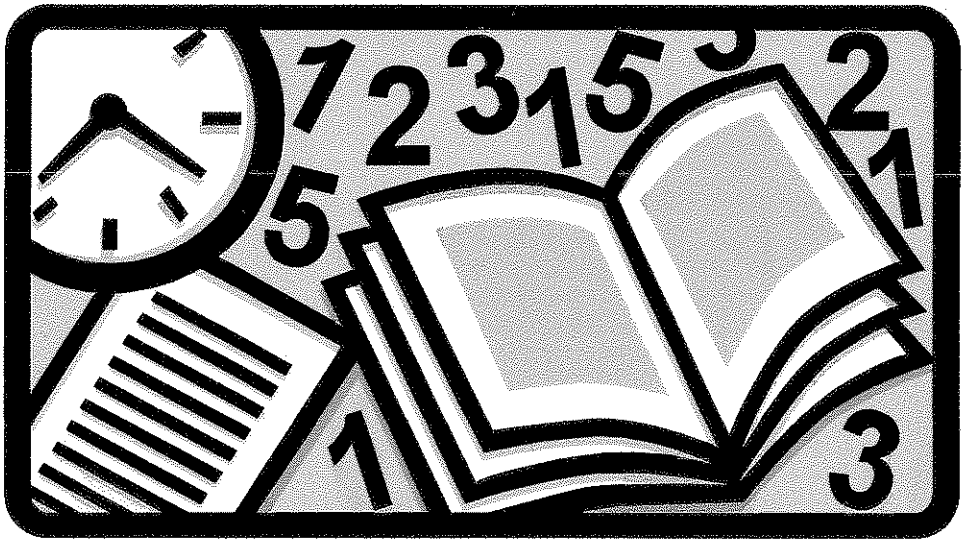
VIPS – Math Friends

EveryOne Counts

Meaningful Math Manipulatives
9/15/10



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7 Musts for Using Manipulatives

By Marilyn Burns
Source: Instructor Magazine

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 others 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.

About the Author

Marilyn Burns is the creator of Math Solutions, inservice workshops offered nationwide, and the author of numerous books and articles. She is author of the book *50 Problem-Solving Lessons, Grades 1-6*, distributed by Cuisenaire.

A Letter to Parents

By Marilyn Burns

Manipulatives in Today's Classroom
Have you ever visited a new city and felt confused about finding your bearings--even if you had a map and directions? After a few days you probably got a feel for the area, and even if you became lost from time to time, you could count on familiar landmarks to help you on your way. And with enough exploring, most likely you ventured with more confidence wherever you needed to go.

We can think of the value of firsthand experiences for learning mathematics in a similar way. Math has many areas--patterns, measurement, geometry, statistics, probability, and more--and they're often unfamiliar, abstract, and confusing to students. We need to help children develop the ability and confidence to find their way around in each of these areas, see how they connect, and know what to do should they forget a fact or procedure. Here are five reasons manipulative materials do just that:

1. **Manipulatives help make abstract ideas concrete**. A picture may be worth a thousand words, but while children learn to identify animals from picture books, they still probably don't have a sense about the animals' sizes, skin textures, or sounds. Even videos fall short. There's no substitute for first hand experience. Along the same lines, manipulatives give students ways to construct physical models of abstract mathematical ideas.
2. **Manipulatives lift math off textbook pages**. While we want students to become comfortable and proficient with the language of math--everything from the plus sign to the notations of algebra--words and symbols only represent ideas. Ideas exist in children's minds, and manipulatives help them construct an understanding of ideas that they can then connect to mathematical vocabulary and symbols.

3. **Manipulatives build students' confidence by giving them a way to test and confirm their reasoning.** One goal of the National Council for the Teachers of Mathematics Standards is to build students' confidence with mathematics. If students have physical evidence of how their thinking works, their understanding is more robust.
4. **Manipulatives are useful tools for solving problems.** In searching for solutions, architects construct models of buildings, engineers build prototypes of equipment, and doctors use computers to predict the impact of medical procedures. In the same way, manipulative materials serve as concrete models for students to use to solve problems.
5. **Manipulatives make learning math interesting and enjoyable.** Give students the choice of working on a page of problems or solving a problem with colorful and interestingly shaped blocks, and there's no contest. Manipulatives intrigue and motivate while helping students learn.

