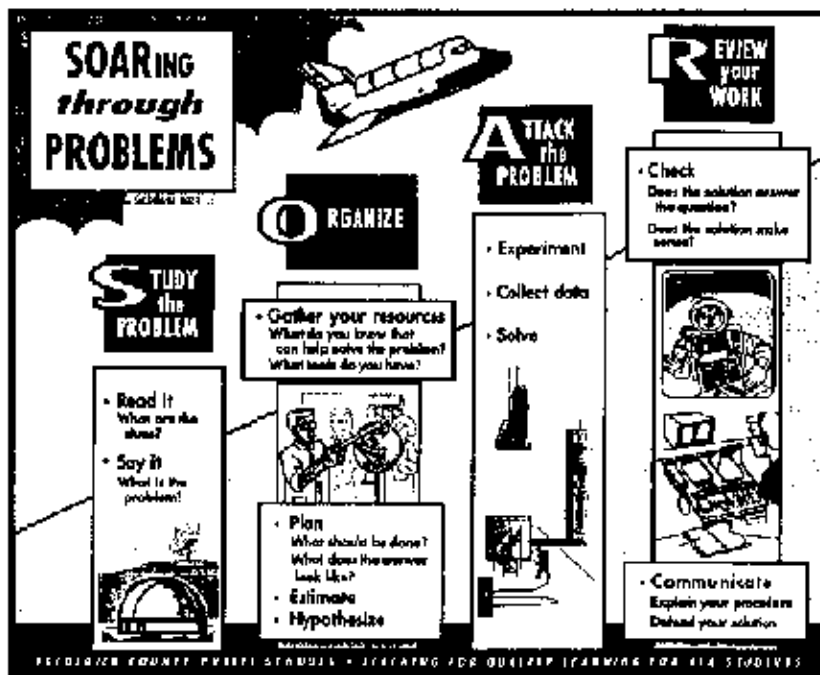


## Problem Solving:

Development of problem solving skills is a necessary part of mathematics instruction and must occur in a variety of ways - through actual instruction, through modeling, through practice.

Students must be taught the steps needed to solve a problem. Typically, a four-step approach, such as the **SOAR** approach, is encouraged. Students need to learn and practice these steps so that they can eventually apply them independently. Teachers and students need to be aware that an approach like **SOAR** is not a lock-step technique requiring the student to proceed from **S** to **O** to **A** to **R**. But instead, when solving problems, one may have to jump back to a previous step as more information is acquired or as failure occurs.



The important thing is for young problem solvers to have a handle on these steps so they can use them as needed. This handle is also needed when it comes to problem solving strategies. For this reason, ten problem solving strategies have been identified for use in the elementary classroom. These strategies are used during the Attack the Problem stage of the **SOAR** approach.

Ten strategies are a lot for young problem solvers to learn and to be able to apply, and some strategies are difficult to use. Teachers, serving as curriculum writers, worked to identify five of these problem solving strategies for special emphasis in K - 5. The grid, Problem Solving Strategies with focus on Dimensions of Learning, was created to demonstrate the development of these five problem solving strategies as they relate to Dimensions 2 - 4. Three terms are used on the grid to refer to these dimensions:

- Explore/ Invent** - Refers to Dimension 2, **Acquire and Integrate Knowledge**. In Dimension 2, the learner is exposed to the strategy or aspect of the strategy. Through instruction, modeling, and guided practice, the learner organizes the strategy into their previous knowledge and stores it for future use.
- Apply** - Refers to Dimension 3, **Extend and Refine Knowledge**. In Dimension 3, the learner practices the strategy or aspect of the strategy in a variety of teacher controlled activities.
- Select/Use** - Refers to Dimension 4, **Use Knowledge Meaningfully**. In Dimension 4, the learner independently selects and applies the strategy to solve problems.

Note that progression from Dimension 2 to Dimension 4 does not occur in steps. This points out that the learner never completes the task of acquiring knowledge but that his/her knowledge continues to grow (as indicated in the text on the grid).

An example is seen in the strategy, Make a Picture or Diagram. Graphing is one aspect of this strategy. The learner begins by making physical graphs, then learns how to make picture graphs, then bar graphs (with pictures), then higher level graphs. The learner continues to **Acquire and Integrate** graphing skills throughout elementary school, but also works to **Extend and Refine** graphing skills and eventually will be able to **Use** graphing skills independently and meaningfully.

Young students can and should be encouraged to use many strategies and not limited to those being emphasized at their math level.

This section includes:

- Problem Solving Strategies - Icons & Definitions
- Problem Solving Strategies with focus on Dimensions of Learning
- Problem Solving Strategies EPR Cards
- Problem Solbing Strategy Cards
- Problem Solving Prompts and Strategies

## Problem Solving Strategies Definitions

### Make a Model or Act It Out



Will often help to visualize a problem before students can begin to solve it. Acting the problem out or using objects to create a model often assists these students to visualize and to take an active role in the problem and the solution.

### Make a Picture or Diagram



Will often help students understand and manipulate information. It also helps students to visualize the problem while stressing independence. This strategy includes pictorial representations like graphs and glyphs.

### Look for a Pattern



A pattern is a systematic, regular repetition. Patterns can be numerical, visual, or behavioral. When the pattern is found, students can predict what comes next.

### Make an Organized List



Helps students organize their information and their thinking. This strategy helps students to visualize and review their problem.

### Make a Table



Helps students organize, see errors, patterns, missing information, and data that will assist in solving the problem. This strategy is often used along with another problem solving strategy.

### **Guess and Check**



Is used when the problem presents so much information that this will assist students in getting started or when the problem asks for one solution. The strategy is used for making a guess, checking for correctness, and using this information to help students get closer to the solution.

### **Work Backwards**



Working systematically from the known to the unknown. This method can be used when you know the result of an action and can work backwards to determine the steps required to reach that result.

### **Use Logical Reasoning**



Is often used throughout problem solving. Some problems lend themselves to this strategy more with the wording used. The statements may direct students to eliminate information, narrow their focus and/or show a relationship that helps solve the problem.

