I hear and it helps a little,

I see and the ideas begin to form,

I do and the ideas become real to me.

I do, see, and hear, and I understand more,

I apply it and I see its value.

Dr. Phares G. O’Daffer
Mathematics Strategies

1. Encourage Exploration and Investigation
2. Build on a Child’s Prior Knowledge / Use the correct mathematical Vocab
3. Use Manipulatives
4. Use Real Problem Solving Activities
5. Use Culturally Relevant Materials
6. Use Technology
7. Encourage Oral and Written Expression
8. Encourage Collaborative Problem Solving
9. Offer an Enriched Curriculum and Challenging Activities
10. Use a Variety of Problem-Solving Experiences
1. **Encourage Exploration and Investigation** – students who engage in mathematical exploration and investigations realize that understanding of mathematics is an area in which they can be creative. This type of activity develops reasoning skills and allows students to use their existing knowledge to explore new situations.

**Mathematic Manipulatives Made Easy**  
*(A variety of inexpensive non-traditional manipulatives for the classroom)*

**Cereals**  
Cheerios X’s and O’s. Trix, Fruit Loops (great for patterning, probability)

**Beans**  
Two different colored beans (brown, white)  Great for probability, place value, Bingo or game board pieces.  
Two sided beans (Lima beans that you have spray painted on one side – spread beans on newspaper and spray paint one side.)

**Wooden Cubes**  
Number cubes sides 1-6 for a regular number generator (dice), or vary numbers to create a variety of number generator (dice) pairs to do a multiple of addition, subtraction, multiplication, etc.

**Plastic Needlepoint Canvas**  
Can obtain at craft stores, cut up for overhead place value pieces and or individual student sets in baggies.

**PASTA**  
A very versatile manipulative  
Pasta is a great, inexpensive, easily obtainable manipulative for the classroom or home. It also offers a wide variety of forms to choose from as well as theme pastas. (Some of the above items can also be used in the following manner to teach mathematics.)

- **Measuring**  
  Use pastas as a unit of measure. It can vary in weight – uncooked/cooked pasta weight differently

- **Computation Bag**  
  Have two kinds of pasta in a paper sack. Students grab a handful. Count the pasta pieces that are alike, then make a mathematical problem. The level of difficulty can be changed by increasing the types of pasta in the bag.

- **Graphing/Sorting**  
  Door graph (Pasta Bow shape with YES/NO sides) Use this graph to yes/no questions, attendance, and lunch count. Sort, graph pasta by color, size, shape.

- **Estimation Pasta Jar**  
  Guess the number of pieces of pasta in jar. Vary by changing pasta sizes. Graph differences, compare, discuss. Keep a class log of the results, use information for later estimations. Estimate how many scoops of pasta are in the jar. Use two different colored pasta to show number of scoops needed to fill the jar.

- **Attendance pasta jar**  
  Each day. Each student puts a piece of pasta in a jar for attendance. Class estimates how many or how high the jar will be of pasta at the end of the day, week, month. Record, discuss.

**Problem Solving**

- **Grab bag**  
  Fill bag with 2, 3, or 4 kinds of pasta. Children can create story problems or number sentences involving the pasta. Assign number values to each kind of pasta on a chart. Students can grab a handful of the pasta, then add or multiply the corresponding numbers. Each student could also keep 3 or 4 pastas at desk and daily assign new number values to alter the days problems.

- **Pasta Line Up**  
  Use deductive reasoning with a lineup of various pastas. Children rule out certain pasta pieces as teacher gives clues to discover the one special pasta. (bunnies, sports, hearts, holiday pieces make great overhead pieces for doing whole group problem solving activities.)
Counting
Count pasta, number lasagna strips and have students arrange in counting order.

Symmetry
Use cooked pasta to create symmetry pictures. Use a mirror to further show symmetry.

Patterning
Use various shapes/colors to create patterns. String dyed pasta pieces to make a pattern necklace.

PASTA DYE RECIPE

Ingredients you will need:
One large zip lock bag for each color
Alcohol (rubbing)
Food Coloring
Pastas-plain color
Newspapers, wax paper, to spread pasta on to dry

Follow these steps:
1. Pour a small amount of alcohol (1/4 cup) in a bag.
2. Add several (4-6) drops of food color. Add more if needed.
3. Pour in pasta, zip closed.
4. Shake
5. Spread colored pasta on “newspaper or wax paper” to dry. (dries quickly)
Milk Lid Math

You will be surprised at the variety of math activities that can be achieved utilizing this free manipulative/
Start saving those milk jug lids because there are countless math activities that you can do in your classroom using this free manipulative. Here are just a few ideas.

1) Sort the lids by various attributes such as:
   a) Color
   b) Snap-on or Twist-on
   c) Label or No Label
   d) Kind of edge (smooth or rough)

2) Make a pattern using two different colors of lids.
   a) Identify the pattern using letters of the alphabet or numbers. The pattern below would be an \textit{A, A, B} pattern or a \textit{1, 1, 2} pattern.
      \begin{center}
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      red & red & blue \\
      red & red & blue \\
      \end{tabular}
      \end{center}
   b) Now ask the students to use more than two colors to make a pattern.
   c) Once more, have the students identify the pattern using alphabet letters or numbers.