About the Author

Marilyn Burns is the creator of Math Solutions, in service workshops offered nationwide, and the author of numerous books and articles. She is author of the book *50 Problem-Solving Lessons, Grades 1-6*, distributed by Cuisenaire.

Marilyn Burns Answers Your Questions About Manipulatives

Q. Manipulatives help my slower learners, but do my better math students need them?

A. Absolutely. The challenge of teaching any subject is to find activities that are accessible to all learners and have the richness to challenge more interested or capable students. Manipulatives are a wonderful resource for this. For example, I introduced fourth graders to Build the Yellow Hexagon. All students found different ways to build the hexagon and recorded their constructions with correct fractional notation. I asked the students who finished quickly: "How much larger is the red trapezoid than the blue parallelogram?" This challenged them to figure out how much more 1/2 is than 1/3.

Q. How often should I use manipulatives in my teaching?

A. Ideally, the materials are available for students to use at any time to help them think, reason, and solve problems. When a manipulative material is key to a lesson, I initiate its use.

Q. What about students who work well with manipulatives but have trouble with textbooks?

A. Showing the bridge from concrete experiences to symbolism is essential. While it may be obvious to adults, it can be a stretch for students to see how a 3-by-4 rectangle built with tiles relates to the textbook explanation that 3 x 4 means three groups of four. I help children make connections by demonstrating how a rectangle can be separated into three rows with four tiles. If your textbook doesn't reference manipulatives, talk about what students might use to help solve a problem. Often, students don't realize that what they use in one setting can be helpful in another.

Q. How many kinds of manipulatives do I need?

A. It makes sense to introduce one material and provide time for in-depth exploration. But one advantage of using a variety is that children can think about ideas in different ways. For example, we wouldn't want children to think of fractions as related only to round pies.

Q. Can't I make cheaper manipulatives?

A. For years I've had children cut paper cookies to explore fractions, fold shapes for geometry, and use strips for measurement. Students also cut paper squares into the seven tangram puzzle pieces to see that the pieces make a square. However, to create other shapes, compare areas andperimeters, or make observations over time, paper pieces aren't durable or exact. Manipulatives stand the test of time and are precise. They also allow students to discover the mathematical relationships inherent in them.

Q. Where do I fit manipulatives in when there's so much to do?

A. I use manipulatives as a support for teaching the math topics that are in the curriculum. I don't reserve materials for special days or assignments, but make them a regular and integral part of my general teaching.

Q. I worry that children will see the same materials year after year and lose interest. Do they?

A. Schoolwide planning to discuss which manipulatives you'll use and how to use them can be valuable. However, be careful not to designate certain materials or activities for only one grade. Most are appropriate for different levels, and repeat experiences help students stretch their thinking. For example, asking primary children to find different ways to make trains of six interlocking cubes using just two colors helps them explore different addends of 6. Older students can be challenged to figure out how many arrangements there are, not only for trains of 6, but also for trains of other lengths.

Q. I don't have enough of any one kind of manipulative to use with my whole class. What can I do?

A. Some teachers I know organize learning centers and have small groups work at them. Others introduce a few activities to be done over several days, and students make choices based on which materials are available. Still others pool materials for a week with other teachers to create class sets. In all cases, having students work cooperatively not only cuts down on the amount of material you need, but also encourages communication — which in turn promotes learning.

Q. How do I know when it's time for students to put away the materials?

A. I let students be my guide. Observing them gives me valuable information. Sometimes I've assigned students the problem of finding all of the rectangular arrays using 6, 12, and 24 tiles. While some need to build all of the rectangles with tiles and then record them, other students stop using the tiles and are comfortable drawing the rectangles.