### **Make it Simpler**



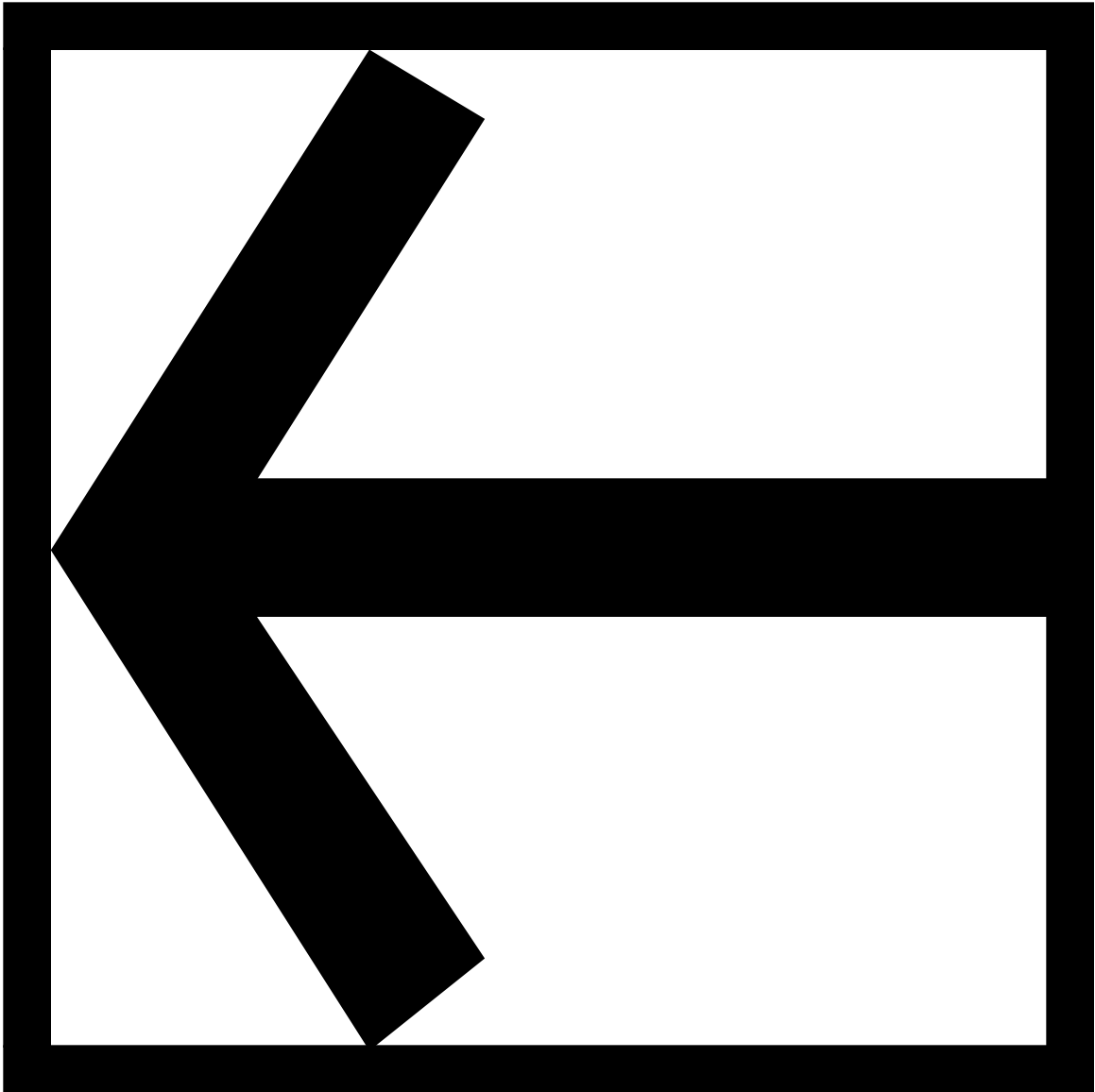
Makes a problem simpler. Students take large complex data and reduce numbers or the amount of information to show a pattern to help solve their original problem.

### **Brainstorm**

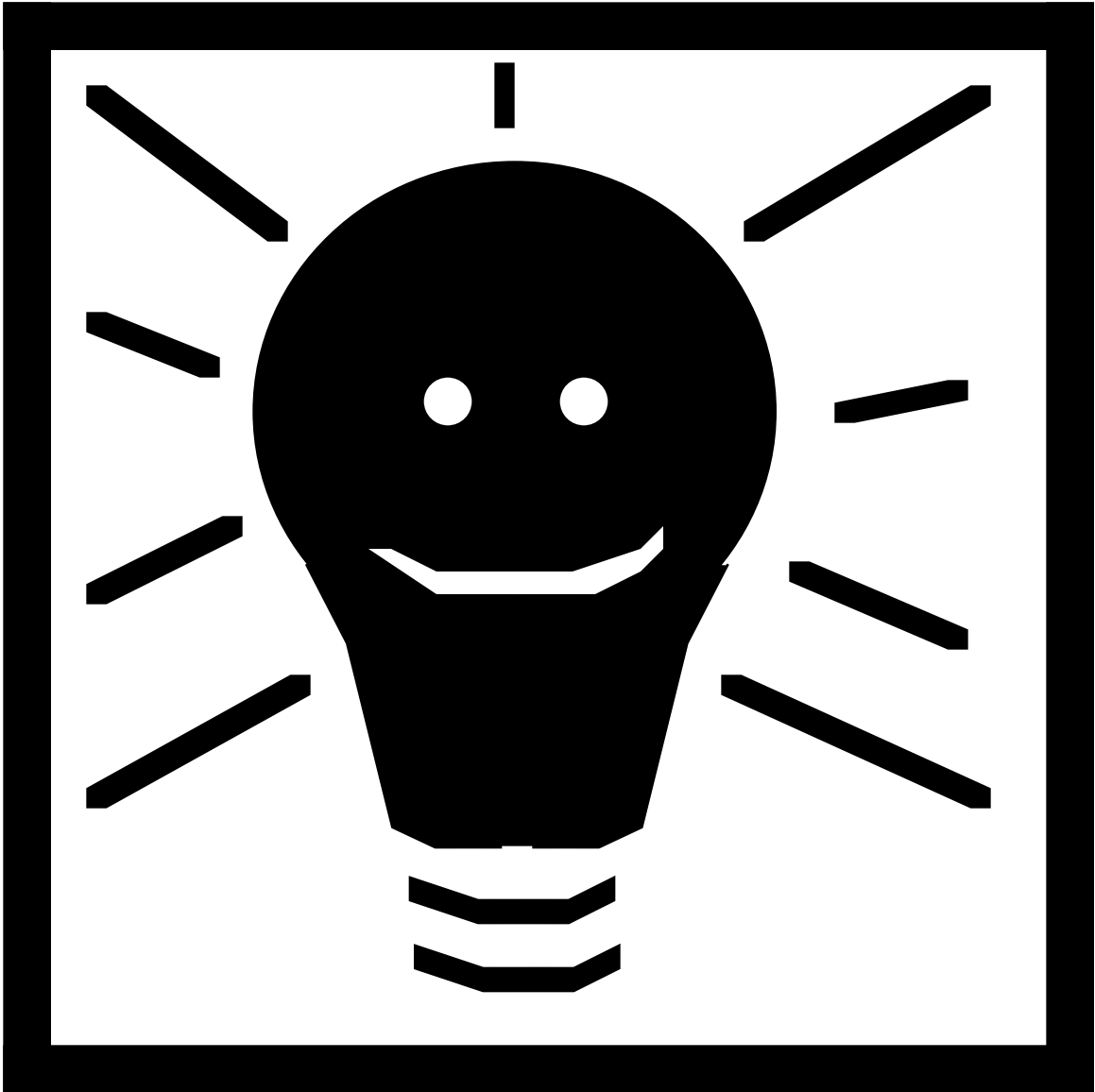


Is often used when all else fails. When students cannot think of a similar problem that they have solved before, and cannot think of another strategy to use, brainstorming is a good strategy to try. When students encounter problems that cannot be solved, they must be encouraged to open up, stretch, allow for inspiration, be creative, be flexible and keep trying. Brainstorming can also be used as a start to a problem for background knowledge and/or to find possible directions in which to go.