3) Let the students grab one handful of lids.
   a) Ask the students to count the lids.
   b) See if the students can write that number.

4) On file cards draw the symbol $>$ on one side and a $=$ on the opposite side. Give one file card to each student. Now have the students grab two handfuls of lids and place them into two piles on their desk. Have the students count the lids in each pile and compare the two numbers.
   a) Which is more?
   b) Which is less?
   c) Have the students correctly place the $>$ file card between the two piles of milk lids. \textit{(The card becomes $<$ by turning it upside down.)}

   \textit{Hint:} Have the child draw two dots by the greater number and one dot by the least number. Connect the dots, and the greater than or less than sign will always be correct!

   \textit{Example:} 8: `6 \quad After connecting the dots, this becomes 8 $>$ 6.
5) Using lids of the same color, ask the students to count out six lids. Have the students organize the lids into two separate sets.
   a) How many different sets can be made using just six lids?
   b) Ask the students to record the different combinations on paper.
   c) To practice a variety of fact families, repeat this activity using a different number of lids.

6) Ask the students to estimate the number of lids it would take to go across their desk top if the lids were laid out flat end-to-end.
   a) Now have the students find the actual number by positioning the lids flat on their desk end-to-end.
   b) Find other objects in the room to measure with the lids.
   c) Remember to have the students estimate first!

7) Work on the concept of fractions using the milk lids.
   a) What fractional part of these four lids is blue?
   b) What fractional part of these four lids is not blue?

8) Probability – Place two blue lids, one green lid, and one red lid into a paper sack. Have the students predict which color the teacher will get when s/he pulls one lid from the bag without looking. Now actually remove a lid from the bag. Ask the students, “Was your prediction correct?”

   Put the lid back into the bag, and have the students make a second prediction. Remove another lid, and again ask, “Was your prediction right?” Ask the students to elaborate on why they believe their prediction was right or wrong.
   a) Repeat this activity at least ten times to arrive at a conclusion.
   b) Divide the students into groups of two to carry out this activity. Have each pair record their results.
   c) Compare the results of each group to arrive at a whole class conclusion.
   d) Change the number of lids as well as the colors placed in the sack. Repeat the activity.
   e) Introduce ratios. What ratio of the lids is blue? Green? Red?

9) With a permanent marker, write the numerals 0-9 as well as the signs of the four math operations on the inside of 14 lids. Make sure the lids are all the same color.
   a) Ask the students to arrange the lids from greatest to least or least to greatest.
   b) Arrange the lids to make equations such as: \(4 + 3 = 7\), \(5 - 2 = 3\)
c) Turn all of the number lids over so the numbers cannot be seen. Select two lids and flip them over. Decide which number is greater and which number is less. Practice using the symbols < and >.

d) Turn over all of the number lids so the numbers cannot be seen. Pick one lid, turn it over, and identify what number comes before and after the number on the lid.

e) Turn all of the number lids upside down so the numbers cannot be seen. Select two lids, turn them over, and name what number comes between these two numbers.

f) Turn all of the number lids upside down so the numbers are hidden. Select one lid, turn it over, and then identify the number that is one more or one less than that number.

g) Flip all of the number lids over so the numbers are out of sight. Choose one lid, turn it over, and decide if that number is even or odd.

h) Turn all of the number lids upside down so the numbers are hidden. Pick out one lid, turn it over, and then write the number word.

i) Flip over all of the number lids so the numbers are not showing. Choose one lid and turn it over. Try to count backwards from that number.

j) Place all of the lids upside down so the numbers cannot be seen. Choose one lid, turn it over, and skip count by that number as far as you can by that number.

10) Decide on a money value for each color of lid. (Example: Red lids are worth a nickel, blue lids are worth a dime, and white lids are worth a penny.) Put all of the lids into a bag and have the students draw out four lids. Have the students add up the total value of these four lids.
   a) Use play money (coins) to have the students show the value of the lids.
   b) Have the students practice writing money as either a part of a dollar or as cents.
   c) Another idea is to have the students find all the combinations of lids that would equal a nickel or a dime or a quarter.

11) Using gram weights and a balance scale, weigh one lid.
   a) Find out if the mass is different for different colored lids.
   b) Find the mass of five lids, ten lids, etc.

12) Since the lids are circles, measure the diameter of the lid.
   a) If you know the diameter, what is the radius of the lid?
   b) Find the area of the lid.
   c) Find the circumference of the lid.

13) Estimate how far a milk lid can roll across the floor.
   a) Do this investigation five times and determine the average length of the five rolls.
   b) Practice using the metric system as well as the English system of measurement.
14) Use the lids to make a bar graph.
2. **Build on a Student’s Prior Knowledge/Use the correct Vocab** – The knowledge a student can bring to a new exploration will easily shape their understanding of a new concept. The one sure way to increase text scores is to use the correct **Vocab**. Make sure the students are getting the same information about the **Vocab**.