Q. I worry older students will complain that manipulatives are babyish. Any advice?

A. I rarely get this reaction. Most are delighted to get their hands on concrete materials. If you anticipate naysayers, talk about how, for example, architects often build models of buildings and engineers construct prototypes. Tell students that they'll use materials to model a problem or situation. Then be sure they first experience something that offers a challenge and that you provide free exploration time.

Activities from EBR Comprehensive Curriculum

Activity: Exploring Snap Cubes

In our mathematics class this year, we will be using many tools to work with numbers as we use them in different ways to solve problems and play math games. Today we will be using snap cubes to look at ways to make 10.

With the students make a list of a few class rules about using the cubes Let students suggest rules such as:

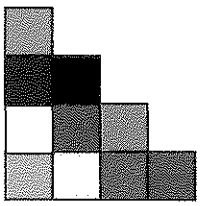
- No throwing (could hit someone in the eye)
- Don't put in mouth (germs make you sick)
- No weapons made (knives, guns .....)
- Never grab anyone else's cubes. Always ask first.

Model the use of the cubes and allow the students to handle them. Give students 10 -15 minutes to explore using the cubes. Let them build anything they wish as long as they remember the "no weapons" rule.

Diagnostic Activity: Combinations that Make Ten

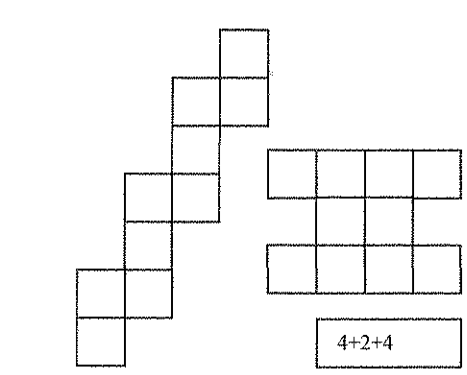
Guiding Question: "Can students use a number sentence to describe a configuration of 10 cubes?"

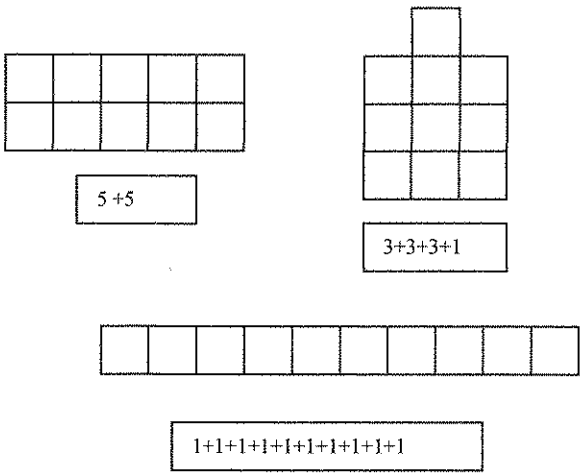
- Provide each student with 10 snap cubes one of each of the 10 colors
- Students use the cubes to build anything they want that will stay together when it is picked up.
- Show students an arrangement you have made that looks like a staircase.



- Explain: If I were to describe this group of cubes using numbers, I could say "4 + 3 + 2 + 1"
- Ask: How could you describe your arrangement of 10 cubes using numbers?

Possible arrangements include:





Activity: Guess My Number on the Number Line
The number line should be posted at a place and height accessible to students and should remain posted throughout the year.
Mathematical Symbols "Greater than" and "less than" clues provide an opportunity to model the use of the mathematical symbols > and <

Call students' attention to the number line that you have posted in your room. Ask whether they are familiar with this tool and how they have used it in the past.

The number like is a tool we will be using in math this year. The number line can help you count and solve problems. It can also help you figure out how to write a number or the order of the numbers.

What do you notice about the number line?

