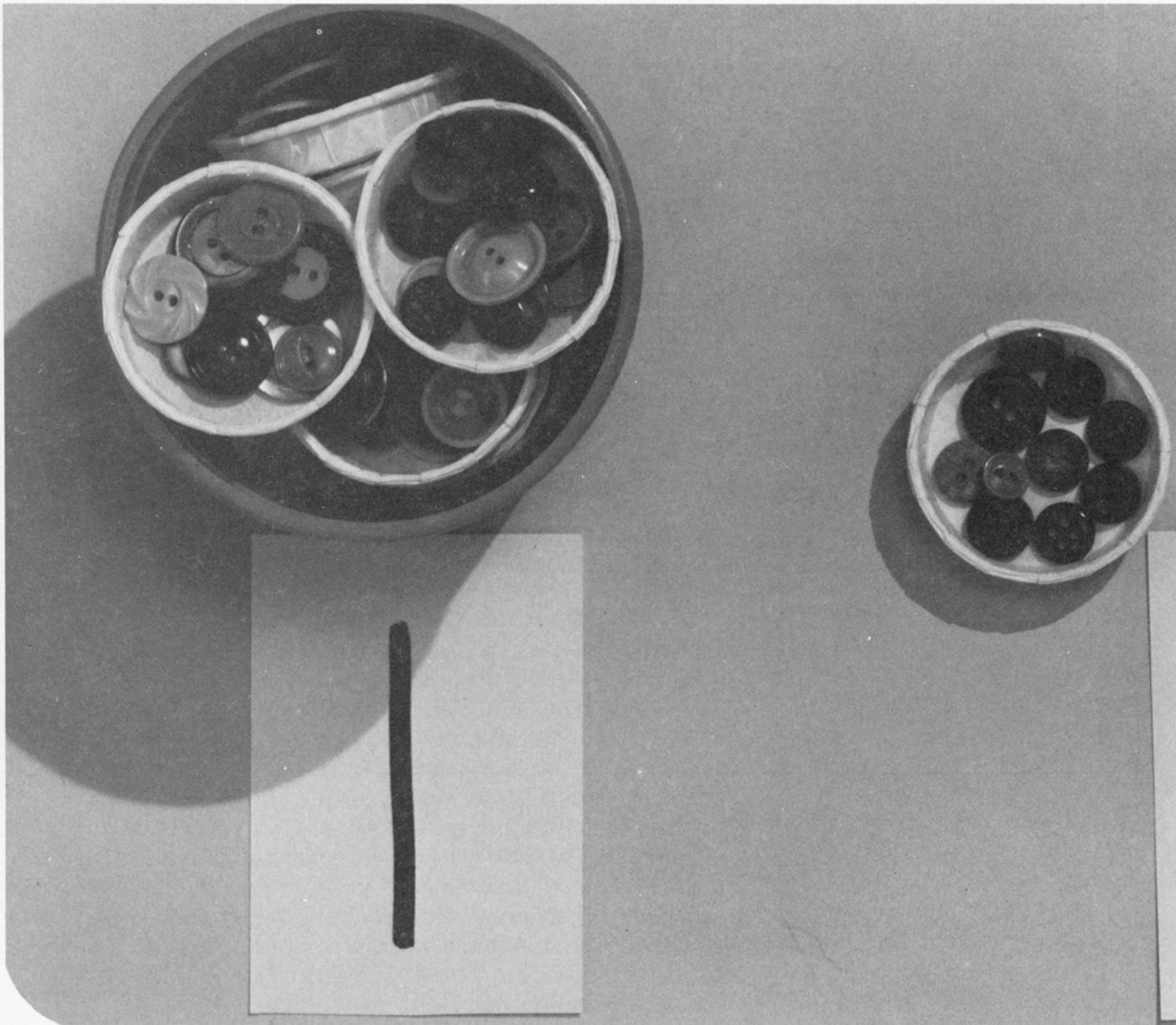


PLACE VALUE

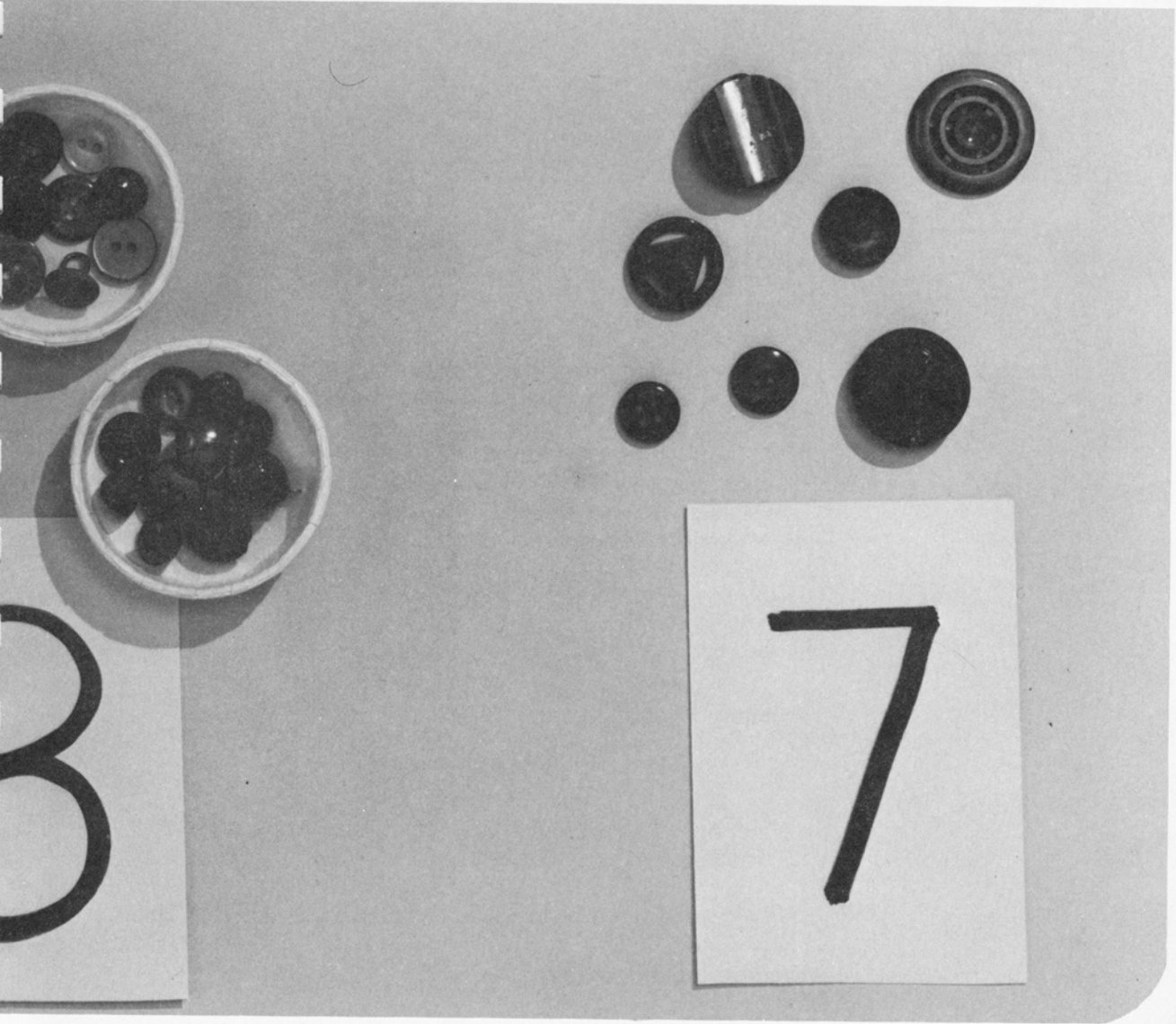


SKILLS AND CONCEPTS _____ Developing an understanding of the structure of the base ten number system
Examining patterns in numbers larger than ten
Observing and identifying numbers greater than ten in real-world situations
in the real world
Measuring
Estimating and counting large groups of objects
Creating and solving two place addition and subtraction problems

SELF CONCEPT AND SOCIAL INTERACTION _____ Sensing the value of one's own and others' ideas as these are used as the core of the curriculum
Developing an image of oneself as a responsible person by being trusted to handle real money

FUTURE APPLICATIONS _____ Using mathematics skills as problem-solving tools in real world situations

PREREQUISITE CHAPTERS _____ Free Exploration Number at the Concept Level
Pattern I Number at the Connecting Level
Counting
Comparing



INTRODUCTION

The goal of the activities in this chapter is to give children a concrete understanding of place value in base ten. In order to achieve this goal the children explore groupings in bases other than ten and look for the patterns which result. Once they grasp the patterns with these smaller groupings, they can readily understand the same patterns in base ten. In this way, base ten evolves as part of a general structure which the children have experienced concretely.