### KUMA STRATEGY

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Run the game on cardstock, laminate and cut out words. Put the words into a baggy. Pass the bag to a student. Student draws a word from the baggy. Says the word and gives the definition for the word. If correct, the student keeps the word card. Continue passing the baggy. If a student draws an uh oh card, he/she must put all of their word cards back in the baggy. Then play continues again by passing the baggy.
VOCABULARY TOSS

Provide a definition and ask students to identify the word-wall word that matches the definition. If they do that correctly, then they get one shot at a goal using a soft squeezable ball. You can play teams on this one.

HOT SEAT

Can be played whole class, in teams or in small groups. One person is in the HOT SEAT. The teacher or classmate puts a word from the Math Word Wall on the chalkboard. The person in the HOT SEAT begins asking questions about the word.

- Is it a geometry word,
- Is it an algebra word
- Is it a shape
- Does it have six sides
- Is it the answer to a problem

ERASING RELAY

Have two teams. Put 2 lists of Math words from the Math Word Wall on the chalkboard. Have the teams line up in front of the lists. The first person goes to the board, pronounces the word and then gives the definition or a real life example of the word. If they are correct, then they erase the word, and the next person on line comes up and goes through the same process.

OPPS!

Can be played whole group or in small groups. The teacher has a small box with index cards in it. On the index cards are written the words that are on the Math Word Wall. On separate cards write the word OOPS! Put several of these cards in sporadically. One at a time a student comes up and pulls out a card. He/she shows the card to the other students and then says the word and gives the definition—if correct a point is scored, if incorrect, the card goes back into the box. If an OOPS! Card is drawn, the student has to give up all of their cards.

MIND READER

A student chooses a mystery word from the Math Word Wall—the other students ask questions to try and find out the mystery word.
3. **Use Manipulatives** – Manipulatives are a must for increasing a student’s visualization of mathematical ideas.

### 7 Musts for Using Manipulatives

By Marilyn Burns

You find them in classrooms across the nation — buckets of pattern blocks; trays of tiles and cubes; and collections of geoboards, tangrams, counters, and spinners. They've been touted as a way to help students learn math more easily. But many teachers still ask: Are manipulatives a fad? How do I fit them into my instruction? How often should I use them? How do I make sure students see them as learning tools, not toys? How can I communicate their value to parents? Are they useful for upper-grade students, too?

I've used manipulative materials at all levels for 30 years, and I'm convinced I can't — and shouldn't — teach without them. Here are my strategies:

1. I talk with students about why manipulatives help them learn math. These discussions are essential for first-time users and useful refreshers to refocus from time to time. I precede discussions by giving children time to explore a manipulative. Then we talk about what students noticed and I introduce the concepts they'll learn with the material.

2. From day one, I set ground rules for using materials. We talk about the similarities and differences between using manipulatives in class and playing with toys or games. With toys or games, children can make up their own rules. With manipulatives, they are given specific problems and activities. I do make clear, however, that they're free to make discoveries and explore new ideas.

3. It's also important for students not to interfere with one another. I step in when I hear a howl of protest as a student who needs one more yellow tile takes it from another group's table. Sometimes I open up the discussion to the entire class. These impromptu reminders help keep students on track.

4. I set up a system for storing materials and familiarize students with it. It's important for students to know where and how to store materials. A clear system makes the materials more accessible. Some teachers designate and label space on bookshelves. Others use zip-top plastic bags and portion materials into quantities useful for pairs or groups. Still other place a supply of each material at students' tables so they're always within reach.

5. Time for free exploration is worth the investment. Whenever I introduce a new material, I allot at least one math period for this. Teacher demonstrations alone are like eating a papaya in front of the class and expecting children to know how it
tastes.

Free exploration time also allows students to satisfy their curiosity so they don't become distracted from the assigned tasks. Expect children to see if tiles can fall like dominoes; build tall towers with rods; or construct rockets out of cubes.

After children have explored a material, I ask what they've discovered and record their observations on a chart so their classmates can get insights from their ideas. Then I assign a specific task.

6. For easy reference, I post class charts about manipulative materials. Charts not only send students the message that I value manipulatives, but also help students learn materials' names and how to spell them. In September I post a chart that lists all the materials we'll use during the year. For some materials, I post separate charts to list their shapes and colors. And I leave posted charts of students' discoveries about materials.

7. Manipulatives are a natural for writing assignments. They provide concrete objects for children to describe.

8. I let parents get their hands on manipulatives, too. It's important for parents to understand why their children are using materials. Follow up by having children take home materials and activities to do with their families. (Hint: I wait until students have had some experience.)

Marilyn Burns, a household name to elementary teachers across the country, is the creator of Math Solutions inservice programs, offered nationwide. She is also the author of numerous books and articles.
4. **Problem Solving in the Real World** – Using real-world situations in the classroom helps students come to value mathematics as a useful tool that can be applied to out-of-school activities.

**Number Order ??????**

**Materials:**

10 index cards – label each card with one number from 1 – 10.