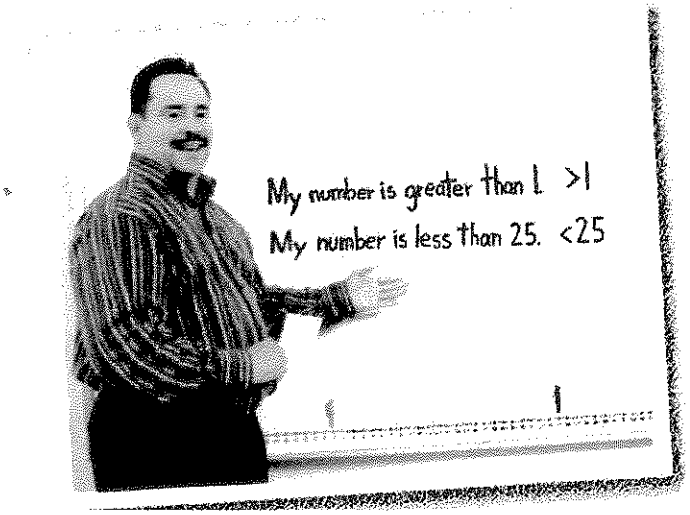
Students might say:

"All the numbers are on it. They are in a line."

"The numbers show how to count: 1, 2, 3. It keeps counting up and up."

Once students have shared some observations, ask them to locate a few numbers on the number line.

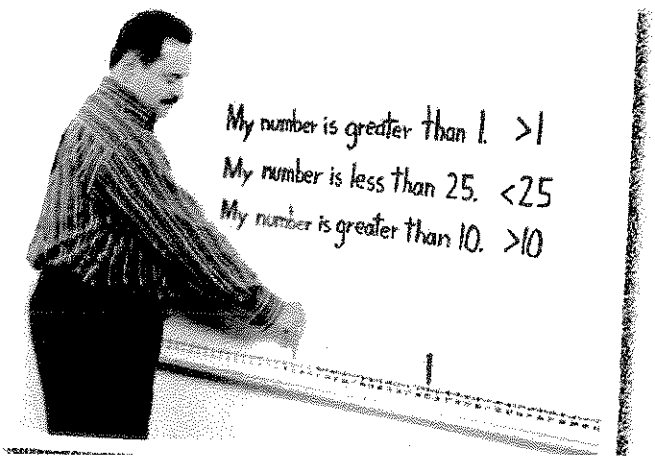
Today we're going to play **Guess My Number** on the number line. I'm thinking of a number that is between I and 25. I am going to write the secret number on a scrap of paper, so I don't forget it. [Demonstrate this without showing the secret number.] So far all you know is that my number is greater than 1 and less than 25.



Write these clues on the board or chart paper.

I'm going to mark these numbers with clothespins [demonstrate]. Your job is to guess my number in the fewest number of guesses. When you make a guess, I will tell you whether or not your guess is greater than or less than my number.

Take guesses from one student at a time. Suppose that your number is 16 and the first student guesses 10. Respond with a new clue,



"My number is greater than 10." Add this new clue to the list of clues on the board.

What do we know now? How should I move the clips?

As students respond, move the left clip from 1 to 10, showing that your number is located between 10 and 25.

What numbers is my number between? Who has another guess? Don't forget you are trying to guess my number in as few guesses as you can.

Continue until students guess the number. Show a single clothespin on this number, and compare it with the number you wrote on the scrap paper.

Play at least two rounds of the game, each time choosing a number between 1 and 25, asking students to help you narrow down the range of possible numbers and discussing students' strategies for selecting numbers to guess.

Ongoing Assessment: Observing Students at Work
As students play Guess My Number, they develop logical reasoning skills and think about the order and magnitude of numbers.

- Do students choose numbers within the designated range? Can they keep track of how the range of possible numbers changes after each guess?
- Do students play strategically, choosing a number midway in the range so as to eliminate the most possibilities?