Counting Game: Concept Development Stage

SKILLS _____

Place value
Creating the structure of a base
Counting
Pattern

MATERIALS _____

Common items found in the classroom, place value boards,*
Unifix cubes*

ACTIVITY _____

Tell the children they are going to play a new counting game. Hold up a wadded piece of paper and tell the children it holds a secret message. Actually, a number is written on it that is to be used in the counting game. Open the paper and show it to the children. Explain that they must think of a nonsense word to use in place of the name of this number, for the real name will be outlawed in this game.

Go to the board and draw stars, one at a time, and ask the children to count along with you.



“One, two, three, zurkle!” (substitute the nonsense word suggested by your students)

Do this several times, erasing the stars each time the children say “zurkle.” “One, two, three, zurkle . . . one, two, three, zurkle . . . one, two . . .”

Now, look around the classroom for some things to count into piles of zurkle.

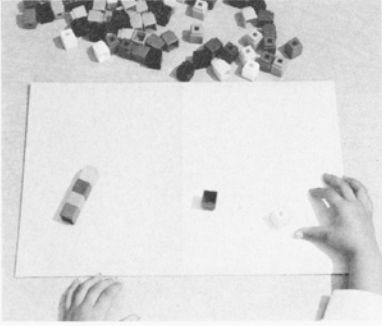

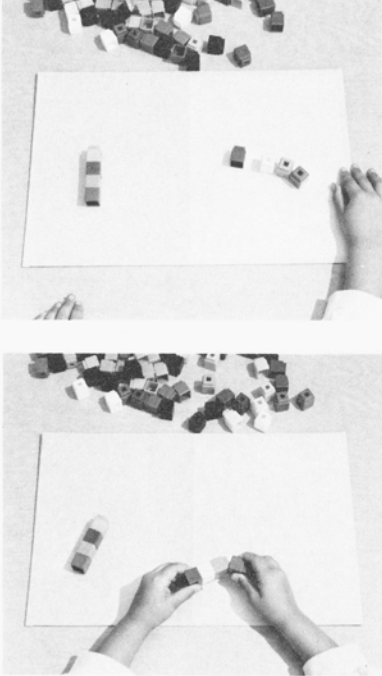


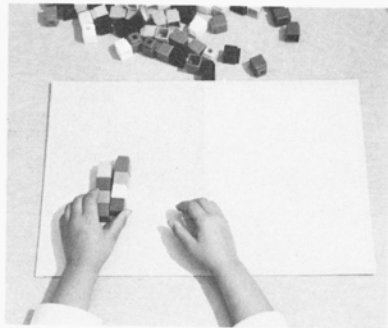
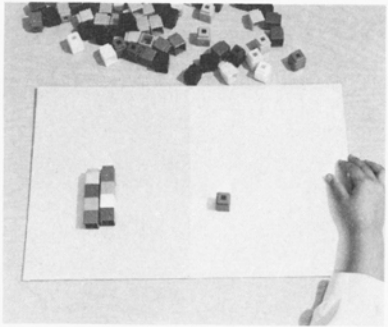
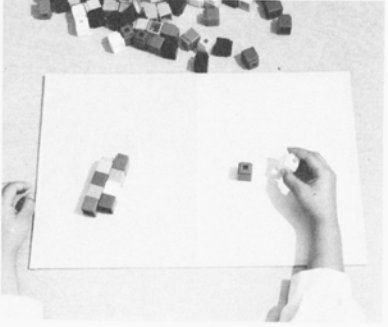
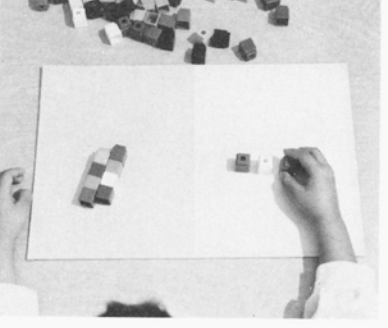
"One, two, three, zurkle."



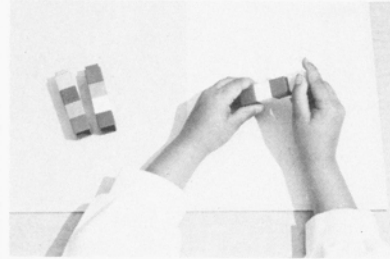
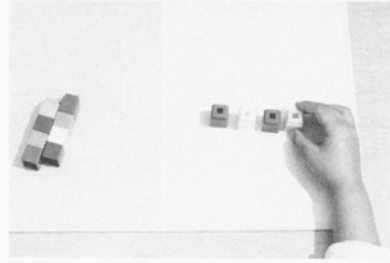
"One, two, three, zurkle."

The children are now ready to play the actual place value game. Give each child a place value board and some Unifix cubes.

| | |
|---------|--|
| "Read." | "One zurkle, one." |
| Ding. |  |
| "Read." | "One zurkle, two." |
| Ding. |  |
| "Read." | "One zurkle, three." |
| Ding. |  <p data-bbox="926 1766 1020 1791">"Zurkle!"</p> |
| | |

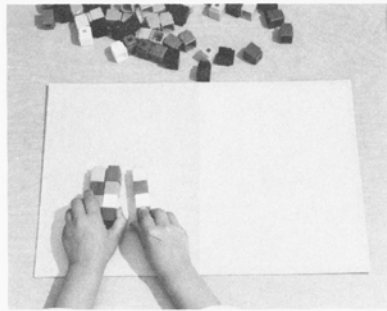
| | |
|----------------|---|
| <p>"Read."</p> |  <p>"Two zurkles, zero."</p> |
| <p>Ding.</p> |  |
| <p>"Read."</p> | <p>"Two zurkles, one."</p> |
| <p>Ding.</p> |  |
| <p>"Read."</p> | <p>"Two zurkles, two."</p> |
| <p>Ding.</p> |  |
| <p>"Read."</p> | <p>"Two zurkles, three."</p> |
| | |

Ding.



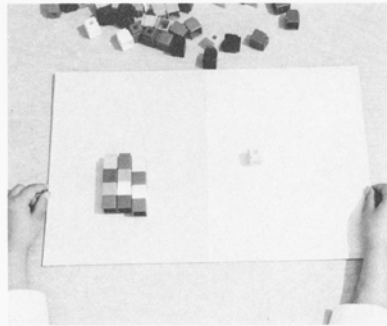
"Zurkle!"

"Read."



"Three zurkles, zero."

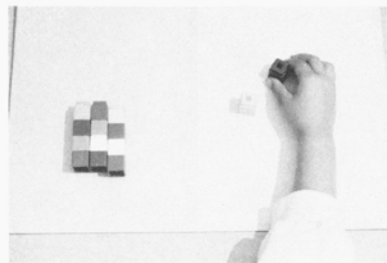
Ding.