**Directions:**

1. Put the number cards in order so that when you do the procedure the cards will be in order from 1 – 10.
2. Stack the cards.
3. Pull one card from the bottom of the stack.
4. That card should be number 1.
5. The next card pulled from the bottom of the stack goes on the top of the stack of cards left.
6. Pull the next card from the bottom and that card should be the number two.
7. Pull the next card from the bottom and put that card on top of the stack of cards left.
8. Pull the next card from the bottom and that card should be the number three.
9. Play continues in like manner until you have all 10 cards in order.
CARD PUZZLE NUMBER GAME

Use 8 index cards; write a 1 on the first card, a 2 on the second card, and so on, until you have the cards numbered from 1 to 8.

The challenge in this puzzle is to place the number cards in the shape of the rectangles below so that no two consecutive numbers are next to each other horizontally, vertically, or diagonally. For example, if the 5 is placed in the far left box, then the 4 or 6 can't be placed in the box directly to the right of the 5 or the two boxes that are diagonally above and below the 5.

Think about how you tried to solve this problem so that you can discuss it afterwards

Adapted from AIMS
Directions: Run master on cardstock, laminate, and cut out. Put pieces in a film canister. Give students a 9 by 12 inch piece of felt. They can then dump the contents of their canister onto the piece of felt. Now they can begin to begin the process of “Making Words”. Make a word with the letters and then figure the math to see how much the word is worth.

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5. **Use Culturally Relevant Materials** - The history of Mathematics can be integrated with the study of new mathematical topics. This can show the student how mathematical knowledge evolved from the needs of social or cultural groups.

A Stick Game

Long ago, Native Americans played games with sticks.

**Materials:**

- Four playing sticks per person
- Put Arkansas River, Cottonwood River and Walnut River on three of the sticks and leave other side of the stick plain.
- One stick with one side colored blue and other side left plain
- Score sheet and pencil

**Directions:**

- Before you begin, record all the different ways the sticks might land. You can use the first letter of each river and the letter B (blue side of stick) and P (plain side of stick) to do your recording.
- Throw the sticks gently up in the air and watch the sticks fall.
- Now do this ten times and each time record the way the sticks landed.
- Scoring is as follows:
  - Colored side of stick + 3 sticks naming a river = 6 points
  - Plain side of stick + 3 plain sticks = 6 points
  - All sticks naming a river = 4 points
  - All sticks are plain = 4 points
  - Pair of sticks naming rivers or 2 plain sticks = 2 points

**Score Sheet**

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What were your results?
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Probability and Statistics
• The Jewish dreidel game is a fun game of culture and chance. It is designed like tops. Each player is given an equal number of coins; in each turn a player puts a coin in a pot and spins the dreidal. The dreidal has four letter-embossed sides, each representing an action (i.e., nun--player does nothing; gimel--player takes the pot). Children can predict the outcome of each spin, count coins and graph the results.

This game advances mathematical skills in prediction, probability, recording and graphing.

Tic-Tac-Toe
• Play different versions from around the world to improve strategy and decision-making skills.

Called "Morris" in England or "Mill" in other European countries, in tic-tac-toe two players take turns placing a red or white game piece in one of nine squares on a cross-hatched board. The player who lines three pieces up in a row first wins.

Shisima, Kenyen for "body of water," is a children's tic-tac-toe game. Draw an octagon with lines connecting each corner with the opposing corner. Game pieces (white and black) are called imbalavali--Kenyan for water bugs. Each player has three bugs which are placed in a row along the perimeter of the octagon, facing the opponent. Each player moves his bug either to the left or right or into the center, one move per turn. The first player to line three "bugs" in a row wins.

Counting and Correspondence
• Mancala, also called the West African stone game, involves 12 hollows (6 per player) into which four stones or seeds are placed in each. Two mancalas (two small bowls on each end of the board) are left empty. Play begins when you take your stones from one hollow and drop them, to the right around the board, one in each hollow until they are gone. If the last one is your own mancala, you get to go again. If your last one is in one of your own hollows, you take the stones from your opponent's hollow across from you. The object is to capture as many of your opponent's stones/seeds and collect them in your mancala. Egg cartons are perfect for this game and children can use small stones or beans.
Nine Men's Morris is a 3000 year old board game that has been played all over the world. Here are the rules.

- There are two players, who each need nine playing pieces. In class you can use unifix cubes of two different colors or colored chips, but at home you can use two different kinds of coins or checkers.
- Playing pieces can only rest on the dots. They can only travel along the lines. Each time a player gets three pieces in a straight line (a string), she gets to take one of her opponents pieces off the game board. She wins when her opponent has only two pieces left on the board.
- To begin, each player takes turns putting one piece at a time on one of the dots.
- When all the pieces are on the dots, players take turns moving one piece at a time along the lines to an empty, adjacent dot.
- Remember, each time you make a string of three pieces in a straight line, you get to take one of your opponents pieces. Play until one person wins! Good luck!
6. **Use Technology** – Calculators, spreadsheets, graphing utilities and structured mathematical environments are used to engage students in solving problems that involve real data.