Activity: Patterns on the 100 Chart

- Draw one row of the 100 chart on the board or on chart paper or use a wall pocket 100 chart (numbers for 100 chart can be found in unit resources). Select two numbers and have students find the missing number between the two numbers selected. Explain how the 2 numbers provided give clues about the number that comes between them.
- Create a large blank 100 chart or display a commercially made 100 pocket chart that will be displayed in your classroom all year.
- Place several numbers in their proper place in the first 5 rows.
- Pass out a number card in random order to each student.
- Call on the students, one at a time, to come place their number in the correct place.
- After about 30 cards have been placed, discuss patterns that are emerging
    - Skip counting
    - all the same one's digit in a row
    - all the same ten's digits in a column

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

MISSING NUMBERS

Name_____ Date_____

1		3	4		6		8		
				15		17		19	20
21	22		24		26		28		
		33		35			38		
	42					47			50
51			54					59	
		63		65		67	68		
71					76		78		80
	82		84			87		89	
91				95		97		99	

Using the Hundreds Chart to Add and Subtract

Solve each of the following. Then write a number sentence to go along with the sum or difference.

1. 45 ↑ =

2. 36 ↓ =

3. 81 ← =

4. 53 → =

5. 35 ↑ ↑ ↑ =

6. 43 ↓ ↓ ↓ ↓ =

7. 68 → → → → →

8. 17 ↓ ↓ ↓ ↓ ↓ → → =

9. 97 ↑ ↑ ↑ ↑ ↑ ↑ ← ← ← ← =

10. 100 ↑ ↑ ↑ ↑ ↑ ← ← ← ← ← =

Now you make up a problem and solve it.

What Time Is It?

Students practice naming, notating, and telling time to the minute on digital and analog clocks. They predict ending times when given intervals and the starting times of activities. Conversely, they predict starting times when given intervals and the ending times. They also determine intervals when given both the starting and ending times.

Basic Activity

Step 1

Write or display the time. Write a time at an interval of 5 minutes (for example, 12:05 or 12:35) on the board or show the time on the demonstration clock. Ask students to say the time and to set that time on their clocks. Alternatively, you may say the time and ask students to write it before setting it on their clocks.

Step 2

Write or display a change in time. Move the minute hand on the demonstration clock to the next 5-minute interval. Move the hour hand slightly as well
(for example, slightly past the 12 when beginning with the time 12:05), again asking students to tell what time it is.

Step 3

Record the new time on the board. Ask: If I move the minute hand to the 3, what time will it be? What about the 4? What time will it be then? What about the 5?
Continue to record the times on the board and identify each new time. Check for students' understanding of the different ways to name each time you record. For example, Sometimes people call this time 12:25. What else do people call this time? (25 minutes after 12) Sometimes people call this time 12:50. What's ano*ther way to say this time? (10 minutes before 1)*

Step 4

Students demonstrate 5-minute intervals. Working in pairs, students practice setting their clocks to 5-minute intervals that you suggest (for example, 1:10, 1:15, 1:20, 1:45, 1:50, 1:55).

Variations

Telling Time to the Minute

Follow the procedure for the basic activity but use any time including times in between 5-minute intervals (e.g. 3:12 or 3:38). Check that students can say what time it is (for example, that 3:12 is 12 minutes past 3 o'clock or that 3:38 can also be read as 38 past 3 or 22 minutes before 4 o'clock) Do they know what interval of 5 minutes tl between (3:10 and 3:15; and 3:35 and 3:40)?

What Time Is It? What Time Will It Be?

In this variation, students begin with a time and determine what the time will be after a given number of minutes have passed.

For example, write a time on the board (or say the time) or show a time on the demonstration clock. Alternate using times at 5-minute intervals and times in between 5-minute intervals. Ask students to set that time on their clocks

Begin by asking questions like the following:

- What time is it?
- What time will it be in one hour? (one-half hour, 15 minutes, etc.)?

Students set their clocks and discuss how they determined the time and how the hands moved on the clock. Record the new time on the board and repeat as above.

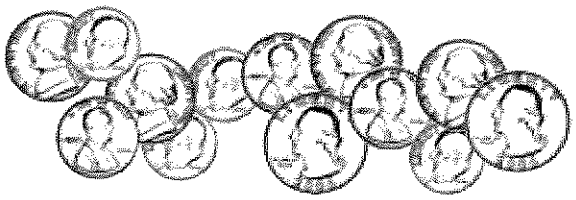
or

Have students determine the duration of dally activities. Show a time on the demonstration clock and ask:

- What time is it?
- If the awards program starts at 9:10 and lasts for 45 minutes, what time will it end?
- If we start silent reading time at 1:45 and we read for 30 minutes, what time will it be when you are done?
- Allow students to share ideas with a partner about what time they think it will be.
-

Collect 25¢

You need

- dot cube  or number cube 
- coins 

Play with a partner.