**WORK  
BACKWARDS**



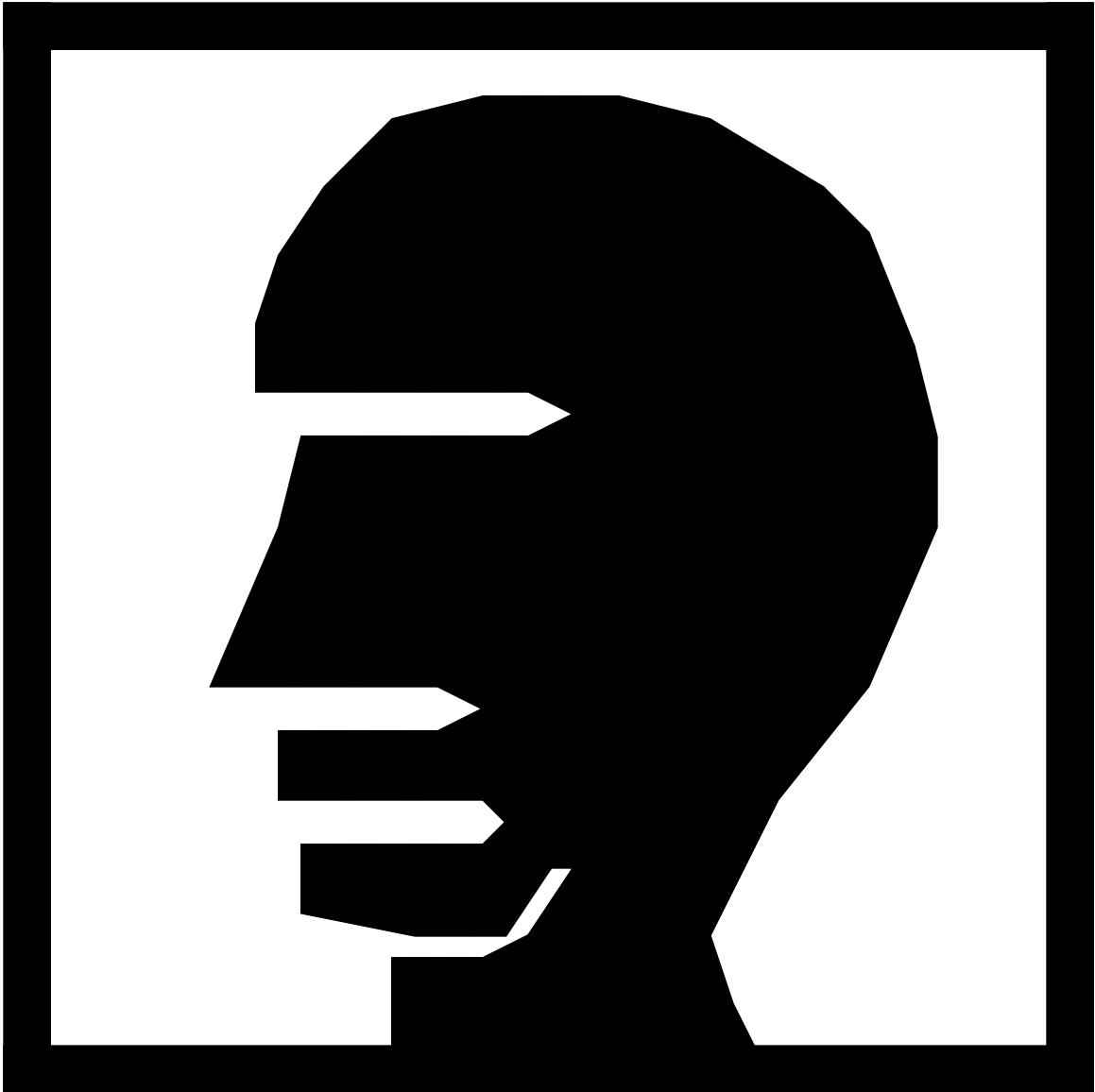
**BRAINSTORM**



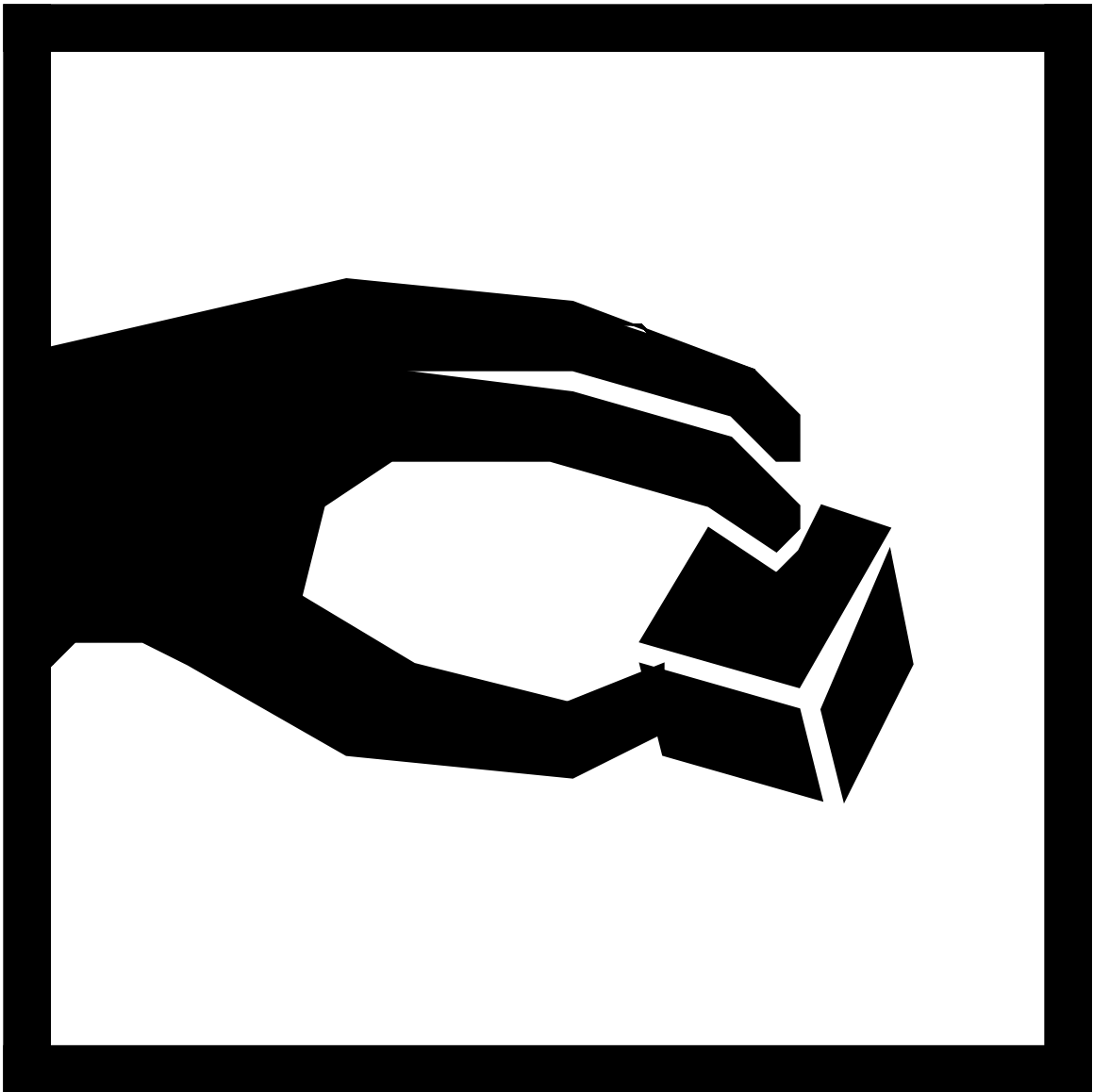
**GUESS AND  
CHECK**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