**Beat The Calculator**

**Materials:** 1 deck of number cards (1-10) 4 copies of each for a total of 40 cards  
1 calculator per 3 players

**Players:** 3 (1 'caller'; 1 'calculator'; 1 'brain')

**Directions:**
- Shuffle cards & place facedown in the playing area.
- 'Caller' turns over the top 2 cards.
- These are the numbers to be added/multiplied (only do 1 operation for the entire game)
- 'Calculator' determines the sum/product using the calculator.
- 'Brain' determines the sum/product WITHOUT using the calculator
- 'Caller' says who was first to get answer.
- Winner collects both cards.
- Players rotate assignment (role) every 5-6 turns.
- Player with the most cards is the winner.

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7. **Encourage Oral and Written Expressions** – Students need to be encouraged to explain their thinking, to express their thinking to other students and to share their ideas. The sharing of mathematical thinking is essential in today’s mathematical settings.

**Writing in the Mathematics Classroom**

*Writing is a way to work yourself into a subject and make it your own.*

William Zinsser – *Writing to Learn*

---

**NCTM Standards**

*All students will learn to communicate mathematically*

---

**Benefits of Writing in the Mathematics Classroom**

- Students will learn to communicate and explain mathematical ideas.
- Writing provides an assessment of student understanding.
- Writing provides an indicator for instruction adjustment for the teacher.
- Writing is one essential component of problem solving.
- Writing provides the opportunity for students to clarify and define their thinking.

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**Modes of Writing**

- Journal or Learning Log
- Narration
- Persuasion
- Exploration

---

**Writing as a Process**

- Prewriting
- Drafting
- Revising
- Editing

---

**Suggestions for Success:**

- Create a safe environment for students as they begin writing.
- Assess student level of experience for writing.
- Start with small writing prompts and build student confidence and success.
- Give all students time to learn the writing process and use it.
- Use pairs or cooperative groups to facilitate the process.
**PRIMARY WRITING IDEAS:**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
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<tbody>
<tr>
<td>Draw a picture of the places where you see numbers.</td>
<td></td>
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<tr>
<td>What do you know about numbers?</td>
<td></td>
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<tr>
<td>What did you learn today about numbers?</td>
<td></td>
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<tr>
<td>What do you know about these shapes?</td>
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<tr>
<td>These shapes are different because.....</td>
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<tr>
<td>These shapes are alike because...</td>
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<tr>
<td>What are some objects in the room that have the same shape?</td>
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<tr>
<td>How many numbers were used in this story?</td>
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<tr>
<td>How do you use numbers each day?</td>
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<tr>
<td>What do you want to learn about numbers?</td>
<td></td>
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<tr>
<td>What is addition?</td>
<td></td>
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<tr>
<td>What is subtraction?</td>
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<tr>
<td>Cut out pictures from a magazine to create math sentences and picture stories.</td>
<td></td>
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<tr>
<td>Find and copy a pattern you see in the room.</td>
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<tr>
<td>Learning a new pattern today was.......</td>
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<tr>
<td>How did you solve the problem?</td>
<td></td>
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<tr>
<td>Is there another way to count the objects?</td>
<td></td>
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<tr>
<td>Why do we need money?</td>
<td></td>
</tr>
<tr>
<td>What do you want to learn about money?</td>
<td></td>
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<tr>
<td>Describe a penny, nickel, and dime. How they look, size, color, shape, value, etc.</td>
<td></td>
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<tr>
<td>Do you think you are good at counting money? Why?</td>
<td></td>
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<tr>
<td>How many ways can you make 25 cents?</td>
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<tr>
<td>What is your favorite number? Draw a picture around it so that it includes that number.</td>
<td></td>
</tr>
</tbody>
</table>
**INTERMEDIATE WRITING ACTIVITIES:**