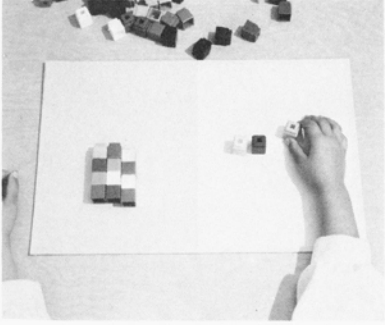
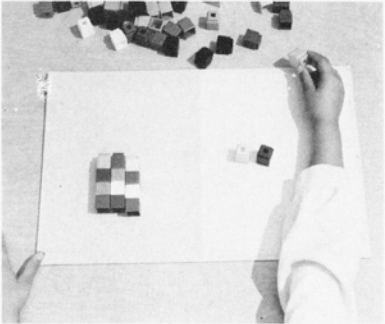
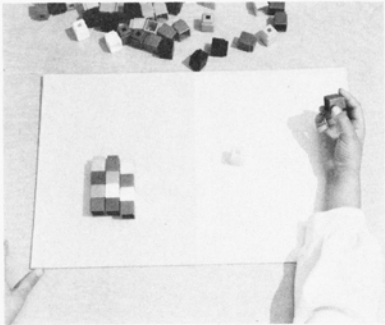
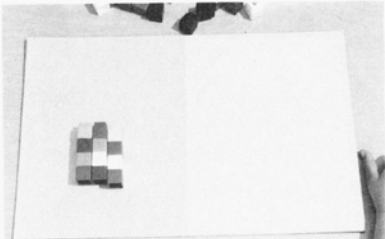


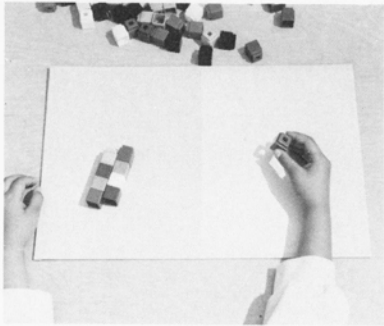
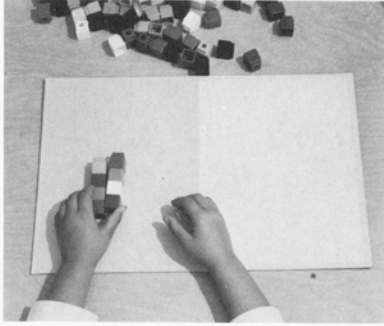
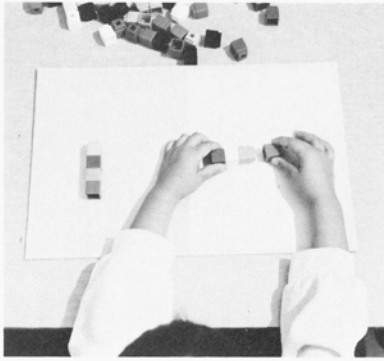
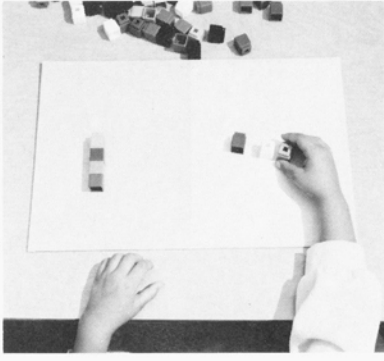
"Read."


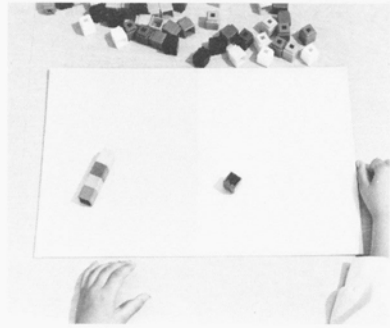
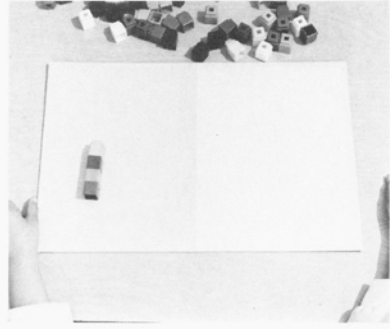
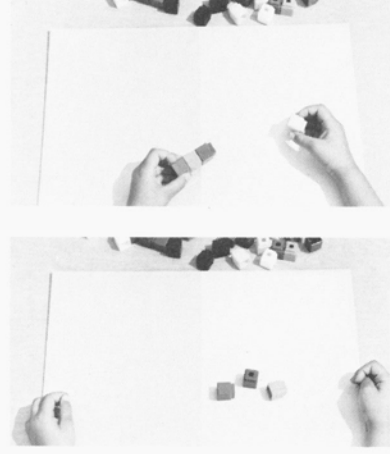
"Three zurkles, one."

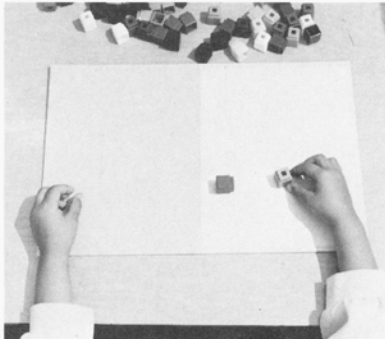
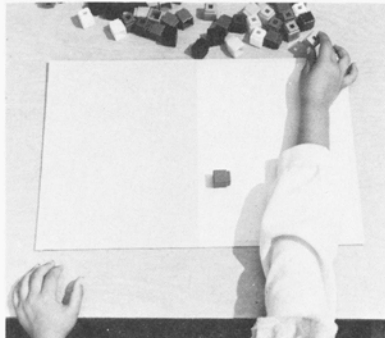


Ding.



| | |
|--|--|
| <p>"Read."</p> <p>Ding.</p> | <p>"Three zurkles, two."</p>  |
| <p>"Read."</p> <p>"Now I'm going to change the game slightly so listen carefully. From now on when you hear the bell, I want you to take one cube away from the white side."</p> | <p>"Three zurkles, three."</p> |
| <p>Ding.</p> <p>"Susan remembered to take one away. So did Gregory and John."</p> |  |
| <p>"Read."</p> <p>Ding. "Take away one cube."</p> | <p>"Three zurkles, two."</p>  |
| <p>"Read."</p> <p>Ding. "Take away one cube."</p> | <p>"Three zurkles, one."</p>  |

| | |
|--|---|
| <p>"Read."</p> <p>Ding.</p> | <p>"Two zurkles, two."</p>  |
| <p>"Read."</p> <p>Ding.</p> | <p>"Two zurkles, one."</p>  |
| <p>"Read."</p> <p>Ding.</p> <p>"Break it off, put it back, break it up."</p> <p>"John's breaking up one of his zurkles so he can take one cube away. Carol has her loose cubes on the white side. . . ."</p> | <p>"Two zurkles, zero."</p>   |
| <p>"Read."</p> | <p>"One zurkle, three."</p> |

| | |
|--|--|
| Ding. |  |
| "Read." | "One zurkle, two." |
| Ding. |  |
| "Read." | "One zurkle, one." |
| Ding. |  |
| "Read." | "One zurkle, zero." |
| Ding. "Break it off, put it back, break it up." |  |
| | |

| | |
|-----------------------------|--|
| <p>"Read."</p> <p>Ding.</p> | <p>"Zero zurkles, three."</p>  |
| <p>"Read."</p> <p>Ding.</p> | <p>"Zero zurkles, two."</p>  |
| <p>"Read."</p> <p>Ding.</p> | <p>"Zero zurkles, one."</p>  |
| <p>"Read."</p> |  <p>"Zero zurkles, zero."</p> |

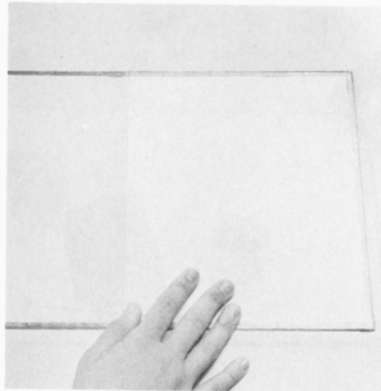
Repeat this session several times over until the children can easily add or subtract by one and regroup the cubes without being instructed. You know they are ready for the next step when the children start anticipating the regrouping step, saying, "Two more and I'll have a zurkle!" "Next it will be zurkle; I'm ready!" and so on. Expect this to take several work periods.