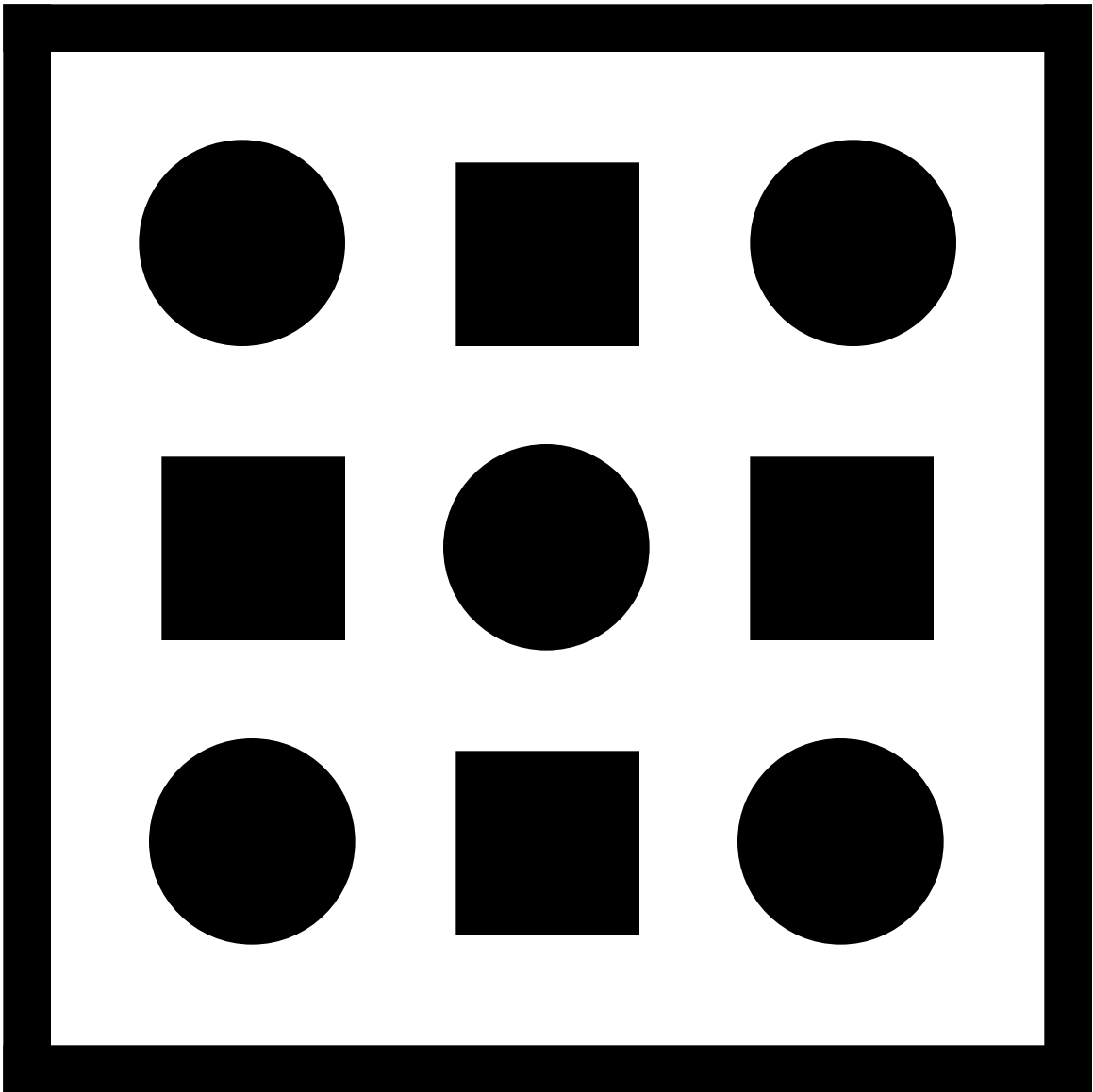
**MAKE AN  
ORGANIZED LIST**



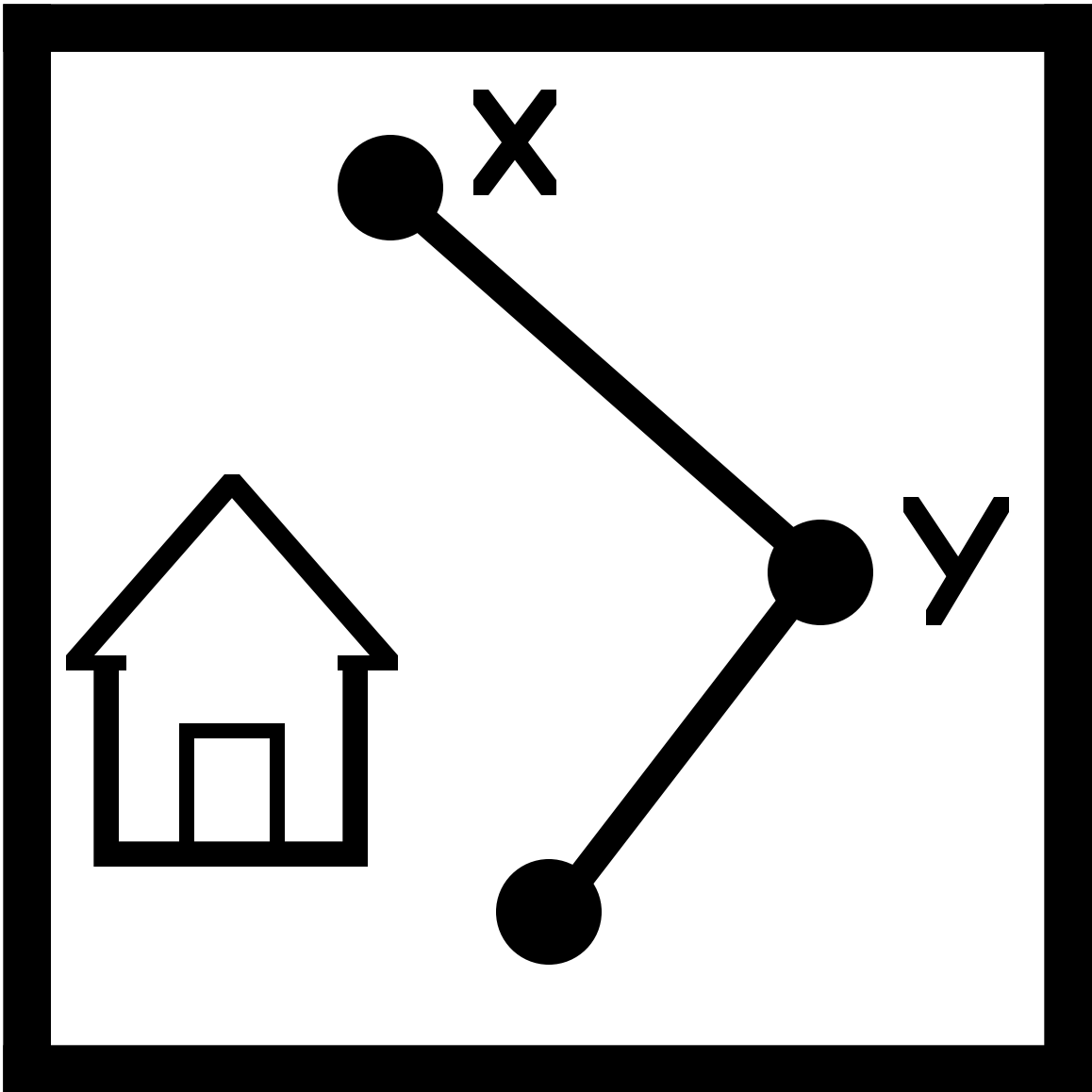
**USE LOGICAL  
REASONING**



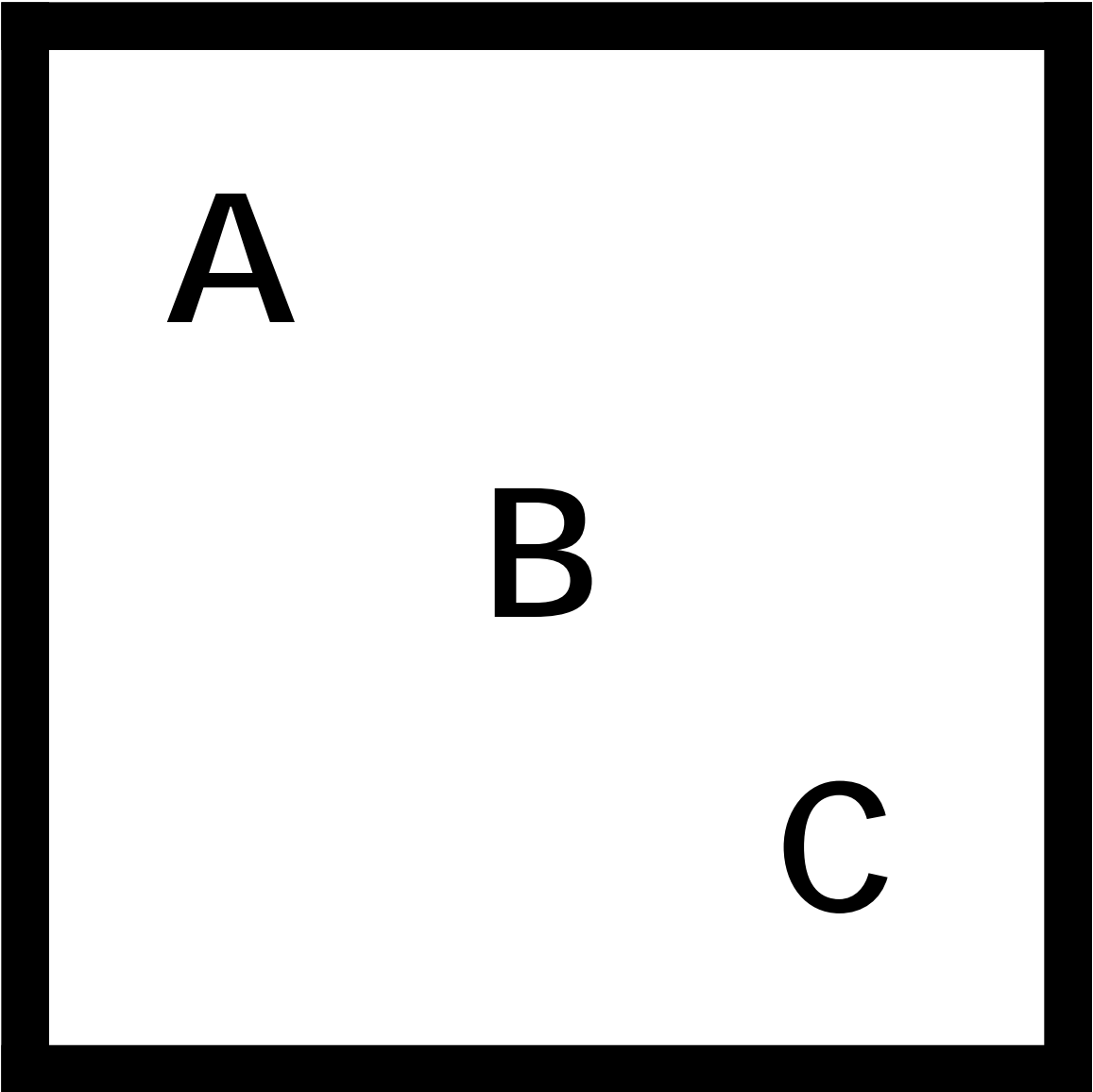
**MAKE A MODEL  
ACT IT OUT**



**LOOK FOR  
A PATTERN**



**MAKE A PICTURE  
OR DIAGRAM**



A

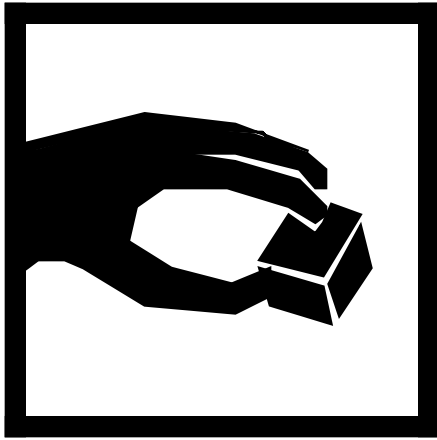
B

C

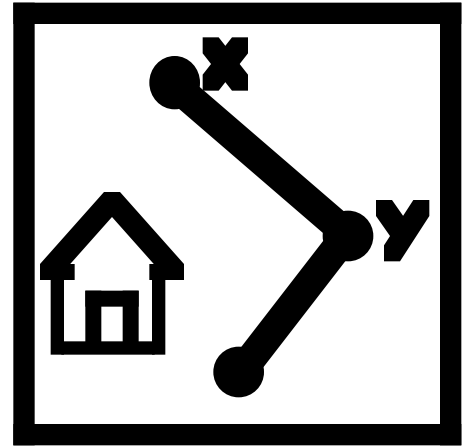
**MAKE IT  
SIMPLER**

A	B
0	7
5	3

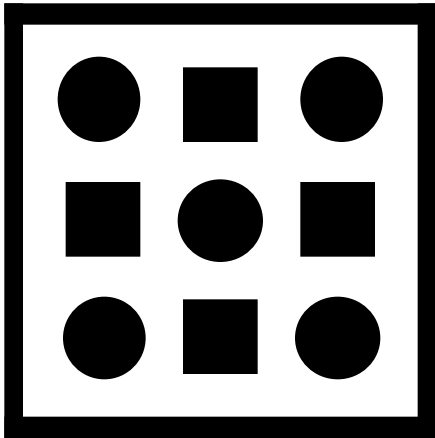
**MAKE A  
TABLE**



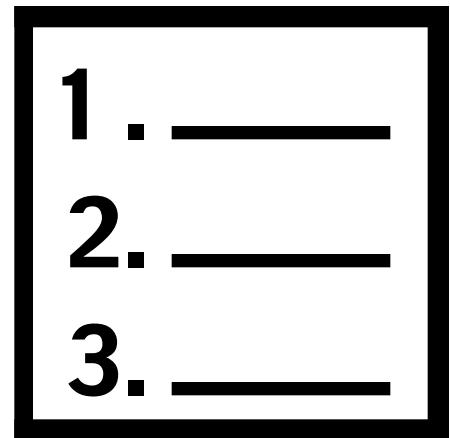
**MAKE A MODEL  
ACT IT OUT**



**MAKE A PICTURE  
OR DIAGRAM**



**LOOK FOR  
A PATTERN**



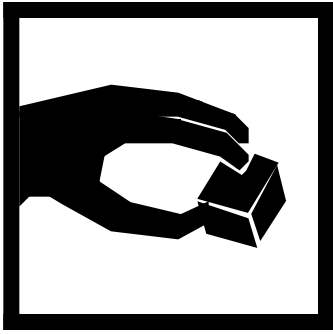
**MAKE AN  
ORGANIZED LIST**

A	B
0	7
5	3

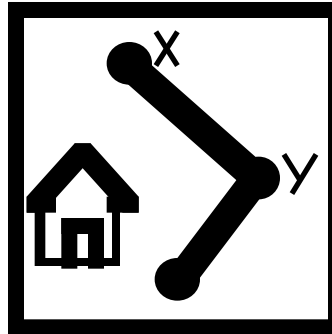