<table>
<thead>
<tr>
<th>Activity</th>
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<tbody>
<tr>
<td>Write directions for playing recess games or team sports.</td>
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<tr>
<td>Write rhymes about math facts.</td>
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<tr>
<td>Create a bulletin board of math vocabulary words and estimate the amounts.</td>
</tr>
<tr>
<td>Write word problems about things at school.</td>
</tr>
<tr>
<td>Write a poem by using math numbers or math concepts.</td>
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<tr>
<td>Write an essay about the way you use math in your life.</td>
</tr>
<tr>
<td>Write a biography about a geometry figure.</td>
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<tr>
<td>Create an advertisement for selling or trading something you own.</td>
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<tr>
<td>Make a dictionary of math terms.</td>
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<tr>
<td>Multiplying is easy if...</td>
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<tr>
<td>Write a song about your favorite numbers.</td>
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<tr>
<td>Write an explanation for how to solve a long division problem.</td>
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<tr>
<td>Read a restaurant menu. Determine what four people could eat for $ 25.00.</td>
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<tr>
<td>Make a timeline of important events in your life.</td>
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<tr>
<td>I want to become better at math so I can...</td>
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<tr>
<td>People who are good at math...</td>
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<tr>
<td>I can do word problems when...</td>
</tr>
<tr>
<td>My goals for math this year are...</td>
</tr>
<tr>
<td>When I hear someone say meth is fun, I...</td>
</tr>
<tr>
<td>I want to become better at math so that I can...</td>
</tr>
<tr>
<td>Compare addition and subtraction.</td>
</tr>
<tr>
<td>Compare multiplication and division.</td>
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<tr>
<td>Write questions for the math test.</td>
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<tr>
<td>Make a list of objects in the room that have symmetry.</td>
</tr>
<tr>
<td>Activity</td>
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<tr>
<td>----------</td>
</tr>
<tr>
<td>Write a summary of today’s math lesson.</td>
</tr>
<tr>
<td>Brainstorm all the words that come to mind when given a <strong>key word</strong>. (fraction – parts, sharing, equal, etc.)</td>
</tr>
<tr>
<td>Write a math autobiography. How do you feel about math? How do your parents feel about math?</td>
</tr>
<tr>
<td>Analyze data from a graph, table, chart or Venn diagram.</td>
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<tr>
<td>Name an occupation and list the skills you would need.</td>
</tr>
<tr>
<td>Write about what life would be like if there were no math.</td>
</tr>
<tr>
<td>Make a tangram picture or origami design. Write about how you made it.</td>
</tr>
</tbody>
</table>
8. Encourage Collaborative/Cooperative Problem Solving – The classroom environment must be structured so that all students can take part in a problem solving activity. Often times a student will go beyond their individual ability when participating in a collaborative problem solving activity.

**Cooperative Learning**

Cooperative learning is a successful teaching strategy in which small teams, each with students of different levels of ability, use a variety of learning activities to improve their understanding of a subject. Each member of a team is responsible not only for learning what is taught but also for helping teammates learn, thus creating an atmosphere of achievement. Students work through the assignment until all group members successfully understand and complete it.

Cooperative efforts result in participants striving for mutual benefit so that all group members:

- gain from each other's efforts. (Your success benefits me and my success benefits you.)
- recognize that all group members share a common fate. (We all sink or swim together here.)
- know that one's performance is mutually caused by oneself and one's team members. (We can not do it without you.)
- feel proud and jointly celebrate when a group member is recognized for achievement. (We all congratulate you on your accomplishment!).

**Why use Cooperative Learning?**

**Elements of Cooperative Learning**

**Class Activities that use Cooperative Learning**

**Why use Cooperative Learning?**

Research has shown that cooperative learning techniques:

- promote student learning and academic achievement
- increase student retention
- enhance student satisfaction with their learning experience
- help students develop skills in oral communication
- develop students' social skills
- promote student self-esteem
- help to promote positive race relations
5 Elements of Cooperative Learning

It is only under certain conditions that cooperative efforts may be expected to be more productive than competitive and individualistic efforts. Those conditions are:

<table>
<thead>
<tr>
<th><strong>1. Positive Interdependence</strong></th>
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<tbody>
<tr>
<td>(sink or swim together)</td>
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<tr>
<td>• Each group member's efforts are required and indispensable for group success</td>
</tr>
<tr>
<td>• Each group member has a unique contribution to make to the joint effort because of his or her resources and/or role and task responsibilities</td>
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</table>

<table>
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<tr>
<th><strong>2. Face-to-Face Interaction</strong></th>
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<tbody>
<tr>
<td>(promote each other's success)</td>
</tr>
<tr>
<td>• Orally explaining how to solve problems</td>
</tr>
<tr>
<td>• Teaching one's knowledge to other</td>
</tr>
<tr>
<td>• Checking for understanding</td>
</tr>
<tr>
<td>• Discussing concepts being learned</td>
</tr>
<tr>
<td>• Connecting present with past learning</td>
</tr>
</tbody>
</table>
3. Individual &
Group Accountability
(no hitchhiking! no social loafing)

- Keeping the size of the group small. The smaller the size of the group, the greater the individual accountability may be.
- Giving an individual test to each student.
- Randomly examining students orally by calling on one student to present his or her group's work to the teacher (in the presence of the group) or to the entire class.
- Observing each group and recording the frequency with which each member contributes to the group's work.
- Assigning one student in each group the role of checker. The checker asks other group members to explain the reasoning and rationale underlying group answers.
- Having students teach what they learned to someone else.

4. Interpersonal & Small-Group Skills

- Social skills must be taught:
  - Leadership
  - Decision-making
  - Trust-building
  - Communication
  - Conflict-management skills

5. Group Processing

- Group members discuss how well they are achieving their goals and maintaining effective working relationships
- Describe what member actions are helpful and not helpful
- Make decisions about what behaviors to continue or change
Class Activities that use Cooperative Learning

Most of these structures are developed by Dr. Spencer Kagan and his associates at Kagan Publishing and Professional Development. For resources and professional development information on Kagan Structures, please visit: www.KaganOnline.com

1. **Jigsaw** - Groups with five students are set up. Each group member is assigned some unique material to learn and then to teach to his group members. To help in the learning students across the class working on the same sub-section get together to decide what is important and how to teach it. After practice in these "expert" groups the original groups reform and students teach each other. (Wood, p. 17) Tests or assessment follows.