When the children are ready to go on, start the game all over again with a new secret message and a new outlawed number. Generate another silly word to use for playing the same game only grouping by sixes.

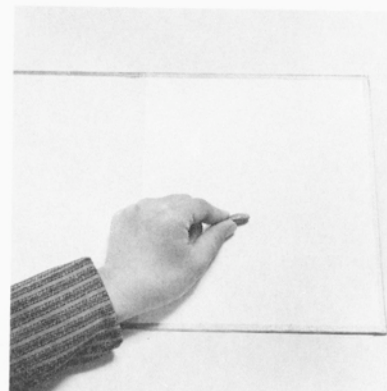
Count together: "One, two, three, four, five, frump," (substituting your class' nonsense word.

Group things in the classroom into groups of frump and then play the frump game on your place value boards. This time use junk boxes and counting cups rather than Unifix cubes. Changing materials encourages flexible thinking in your students.

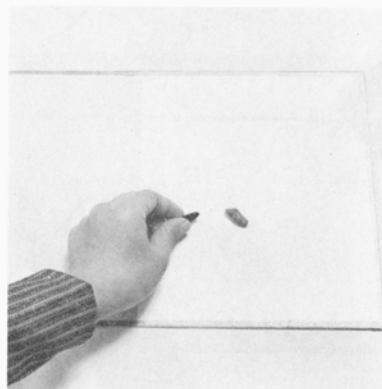
Ring the bell and ask the children to read their board over and over as they work through grouping by sixes (frumps), as follows:



"Zero frumps, zero."



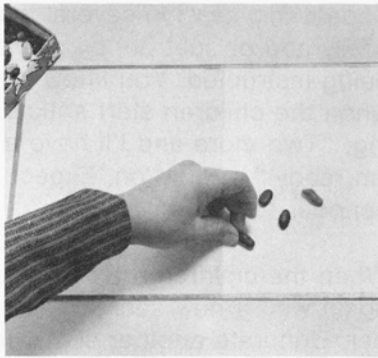
"Zero frumps, one."



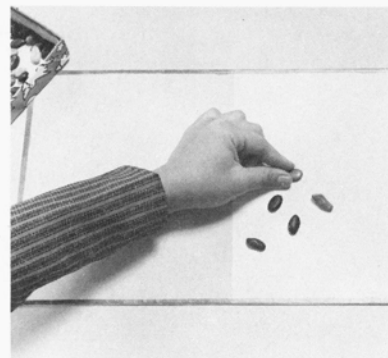
"Zero frumps, two."



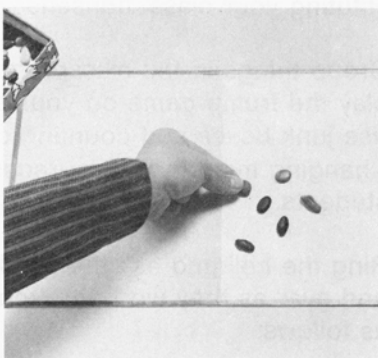
"Zero frumps, three."



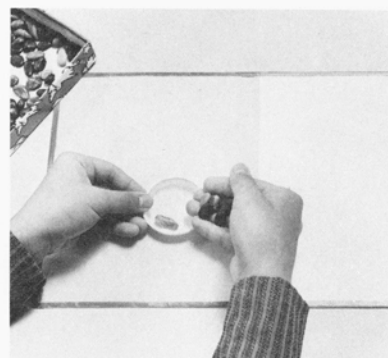
"Zero frumps, four."



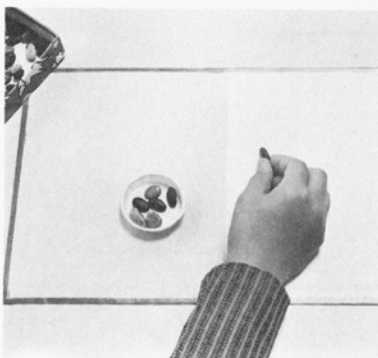
"Zero frumps, five."



"Frump!"



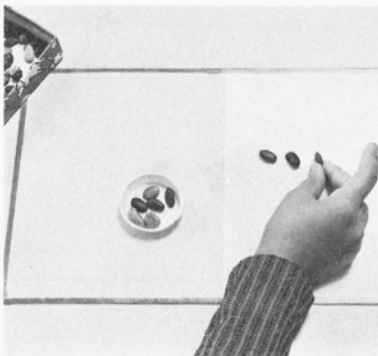
"One frump, zero."



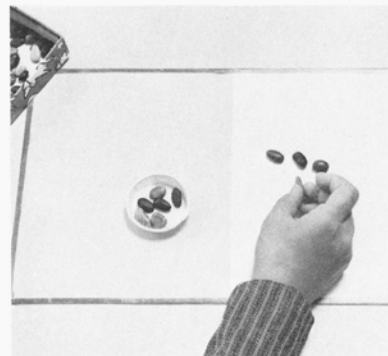
"One frump, one."



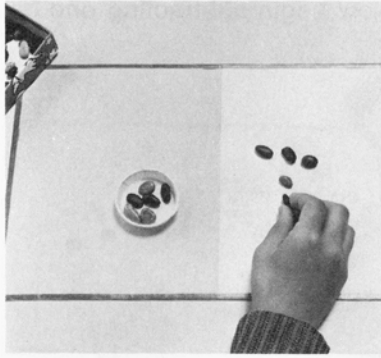
"One frump, two."



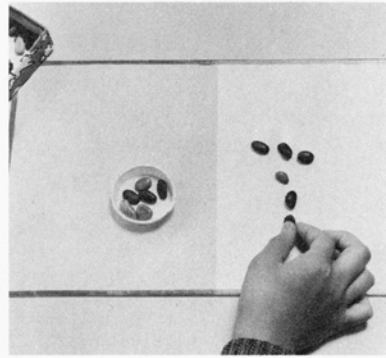
"One frump, three"



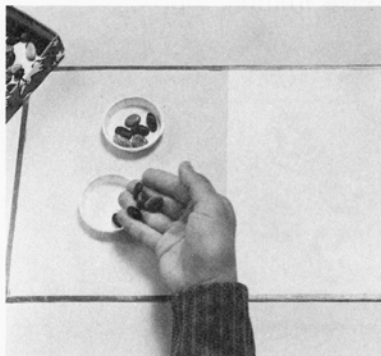
"One frump, four."



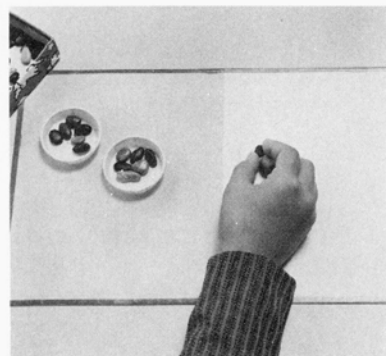
“One frump, five.”



“Frump!”



“Two frumps, zero.”



“Two frumps, one.”

“Two frumps, two.”

“Two frumps, three.”

“Two frumps, four.”

“Two frumps, five.”