1. Player 1 rolls the cube and takes that amount in coins.

2. Player 2 rolls the cube and takes that amount in coins.

3. Keep taking turns. You can trade coins. At the end of each turn, figure out how much money you have.

4. The game is over when each player has collected at least 25¢.

More Ways to Play

- At the end of the game, try to make trades so that you have the fewest possible coins.
- Try to collect *exactly* 25¢.

Turn Over Ten

Directions:

For 2 players

1. Deal out all the number cards face down in straight rows.
2. Each player tries to make a match of two cards that add up to ten.
3. The first player turns over 2 cards.
4. If the player turns over 2 cards that have a sum of ten, he/she lays the two cards down side by side to make a pair and gets to turn over 2 new cards.
5. If the player turns over 2 cards that do not add up to ten, the player's turn is over
6. Continue the playing with players trying to make pairs totaling 10 until there are no more cards left.
7. Each player must record all the pairs of cards they collected on the recording sheet.

Turn Over Ten
_____ + _____ = 10
_____ + _____ = 10

Turn Over Ten
_____ + _____ = 10
_____ + _____ = 10

Tens Go Fish Directions

For 3 to 6 players

1. Deal each player 5 cards face down.
2. Place the rest of the cards face down in the middle of the table. This is the drawing pile when you have to "go fish."
3. Each player tries to make a match of two cards that add up to ten.
4. The first player asks another player for a card that will pair up with one of their cards to make a sum of ten.
5. If the player has a card to make a match of ten, the first player lays the two cards down side by side to make a pair.
6. If the player does not have the card asked for to make a match equaling 10, the player says "Go Fish"
7. The first player must "Go Fish" (draw one card from the deck). Their turn is now over even if they draw the card they asked for. They still have a match and can lay the 2 cards down.
8. Continue playing with players all trying to make pairs totaling 10 until there are no more cards left.
9. Each player must record all the pairs of cards they collected on the recording sheet.

Tens Go fish
_____ + _____ = 10
_____ + _____ = 10

Roll and Order

Roll the number cube 3 times and write down the three numbers you roll.

_____ _____ _____

Now make as many 3-digit numbers as you can. Use only the three digits above.

Put the 3-digit numbers above in order from **least to greatest**.

Now play again, but be careful. You will put the numbers in order from greatest to least.

Roll the number cube 3 times and write down the three numbers you roll.

_____ _____ _____

Now make as many 3-digit numbers as you can. Use only the three digits above.

Put the 3-digit numbers above in order from **greatest to least.**

Dominoes are rectangular blocks with dots. Use dominoes to teach math operations. Add the two sets of dots. Have your child find other dominoes with the same sum. Subtract the smaller number of dots from the larger number of dots. Another activity would be to multiply the dots.

Linking cubes or **Unifix cubes** are colored cubes that can be used to add, subtract, multiply and divide. The cubes come in 10 different colors. The cubes also link together so they can be used for nonstandard measurement and making bar graphs. Linking cubes and Unifix cubes are very similar. I would buy one or the other. You do not need both.

Here are some activities for linking cubes. Build an AB pattern using two colors. When your child can make AB patterns himself move on to more complex patterns. Teach AAB patterns such as red, red, blue. Have your child make up patterns.

Teach operations using cubes. Have your child link three blue cubes and two brown cubes together. Ask your child, "How many cubes do you have all together?" Make up other addition problems. Have your child make up problems.

An example of a subtraction problem is link six cubes together then take away three.

To teach multiplication, have your child make two chains of five cubes each.

For division give your child a chain of nine cubes. Ask your child, "How he can make three equal chains?" Make sure that you give lots of practice with each operation.