2. **Think-Pair-Share** - Involves a three step cooperative structure. During the first step individuals think silently about a question posed by the instructor. Individuals pair up during the second step and exchange thoughts. In the third step, the pairs share their responses with other pairs, other teams, or the entire group.

3. **Three-Step Interview** (Kagan) - Each member of a team chooses another member to be a partner. During the first step individuals interview their partners by asking clarifying questions. During the second step partners reverse the roles. For the final step, members share their partner's response with the team.
4. **RoundRobin Brainstorming** (Kagan) - Class is divided into small groups (4 to 6) with one person appointed as the recorder. A question is posed with many answers and students are given time to think about answers. After the "think time," members of the team share responses with one another round robin style. The recorder writes down the answers of the group members. The person next to the recorder starts and each person in the group in order gives an answer until time is called.

5. **Three-minute review** - Teachers stop any time during a lecture or discussion and give teams three minutes to review what has been said, ask clarifying questions or answer questions.

6. **Numbered Heads Together** (Kagan) - A team of four is established. Each member is given numbers of 1, 2, 3, 4. Questions are asked of the group. Groups work together to answer the question so that all can verbally answer the question. Teacher calls out a number (two) and each two is asked to give the answer.

7. **Team Pair Solo** (Kagan) - Students do problems first as a team, then with a partner, and finally on their own. It is designed to motivate students to tackle and succeed at problems which initially are beyond their ability. It is based on a simple notion of mediated learning. Students can do more things with help (mediation) than they can do alone. By allowing them to work on problems they could not do alone, first as a team and then with a partner, they progress to a point they can do alone that which at first they could do only with help.
8. **Circle the Sage** (Kagan)- First the teacher polls the class to see which students have a special knowledge to share. For example the teacher may ask who in the class was able to solve a difficult math homework question, who had visited Mexico, who knows the chemical reactions involved in how salting the streets help dissipate snow. Those students (the sages) stand and spread out in the room. The teacher then has the rest of the classmates each surround a sage, with no two members of the same team going to the same sage. The sage explains what they know while the classmates listen, ask questions, and take notes. All students then return to their teams. Each in turn, explains what they learned. Because each one has gone to a different sage, they compare notes. If there is disagreement, they stand up as a team. Finally, the disagreements are aired and resolved.

9. **Partners** (Kagan) - The class is divided into teams of four. Partners move to one side of the room. Half of each team is given an assignment to master to be able to teach the other half. Partners work to learn and can consult with other partners working on the same material. Teams go back together with each set of partners teaching the other set. Partners quiz and tutor teammates. Team reviews how well they learned and taught and how they might improve the process.

**Credits:**


**Reference**

9. **Use Errors to Enhance Learning** – Every child’s way of thinking mathematically is important. He/she needs to share his/her thinking with a small group of students or with the whole class. Teachers can then question the process used to obtain the solution.
10. Use a Variety of Problem Solving Experiences –

The T Problem

Using these 4 pieces you must make a CAPITAL LETTER 'T' with no jagged bits, no gaps, no overlaps, no bumpy bits. The solution must be all one color. Don’t turn pieces over.

Constant manipulation is a problem solving strategy that may help you.
Mrs. Bond picked the numbers 2, 7, 5 and 8. She asked her second graders to arrange these numbers into two digit numbers and then add them. She wanted to see who could arrange the numbers to make the largest sum. How should the students arrange the numbers to get the largest sum?

How about the smallest sum?

Susan and Jill are playing a game. They toss the die 20 times and record the results. Susan gets a point for each odd number they toss on the die, while Jill gets a point for each even number they toss on the die. Who won this game? Explain your answer.
Splash of Math Canister

What will we learn about Math from our Math Splash Canister?

1.) Draw one number from your Math Splash Canister.
   - Number less than 25, come to the front of the room.
     Rules: No talking.
     - Put numbers in order from the smallest to the largest.
   - Numbers smaller than 50, come to the front of the room.
   - Numbers that are odd
   - Numbers that are even
   - If two digit numbers: What number is in the ones place, tens place?

2.) Draw out two numbers from your Math Splash Canister.
   - Add the two numbers
   - Subtract the two numbers
   - What is the difference between the two numbers
   - Multiply the two numbers
   - Divide the two numbers
   - Make an equation that is greater than or less than with the two numbers
   - Make a fraction with the two numbers—can it be reduced?

3.) Draw out three, four or five numbers from your Math Splash Canister.
   - Put the numbers in order
   - Add the numbers
   - Look for even numbers
   - Look for odd numbers
   - Look for prime numbers
   - Read the numbers telling the place value of each number.
     - Change the numbers around coming up with a different number—how many different numbers can you make using three numbers, four numbers, or five numbers?
   - Is there a pattern you can make with the numbers?

4.) Draw out two numbers from your Math Splash Canister and make a real-life problem solving situation using the two numbers.