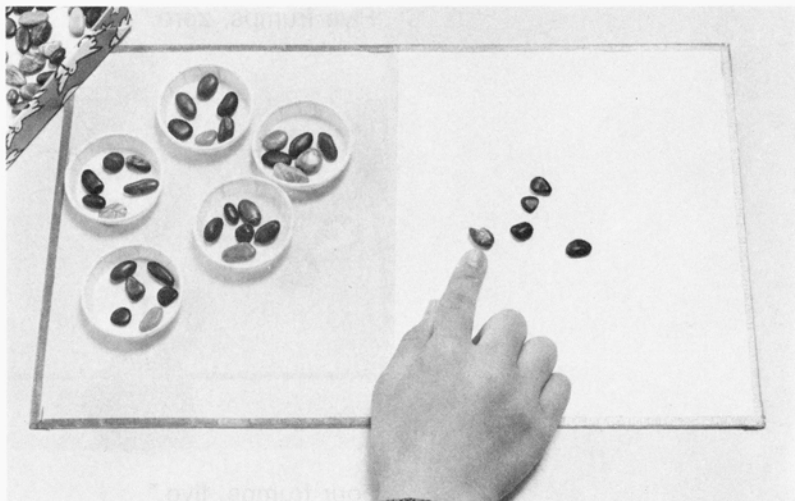
“Frump!”

“Three frumps, zero.”

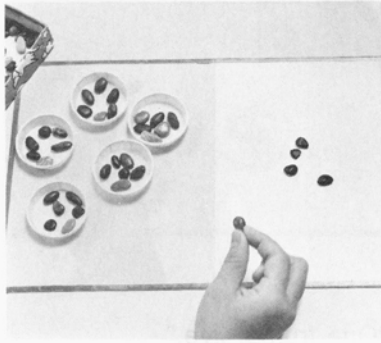
“Three frumps, one.”

“Three frumps, two . . .”

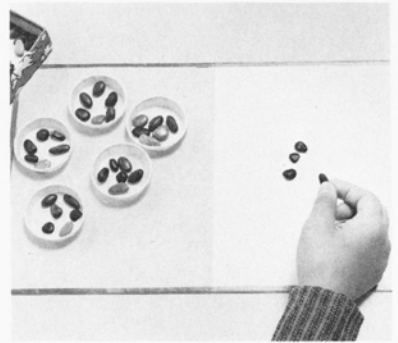
Continue working until the children reach five frumps, five.



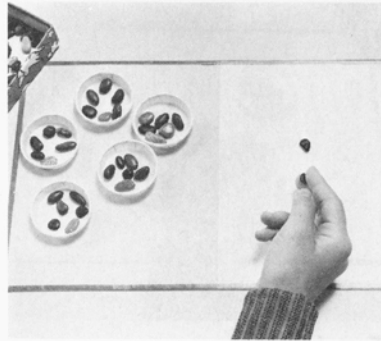
Now begin subtracting one each time the bell is rung.



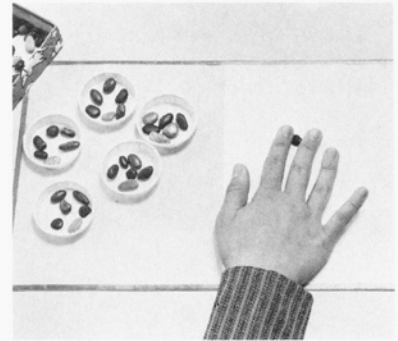
"Five frumps, four."



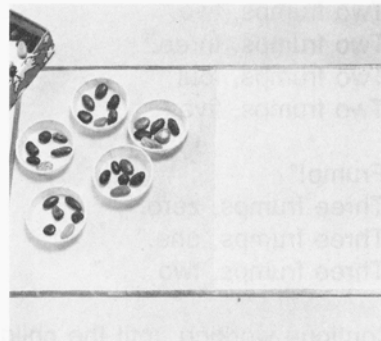
"Five frumps, three."



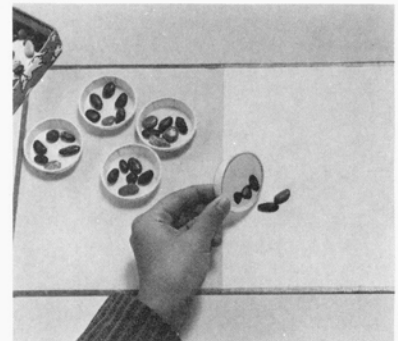
"Five frumps, two."



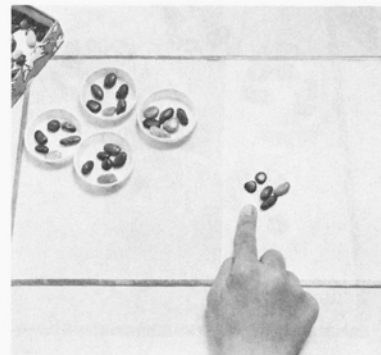
"Five frumps, one."



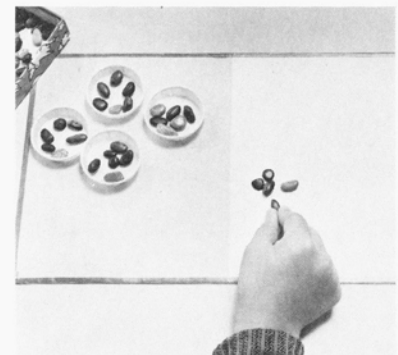
"Five frumps, zero."



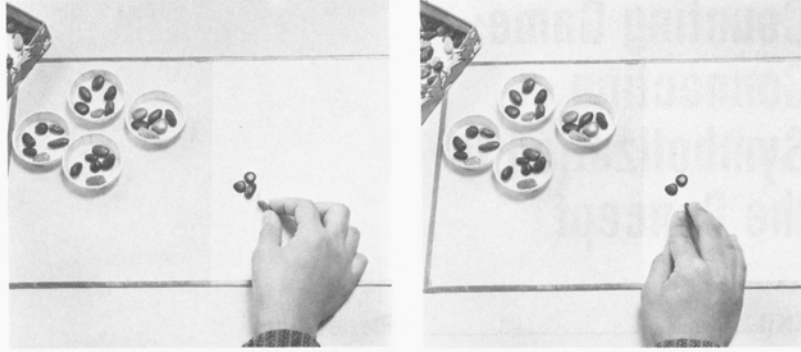
"Take one out, put it back, dump out the rest."



"Four frumps, five."



"Four frumps, four."



"Four frumps, three."

"Four frumps, two . . ."

Continue counting back down to zero frumps, zero.

Have the children repeat this game until they anticipate the regrouping steps counting forward and backward (adding and subtracting). Then try the same game with other groupings, such as grouping by three or by sevens or by fives, making up a new word to use with each game. These lessons will go much more quickly than the earlier ones, because by now the children really understand the pattern and recognize the frump game and the zurkle game as the same game. This is the whole point of doing these activities. When the children begin grouping by tens, they will see the same pattern! Keep a class chart for reference and use the original nonsense word for each number every time you repeat the activity. On the chart the numbers after each nonsense word indicate the point at which the children stop adding and begin subtracting.

3: bloop (2 bloops & 2)

4: zurkle (3 zurkles & 3)

5: bosco (4 boscos & 4)

6: frump (5 frumps & 5)

7: cornball (6 cornballs & 6)

8: King Kong (7 King Kongs & 7)

9: snort (8 snorts & 8)

10: tens (9 tens & 9)

Each year your class will come up with different words for each number. It seems the sillier the word the more the children enjoy the game and the quicker they grasp the concept of pattern.

After several weeks when the children have played several grouping games and you feel they really understand the pattern, proceed to the connecting stage which follows, and add its concepts to the games.

Counting Game: Connecting Symbolization to the Concept

SKILLS _____

Place value
Creating the structure of a base
Counting
Pattern
Labeling concepts with mathematical symbols

MATERIALS _____

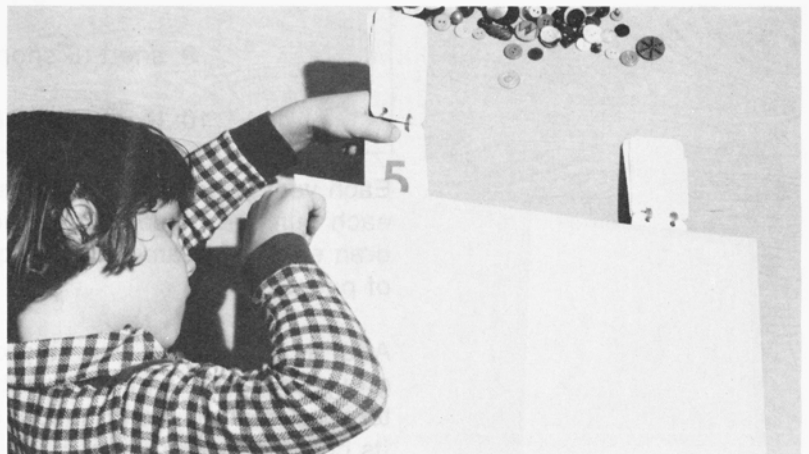
Number flips,* place value boards,* junk boxes* and counting cups* or Unifix cubes*

ACTIVITY _____

Now your students are ready to add another step to the earlier grouping games, which involves connecting the mathematical symbol to the number of objects being added or subtracted.