Another activity is to use cubes to teach place value. Assign a color such as red for ones, blue for tens and brown for hundreds. Show your child 9 red cubes, 2 blue cubes and 5 brown cubes. Ask what number you should write. The answer should be 529.

How to Teach Math With Dice Games

Instructions

Things You'll Need:

- Dice
- Paper
- Timer
- Pencils

1. Collect all supplies needed before beginning the game. Common items include dice, paper, a stopwatch or timer, pencils and any self-made game boards.

2. Use simple games for elementary aged children who are learning addition and subtraction. One idea is that the child rolls one die and you roll the other, then have the child add the two numbers together. When this becomes easy, make a race out of it and see who can yell out the answer first. This helps the child practice speed and accuracy with math facts.

3. Reinforce subtraction concepts by having the child roll one die and you roll the other. Whoever rolls the larger number gets to think up a simple subtraction problem the other person must answer. This is fun for kids because they get to quiz you, and you can increase their math skills by answering incorrectly and seeing if they catch you.

4. Practice multiplication facts by rolling the dice and having the child add the two numbers together. They then think of a multiplication problem that has the same answer as the sum they just rolled. Increase speed and accuracy by setting a timer for a few minutes and seeing how many they can finish.

5. Make a race out of math drills by using four dice instead of two. Each person gets a set of dice and rolls them repeatedly in front of them, writing down a math problem using the numbers rolled and filling in the answer. Set a timer

for five minutes and the person who has the most problems done when the timer goes off is the winner.

6.

Let younger children practice beginning math skills such as greater and less, grouping, counting and sorting by using dice. Small children can roll two dice and figure out which dice has the greatest or least number on it. You can also use the dice along with sorting blocks and let the child sort, group or count the blocks based on what number they rolled.

Pattern Block Activities

By Marilyn Burns | March 2005
Source: Instructor Magazine

Pattern blocks fit together to make intriguing and beautiful patterns, and theyhelp children learn math in a multitude of ways. Here are classroom activities ofall levels--plus homework assignments that extend learning and bring parents intothe loop. (The last problem may even challenge you!)

Scoop and Sort (K-2)

Step 1:

Have children take a two-handed scoop of pattern blocks,sort them by shape, and place matching shapes in separate columns on18-by-24-inch newsprint. It helps to draw a grid.

Step 2:

Ask students to trace and color the blocks, or pasteconstruction paper shapes onto the grid. Post one of the children's graphs andhave children talk about what they notice. Over several days, repeat for all ofthe children's graphs.

Homework: In class have students write three sentences abouttheir graph. Send home their graphs and ask parents to help them write three additional sentences.

Build the Yellow Hexagon (Grades 3-5)

Step 1:

Have students work in groups to find all the differentways to re-create the yellow hexagon using different assortments of blocks.

Step 2:

After they think they've found all the ways, havechildren record them using fractions, with the yellow hexagon assigned the valueof 1. For example, if they build the hexagon with one red trapezoid and threegreen triangles, they'll write: 1/2 + 1/6 + 1/6 + 1/6 = 1. (Show students how toshorten that to 1/2 + 3/6 = 1.)

Homework: Send home the student work with a sampler of patternblocks.

Building Larger Shapes (Grades 4-6)

Step 1:

Ask students to investigate which of the pattern blocksthey can use to build shapes that are larger but similar--such as four or ninesquares to make a larger square. To get children started, ask: Can you use greentriangles to build a larger green triangle that is still the same shape? How manydo you need?

Step 2:

Send the problem home with a sampler of pattern blocks.

A Challenge (Grades 6 AND UP)
You can easily compare the areas of some shapes of pattern blocks. The redtrapezoid, for example, is half the area of the yellow hexagon and three times aslarge as the green triangle. How do the areas of the orange square and tan parallelogram compare?

Try this yourself! If you get stuck, click on The Solution to Marilyn Burns' Pattern Block Puzzler

About the Author

Marilyn Burns is the creator of Math Solutions, inservice workshops offered nationwide, and the author of numerous books and articles. She is author of the book *50 Problem-Solving Lessons, Grades 1-6*, distributed by Cuisenaire.