5.) Pair up with a partner and each of you draw one number out of your Math Splash Canister.
   Compare the numbers.
   - Who has the smallest number, the largest number?
   - Who has an odd number, an even number?
   - Using both of the numbers, make an equation.
   - Make some comparison statements about the two numbers.

6.) Pair up with a partner and take turns drawing a number out of the Math Splash Canister.
   Keep drawing one number at a time. See who can get to 100 first by adding the numbers you draw out of the canister.

7.) Start with a 100 and subtract the numbers you draw out of the canister.

8.) Draw five, six or seven numbers from the Math Splash Canister. Add the numbers together.
   Put the numbers in order from the smallest to the largest. Calculate the mean, and find the minimum and maximum values, mode, range, and median for the numbers.

9.) Draw one number from the Math Splash Canister.
   - Divide the number by 2. Can it be divided evenly?
   - Divide the number by 3. Can it be divided evenly?
   - What else can you tell me about this number?

10.) Draw a number from the Math Splash Canister. How many ones, tens does this number have?

11.) Draw a number from the Math Splash Canister. Use that number as an answer to a number sentence. Write as many equations as you can think of with the answer that you drew out of the canister.

12.) Draw a number from the Math Splash Canister. Use that number as the numerator of a fraction with the denominator being 100.
   - Can with fraction be reduced?
   - Write the fraction as a percent

13.) What Math ideas can you come up with using your Math Splash Canister?
Copy the 100’s chart on blue cardstock, laminate, and cut out. Put all pieces in a film canister marked Splash of Math.

### Hundreds Board

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</table>
Math Problem Solving Using a Hundreds Board

1) The number is between 1 and 50.
   The number is even.
   Both digits are a multiple of 3
   The difference between the two digits is three. (36)

2) The number is between 10 and 30.
   The sum of the digits is 6.
   The difference of the two digits is two. (24)

3) The number has two digits.
   The number is between 10 and 30.
   Both digits are even.
   The sum of the digits is 10. (28)

4) The number has two digits.
   The number is between 50 and 80.
   The number is a multiple of 5.
   Both digits are odd.
   If you multiply the digits together you will get 35. (75)

5) This number is between 0 and 20.
   The number has two digits.
   The number is even.
   The ten’s place value is less than the one’s place value.
   The sum of the digits is nine.
   The difference between the two digits is seven. (18)

6) This number is between 20 and 50.
   One digit is odd.
   The number is a multiple of 5.
   The difference between the two digits is three
   When you multiply the digits you get 0. (30)

7) My number is between zero and 30.
   My sum is odd.
   Both of my digits are greater than 0, but less than 5.
   I’m one year shy of being a teenager.
   I represent one dozen. (12)
8) Number is between 12 and 55.
   The number is odd.
   The number is a multiple of 5.
   When you multiply the two digits the product is 10.  (25)

9) Pick a number between 3 and 30.
   The number is a multiple of 7.
   The 1\textsuperscript{st} digit is a prime number.
   If you add the digit in the one’s place, it will equal the prime number in the ten’s place.  (21)

10) Pick a number between 50 and 99.
    The number is odd.
    The number is a multiple of 5.
    The sum of the digits is 12.  (75)

11) The number is between 0 and 20.
    The sum of the two digits is even.
    One digit is odd and the other digit is even.
    The sum of the two digits is 3.  (12)

12) The number is between 30 and 50.
    The sum of the two digits is 11.
    The difference between the two numbers is 5.  (38)

13) The number is a multiple of 8.
    The number is between 60 and 100.
    Both digits are even.  (64)

14) Number is between one and 50.
    One digit is even.
    Sum of the digits is 11.
    The number is prime.  (47)

15) This number has two digits.
    Number is between 40 and 80.
    One digit is odd and one digit is even.
    The sum of the digits is 11
    The ten’s digit is one more than the one’s digit.  (65)
16) The number is between 15 and 40.
The tens column is an even number.
The number can be divided by two odd numbers.
The sum of the digits is 3.
The difference between the digits is 1. (21)

17) Number between 10 and 30.
Multiple of 5.
Both digits are odd.
Number is odd.
Ten’s place is a prime number.
Sum of the digits is 6. (15)

18) Number is between 50 and 99.
Sum of the two digits is 13.
One digit is even and one is odd.
The digits are consecutive numbers.
The larger digit is in the ones place. (67)

19) Both digits are odd.
The number is between 50 and 100.
The sum of the digits is 10.
The number in the ten’s column is greater.
The number in the one’s column is between 0 and 2. (91)

20) Number between 36 and 88.
Both digits are even.
The digit in the ones column is larger than the digit in the tens column.
The sum of the digits is 14. (68)
Each player has 16 stars (four of each color, red, blue, yellow, and green.)
Arrange the 16 stars so that one of each color is in each row and column. Only one of each color can be placed horizontally, vertically and diagonally in a row or column.
Find out how many squares are possible on this checkerboard.

Be sure to count all of them.

How many squares did you end up with? ______