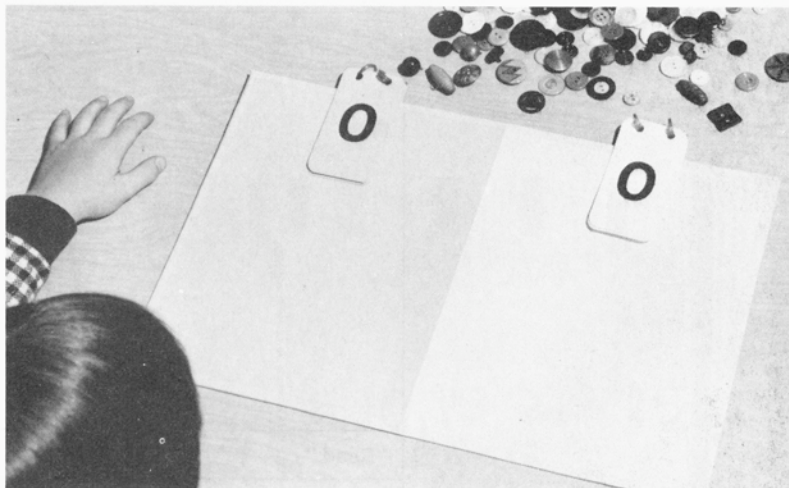
The bell will continue to indicate when children should add or subtract one cube. As soon as each child is ready, say "flip." Each child should flip to the number that shows the total number of loose objects and groups of objects on his or her place value board. This is the only new step the children must learn at this level. Then the children read their board as before, sliding their hand along the bottom. They know how to play the basic game, adding or subtracting when they hear the bell; they know how to borrow a group from the blue side of their board when they need to, how to regroup when they get enough objects on the white side, and how to "read" their board. The new step merely connects a symbol to a process the children already understand.

Ask your students to turn their number flip so that the number five is showing and then to slip it into the pocket on the back of the place value board to hide the numbers five, six, seven, eight, and nine.



The result is that the only numbers still available are zero, one, two, three, and four, the only numbers needed to play the bosco game (grouping by fives). (See page 293.) When you plan to group by sixes, hide the numbers 6–9 behind the board so that the numbers zero, one, two, three, four, and five are the only numbers available. When grouping by tens, you will need the numbers zero to nine inclusive.

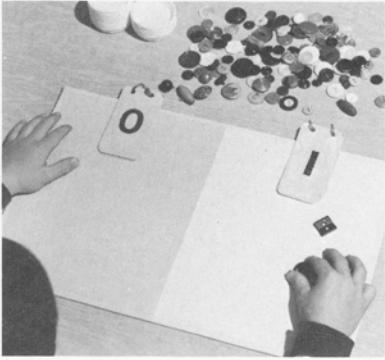

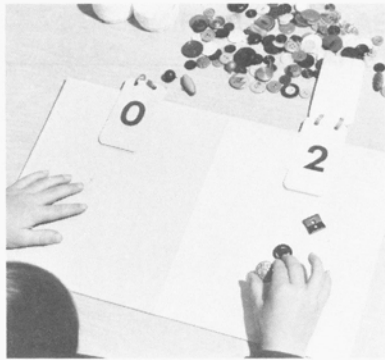
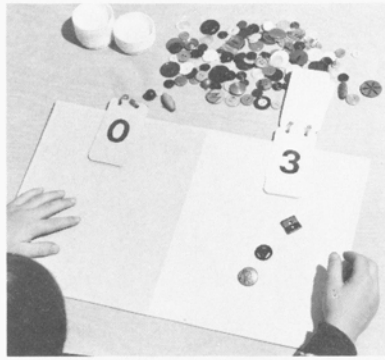
As you play each game at the connecting level, use the words “plus” and “minus” along with the bell. The concepts of addition and subtraction are firmly established from the earlier games; you are merely linking new mathematical language with these concepts.



SAMPLE TEACHING STRATEGY

| TEACHER | CHILDREN |
|----------------------------|----------------------|
| "Read your board, please." | "Zero boscos, zero." |
| Ding. "Plus one." | |
| Flip. | |
| | |

Counting Game: Connecting Symbolization to the Concept

| | |
|---|---|
| <p>"Read."</p> <p>Ding. "Plus one."</p> | <p>"Zero boscos and one."</p>  |
| <p>Flip.</p> |  |
| <p>"Read."</p> | <p>"Zero boscos, two."</p> |
| <p>Ding. "Plus one."</p> |  |
| <p>Flip.</p> |  |
| <p>"Read."</p> | <p>"Zero boscos, three."</p> |

| | |
|--|-----------------------------|
| <p>Ding. "Plus one."</p> | |
| <p>Flip.</p> | |
| <p>"Read."</p> | <p>"Zero boscos, four."</p> |
| <p>Ding. "Plus one."</p> <p>"Bosco!"</p> | |
| <p>Flip.</p> | |
| <p>"Read."</p> | <p>"One bosco, zero."</p> |

Ring the bell and say, "plus one," repeatedly as the children continue grouping by fives.

"One bosco, one."
 "One bosco, two."
 "One bosco, three."
 "One bosco, four."
 "Bosco!"
 "Two boscos, zero."
 "Two boscos, one."
 "Two boscos, two."
 "Two boscos, three."
 "Two boscos, four."
 "Bosco!"
 "Three boscos, zero."
 "Three boscos, one . . ."

Continue working until the children reach four boscos and four and then subtract one object each time the bell is rung.

"Four boscos, four."
 "Four boscos, three."
 "Four boscos, two."
 "Four boscos, one."
 "Four boscos, zero."
 "Three boscos, four."
 "Three boscos, three."
 "Three boscos, two."
 "Three boscos, one."
 "Three boscos, zero."
 "Two boscos, four."
 "Two boscos, three."
 "Two boscos, two."
 "Two boscos, one."
 "Two boscos, zero."
 "One bosco, four."
 "One bosco, three . . ."

Continue subtracting to zero boscos, zero.

Repeat this connecting stage with several different groupings such as with bloops (threes), King Kongs (eights), and frumps (sixes) using your class' own nonsense words for each grouping. When you feel the children are ready for an additional challenge, introduce the recording level, which follows, and add it to the games.