**MAKE A  
TABLE**



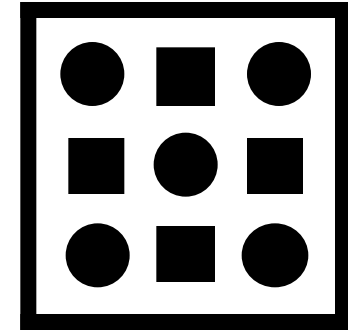
**GUESS AND  
CHECK**



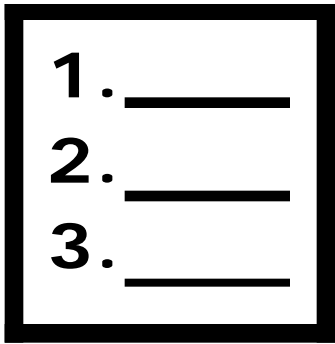
MAKE A MODEL  
ACT IT OUT



MAKE A PICTURE  
OR DIAGRAM



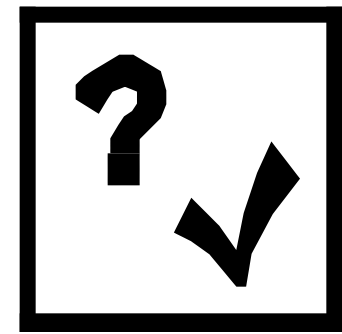
LOOK FOR  
A PATTERN

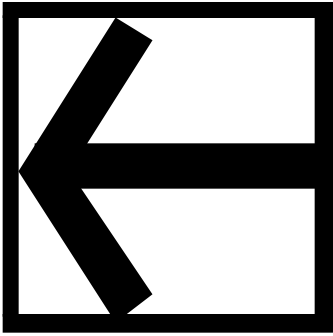
MAKE AN  
ORGANIZED LIST

A	B
0	7
5	3

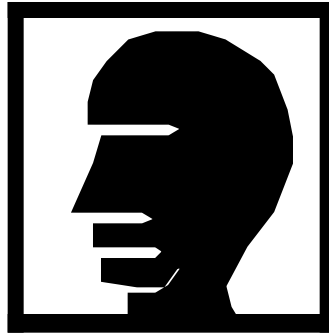
MAKE A  
TABLE



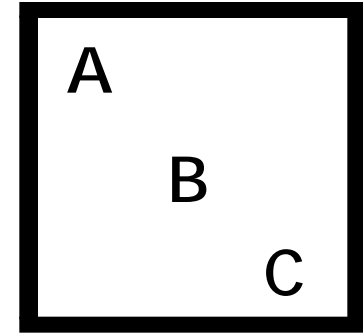
GUESS AND  
CHECK



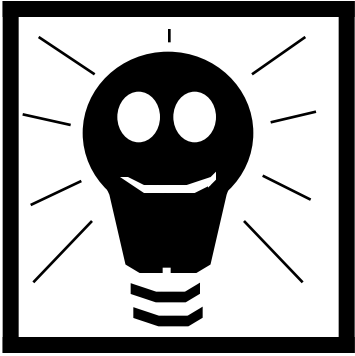
WORK  
BACKWARDS



USE LOGICAL  
REASONING



MAKE IT SIMPLER

**BRAINSTORM**


## **Problem Solving Prompts and Strategies**

This section is designed to provide both the primary and intermediate math teacher with a variety of problem solving prompts and suggested strategies. The teacher may use these as: journal tasks, warm-ups, problem of the week, homework, lessons to teach a strategy, etc.

The open-endedness of many of the prompts is for the purpose of allowing for a variety of strategies and solutions within each class according to grade level, developmental level, and previous exposure to problem solving.

### **SAMPLE**

**Prompt**     There are three gorillas at the zoo. They had two apples. How will they share them?

#### **Possible Solutions**

Solutions will vary. Attempts are encouraged and accepted. You will see a progressive growth as in the following student responses 1 - 4 on the following pages.

1.