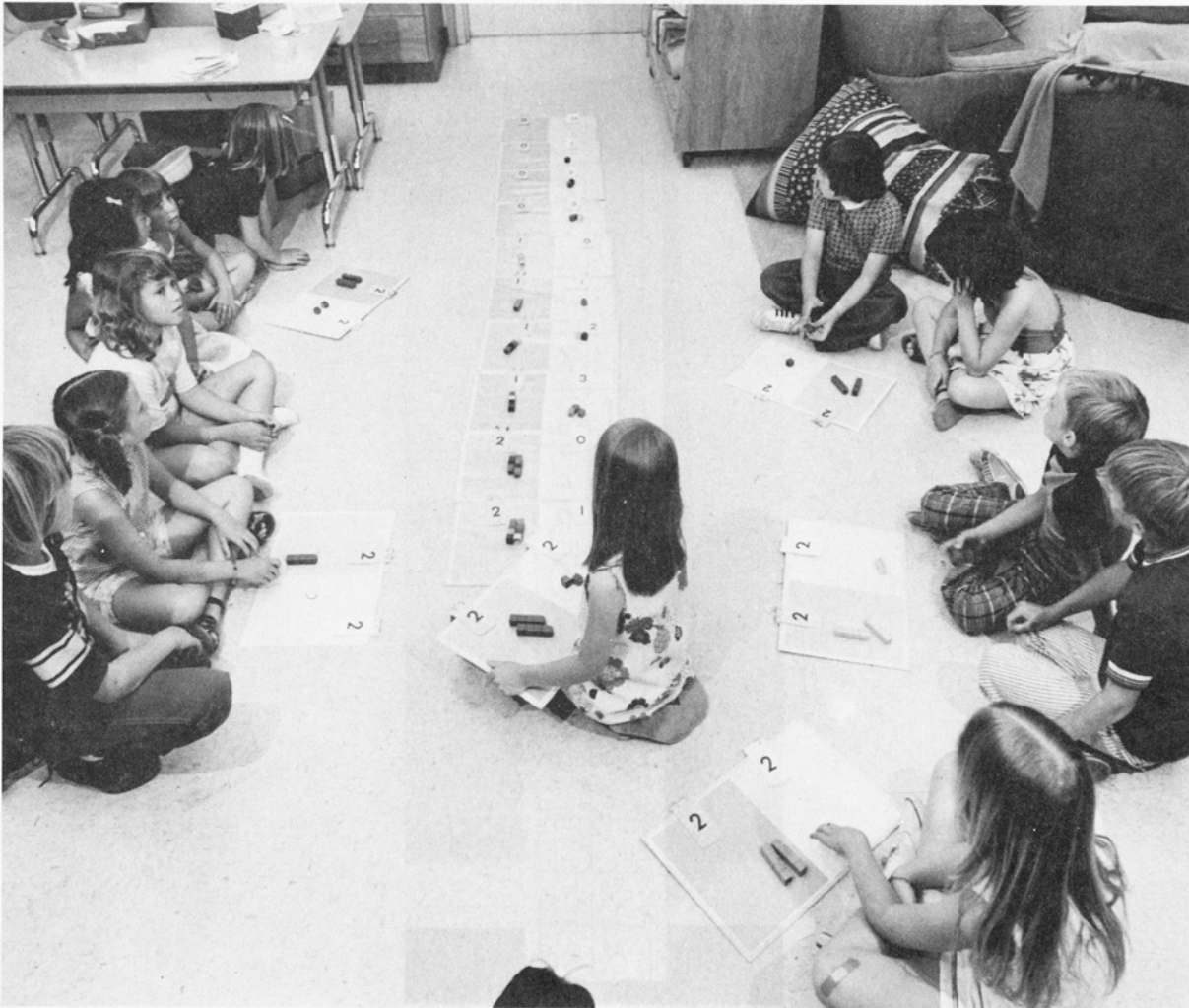
Counting Game: Using Symbols to Record the Concept

SKILLS _____ Place value
Pattern
Writing mathematical symbols

MATERIALS _____ Place value boards,* junk boxes* and counting cups* or
Unifix cubes,* worksheets for recording

ACTIVITY _____ The children record the pattern in sequence as follows:

Have the children sit together and play the place value counting game. After each addition or subtraction take one child's board away, placing it on the floor in sequence. The children who still have their board continue working as the rest of the class looks on.



When everyone's board has been placed on the floor, record the sequence on a piece of butcher paper, writing each step as the children read it to you from the place value boards.

In this activity the children relate a written record to the place value boards. This helps them connect the appropriate mathematical symbol to the quantity on their board. Have the children remove the number flips from the boards and build the last number you have recorded with the Unifix cubes. Have them continue to add one cube at a time to their board, but instead of flipping to the appropriate number, ask them to read their board and repeat the number for you to add to the record.

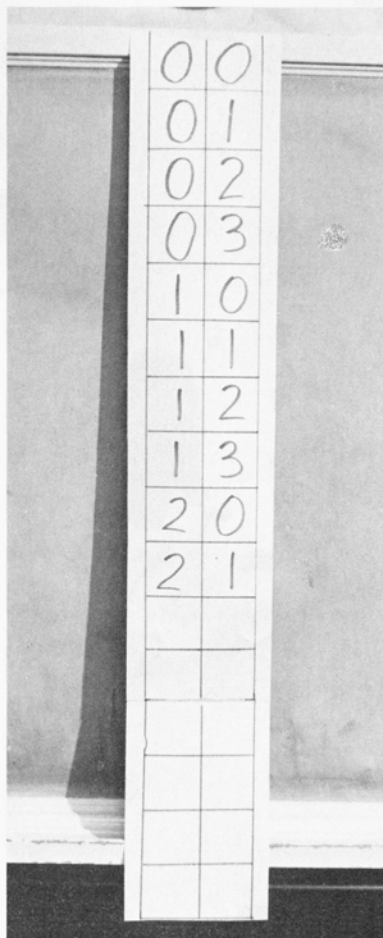


The number flips are removed at the connecting stage because the children have internalized the concept, making this step no longer necessary.



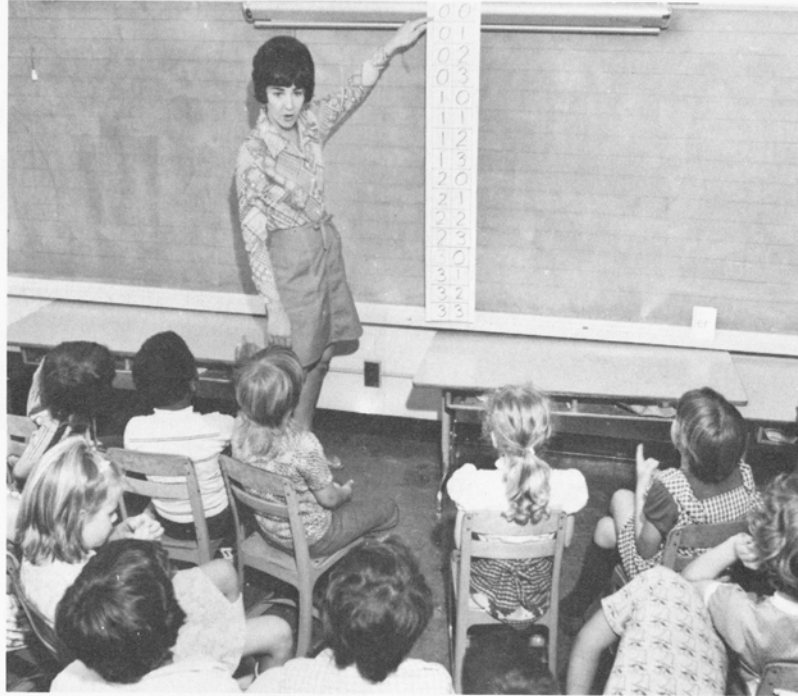
Repeat this activity with several other groupings and then allow the children to work independently on the place value papers.

When the children finish a paper which the teacher has written or one which they have written independently, they should always look for patterns.