The gorillas got 2 apples. He forgot to give them one more but it was the last one. The gorillas were unhappy because they needed one more. So now they are gonna get 3 bananas. I think they will buy more apples. So they might go back and get bananas and apples. One gets 2 apples, one gets 2 pineapples and one gets 20 bananas and that's all.

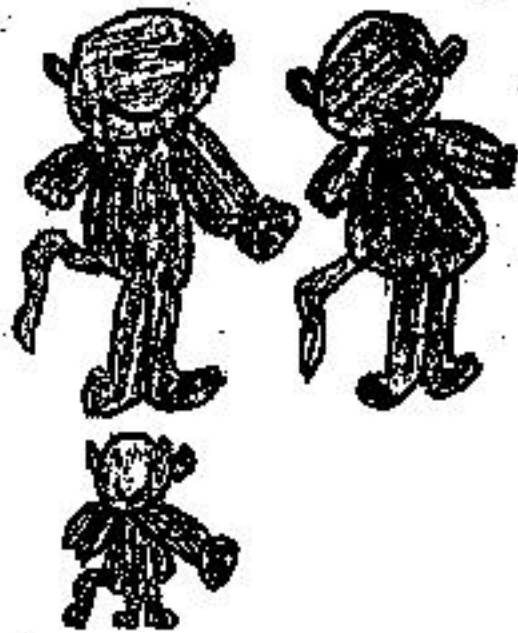
2.



3 gorillas  
2 apples  
How do they eat?

3.

3 gorillas  
2 apples  
How do they eat?



"The daddy got the whole apple and the children got 1/3 each."

4.

Problem

There are 3 gorillas at the zoo. They had 2 apples. How will they share them?



Give two slices to the 3 gorillas.

$2 \times 2 + 2 = 6$  and two odd number make a even number

## **PRIMARY**

**Prompt:** Some ladybugs have 5 spots, some ladybugs have 7 spots, and some ladybugs have 2 spots. Show 18 spots.

**Strategies:** Make a Picture or Diagram (Picture)  
Look for a Pattern  
Make a Model or Act it Out

**Prompt:** Billy saw three people going to school. The people could travel by car, bike or roller blades. How many wheels did he see?

**Strategies:** Make a Picture or Diagram (Picture)  
Make an Organized List  
Make a Model or Act it Out

**Prompt:** The teacher wants to set up a classroom so that 16 children can sit at tables.

Some tables have space for 4 children.  
Some tables have space for 2 children.  
Some tables have space for 6 children.  
What tables would you use?

**Strategies:** Make a Picture or Diagram (Picture)  
Make a Model or Act it Out  
Make an Organized List

**Prompt:** 5 children, 2 bags of play dough. How will they share?

**Strategies:** Make a Model or Act it Out  
Make a Picture or Diagram (Picture)  
Make an Organized List

## **PRIMARY**

**Prompt:** I would like to plan for the next field trip we go on. If cars can hold 4 people and vans can hold 6 people, how many cars and vans do we need?

**Strategies:** Make a Picture or Diagram (Picture)  
Make a Model or Act it Out  
Make an Organized List

**Prompt:** I would like to plan for the next field trip we go on. If cars can hold 5 people and vans can hold 7 people, how many cars and vans do we need?

**Strategies:** Make a Picture or Diagram (Picture)  
Make a Model or Act it Out  
Make an Organized List

**Prompt:** A farmer planted 12 seeds of corn. How did he put them in even rows?

**Strategies:** Make a Picture or Diagram  
Look for a Pattern

**Prompt:** apple 2¢  
banana 4¢  
orange 5¢

What can you buy to spend exactly 10¢?  
You can buy more than one of the same thing.  
Find other ways to spend exactly 10¢.  
Show each way you find.

**Strategies:** Make a Picture or Diagram (Picture)  
Make an Organized List  
Make a Model

**PRIMARY**

**Prompt:** Freckles

Some kids have 10 freckles.  
Some kids have 5 freckles.  
Some kids have 2 freckles.  
Show 20 freckles.

**Strategies:** Make a Picture or Diagram  
Look for a Pattern  
Make a Model

**Prompt:** Measure how tall you are.  
Measure your teacher's height.  
What can you do to make yourself as tall as your teacher?

**Strategies:** Make an Organized List  
Make a Model  
Make a Picture or Diagram

**Prompt:** What Pattern do you see below?  
Write the next two problems.  
Find all the sums.  
What Pattern did you find?

1 2 + 3 □	2 3 + 4 □	3 4 + 5 □	4 5 + 6 □	+ <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td> </td></tr><tr><td> </td></tr><tr><td> </td></tr><tr><td> </td></tr></table>					+ <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td> </td></tr><tr><td> </td></tr><tr><td> </td></tr><tr><td> </td></tr></table>				

**Strategies:** Make a Model  
Make a Picture or Diagram  
Look for a Pattern

**Prompt:** Add me to 5 or subtract me from 13. The answer is the same.  
Who am I?

**Strategies:** Make a Picture or Diagram  
Look for a Pattern  
Make a Model or Act it Out

## **PRIMARY**

**Prompt:** You have 30¢. You do not have any pennies.  
What coins might you have?

**Strategies:** Make a Picture or Diagram  
Look for a Pattern  
Make an Organized List

**Prompt:** Use a paper clip to measure the length of your foot.  
Now measure your desk with the paper clip.

Compare the totals. About how many of your feet would equal  
the width of your desk?

**Strategies:** Make a Model or Act it Out  
Make an Organized List  
Look for a Pattern

**Prompt:** Count out 10 toothpicks.  
How many shapes can you make?

**Strategies:** Make a Picture or Diagram  
Make a Model or Act it Out  
Make an Organized List

**Prompt:** If a bear ate 2 berries the first day, 4 berries the second day, 6  
berries the third day and 8 berries the fourth day, how many  
berries would he eat on the fifth day?

How many berries would 2 bears eat on the fifth day?

**Strategies:** Make a Picture or Diagram  
Make an Organized List  
Look for a Pattern  
Make a Model or Act it Out

## **PRIMARY**

**Prompt:** You're going to the ice cream store and you want a triple cone with chocolate, vanilla, and strawberry ice cream. What are all the different ways your cone could look?

**Strategies:** Make a Picture or Diagram  
Make an Organized List  
Make a Model or Act it Out

**Prompt:** Write a number sentence with these numbers, 3 7 4.  
Draw a Picture to tell a story for the sentence.

**Strategies:** Make an Organized List  
Look for a Pattern  
Make a Picture or Diagram

**Prompt:** Your mother has you read every evening except Sundays, for 15 minutes. Show how much time you spend reading in the evenings every week.

**Strategies:** Make a Picture or Diagram  
Make a Model or Act it Out  
Look for a Pattern

**Prompt:** Build 3 boats. There are 4 people fishing on each boat. Each person may catch up to three fish. How many fish were caught?

**Strategies:** Make a Picture or Diagram  
Make a Model or Act it Out

**Prompt:** Make pizzas with 4 slices, 6 slices and 8 slices. If I have 6 friends over, how many slices will each get? Do you think everyone got a fair share of pizza?

**Strategies:** Make a Picture or Diagram  
Make a Model or Act it Out  
Look for a Pattern

## **PRIMARY**

**Prompt:** Choose a Pattern Block piece. Give clues about your polygon so someone reading your clues will be able to name the polygon you picked. Trace your polygon at the bottom and fold the paper so only your clues are showing.

**Strategies:** Make a Picture or Diagram  
Make an Organized List  
Make a Model or Act it Out

**Prompt:** How many tentacles are on four octopuses?

**Strategies:** Make a Picture or Diagram  
Make a Model or Act it Out

**Prompt:** There are 16 apples to put in bowls. Each bowl must have the same number of apples. Show how you could put the apples into bowls.

**Strategies:** Make a Picture or Diagram  
Make a Model or Act it Out  
Look for a Pattern

**Prompt:** How many different snow persons can you draw with a red or green hat and a blue or orange scarf?

**Strategies:** Make a Picture or Diagram  
Look for a Pattern  
Make a Model or Act it Out

**Prompt:** How many shoes are in our room?

**Strategies:** Make a Model or Act it Out  
Make Picture or Diagram  
Look for a Pattern

## PRIMARY

**Prompt:** If you have 15 red beads and 4 yellow beads for a necklace, how many different ways could your necklace look?

**Strategies:** Make a Picture or Diagram  
Make a Model or Act it Out  
Look for a Pattern

**Prompt:** How many  $\triangle$  do you think you can draw in one minute?  
How many  $\triangle$  can you then make in 5 minutes?

**Strategies:** Make a Model or Act it Out  
Make a Picture or Diagram

**Prompt:** How many ways can you make the number 12?

**Strategies:** Look for a Pattern  
Make a Picture or Diagram

**Prompt:** How many different shapes can you make from 4 triangles? How many different ways can you make a rectangle with your 4 triangles? (You may use 4 different colored triangles.)

**Strategies:** Make a Model or Act it Out  
Look for a Pattern  
Make a Picture or Diagram

**Prompt:** A farmer saw.....

4 heads  
10 legs  
3 tails

What animals did he see?

**Strategies:** Make a Picture or Diagram (Picture)  
Make a Model or Act it Out  
Make an Organized List

## INTERMEDIATE

**Prompt:** Beto, Phil, Kara, and Jo are playing one-on-one basketball. If each team member played one time against each of the others, how many games were played in all?

If two other players, Chris and Juan, join the games tomorrow, how many games will be played?

**Strategies:** Make a Model or Act it Out  
Make a Table

**Prompt:** During the summer Friday was clean-up day at the park. Colleen arrived at the park at 11:00 am. Jarvis arrived ten minutes before Colleen, and twenty minutes ahead of Oswald. Crisma arrived five minutes after Jarvis. What time did each person arrive at the park?

**Strategies:** Making a Picture or Diagram  
Look for a Pattern  
Make a Table

**Prompt:** On the first day there was a total of three new students enrolled Frederick County Schools. On the second day there was a total of seven new students. On the third day there was a total of twelve new students in all, and on the fourth day, a total of eighteen new students. If this Pattern continues, on what day will there be a total of seventy-five new students?

**Strategies:** Look for a Pattern  
Make a Table

**Prompt:** Suppose your family goes out for ice cream cones. The flavors today are vanilla, chocolate, strawberry, cherry, and orange-pineapple. How many different two-dip cones could you order?

**Strategies:** Make a Model or Act it Out  
Make a Table

## INTERMEDIATE

**Prompt:** Habib bought a toy. He received \$0.57 in change. Think of all the coin combinations he could have received as change. Then list the coins in order from least value to greatest value using the smallest number of coins possible. Then list two other combinations of coins in order from least value to greatest that will total \$0.57.

**Strategies:** Make an Organized List  
Make a Model or Act it Out

**Prompt:** At the Catoctin Mountain Zoo the keepers feed the snakes every other day, and the lizards every third day. On September 1 they fed both the snakes and the lizards. How many more times in September will they feed both the snakes and the lizards on the same day?

**Strategies:** Make A Table  
Make an Organized List

**Prompt:** In Mr. Short's reading group there are five children. Chris is taller than Pat, but shorter than Lynn. Two of the children are taller than Sam. Terry is the tallest. List the children in order from shortest to tallest.

**Strategies:** Make a Picture or Diagram  
Act it Out

**Prompt:** Three Spot-nosed Guenons, small monkeys, eat about 4 pounds of monkey food each day. Four pounds of monkey food costs \$1.50. How many pounds of food will 12 Guenons eat and how much will it cost?

**Strategies:** Look for a Pattern  
Make a Table

## INTERMEDIATE

**Prompt:** The campers at Camp Iwanna are making beaded necklaces. One camper puts beads on a string in this Pattern: 5 red beads and 3 blue beads. How many red beads are on the string when the 18th blue bead is added?

**Strategies:** Look for a Pattern  
Make a Model or Act it Out  
Make a Picture  
Make a Table

**Prompt:** Another camper put 2 blue beads on a string. Then she adds 1 red bead and 1 white bead. She repeats this Pattern. How many blue beads are on the string when the 10th white bead is added?

**Strategies:** Look for a Pattern  
Make a Model or Act it Out  
Make a Picture  
Make a Table

**Prompt:** One necklace has 1 white bead, 5 red beads and 4 blue beads. How many red beads are on the string when the 28th blue bead is added?

**Strategies:** Look for a Pattern  
Make a Model or Act it Out  
Make a Picture  
Make a Table

**Prompt:** Five Children were picking berries. There are six baskets of berries on each tray. Each basket holds 31 berries. How many berries are on each tray?

**Strategies:** Look for a Pattern  
Make a Picture  
Make a Table

## **INTERMEDIATE**

**Prompt:** The children counted six trays with six baskets of berries on each. Each basket holds 31 berries. How many berries did they pick?

**Strategies:** Look for a Pattern  
Make a Picture or Diagram  
Make a Table

**Prompt:** Each year the secretary orders pads of daily attendance forms for the 30 classroom teachers. Each teacher will receive 200 forms to have enough for the year. If each pad has 75 forms, how many pads does the secretary need to order to have enough for each teacher?

**Strategies:** Make a Table  
Look for a Pattern  
Make a Picture or Diagram

**Prompt:** Your class of 24 students and Mr. Stein's class of 27 students are planning an overnight. You will be sleeping in tents. The campground leader says that each tent can sleep six people. How many tents should you reserve for the overnight?

**Strategies:** Look for a Pattern  
Make a Picture or Diagram  
Make a Table

**Prompt:** The zoo keeper is making plans to take care of the animals in the zoo. One elephant eats about 3 bales of timothy hay each day. The cost for 3 bales is \$8. How many bales of hay will be needed for up to 5 elephants and how much will it cost each day?

**Strategies:** Look for a Pattern  
Make a Table