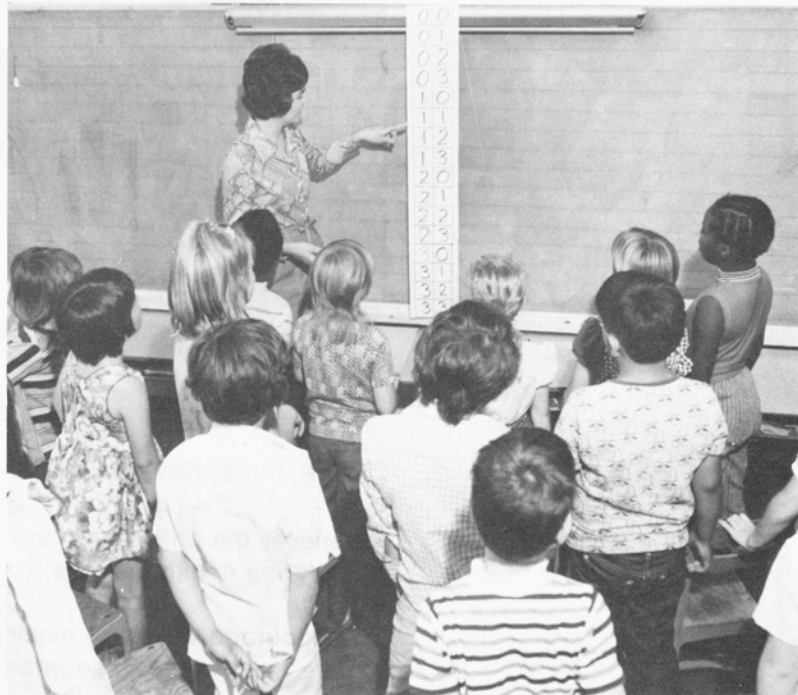


Ask the children to read down one column at a time. The white column: "zero, one, two, three, zero, one, two, three, zero, one, two, three . . ." The blue column: "zero, zero, zero, zero, one, one, one, one, two, two, two, two . . ."

Ask them to stand in front of a chair and alternate standing and sitting, changing position when the sequence repeats.



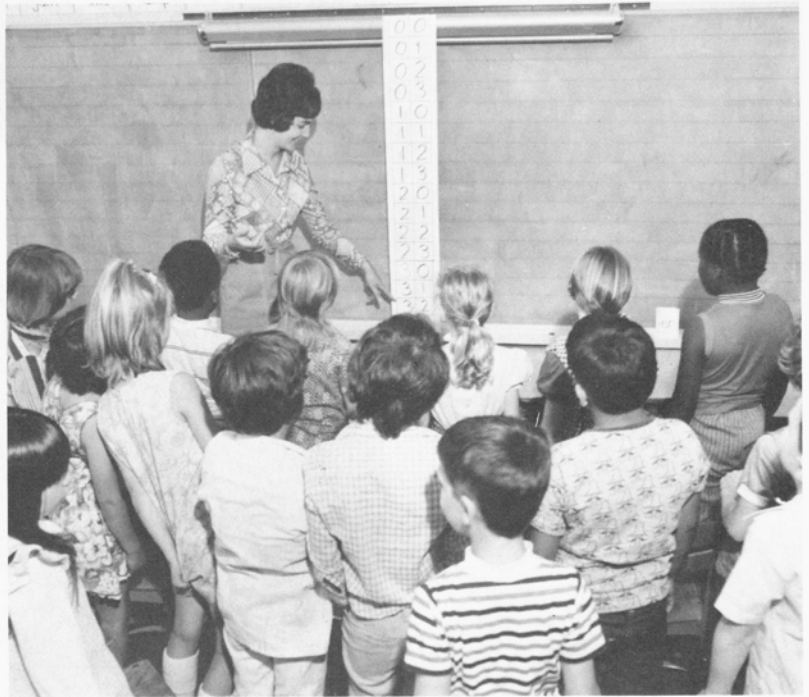
"Zero, zero, zero, zero." (sit)



"One, one, one, one." (stand)



"Two, two, two, two." (sit)



"Three, three, three, three." (stand)

Whenever the children notice a pattern, it can be reinforced by coloring it with crayons.

To encourage variety in making written records, introduce a square array chart as soon as you feel your children can handle something new. If you are doing sixes, draw six spaces across and six down (a 6×6). If you are doing

King Kongs (nines) draw nine spaces across and nine down (a 9×9). The following example uses blosps (threes).

Each child works on hisorher own place value board as the teacher fills in the square array chart with the numbers read by the children.



“Four boscós, zero.”



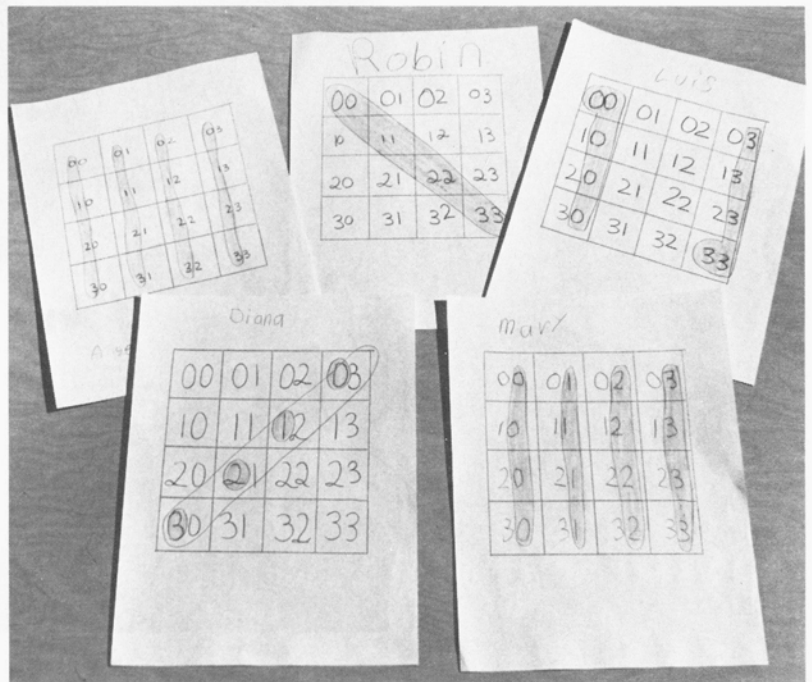
“Four boscós, one.”



Repeat this lesson for other groupings until you feel the children are ready to record these patterns independently.

Be certain to establish firmly the routine of verbalizing the total with both the objects and the written record. This assures a connection between the concept and the symbolization.

Encourage the children to look for patterns and color them with different colored crayons to make them stand out.



APPLICATION AND EXTENSION OF PLACE VALUE



The following activities extend the concept of place value in base ten, giving children many concrete opportunities to use their knowledge and practice adding, subtracting, and creating patterns.

All of the activities which follow are in base ten. It is critical that both you and your children use the same terminology for base ten as you used for the other bases. In this way the earlier grouping games are linked to base ten and the children receive full benefit from the earlier games. When the children say, "twelve" or "thirty-five" for "12" or "35," acknowledge it but focus their attention by saying, "and that *means* one ten and two" or "that *means* three tens and five." Every time you write a number reinforce this concept, and every time the children write a number they should repeat what the number means in base ten as they write it. When you follow this procedure, large numbers make sense to children, and there is hope of real understanding. Without this, children rely on their memory, and the skill is quickly lost through disuse.

There is a fundamental discrepancy between the names of the numbers and the numbers themselves. This causes children great difficulty in trying to make sense out of large numbers. The visual pattern is wholly consistent:

| | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|
| 0 | 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 | | | | | |

The traditional auditory sequence unfortunately is not consistent:

| | | | | | | | | | |
|--------|------------|------------|--------------|-------------|-------------|------------|--------------|--------------|-------------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| zero | one | two | three | four | five | six | seven | eight | nine |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| ten | eleven | twelve | thirteen | fourteen | fifteen | sixteen | seventeen | eighteen | nineteen |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| twenty | twenty-one | twenty-two | twenty-three | twenty-four | twenty-five | twenty-six | twenty-seven | twenty-eight | twenty-nine |
| 30 | 31 | 32 | 33 | 34 | | | | | |
| thirty | thirty-one | thirty-two | thirty-three | thirty-four | | | | | |

With a slight change the language pattern can be made consistent with the visual pattern and large numbers become suddenly intelligible. Keep the same pattern as was used in the grouping games, counting as follows:

| | | | | | | | | | |
|------------------------|-----------------------|-----------------------|-------------------------|------------------------|----------------------|---------------------|-----------------------|-----------------------|----------------------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| zero | one | two | three | four | five | six | seven | eight | nine |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| one ten and zero | one ten and one | one ten and two | one ten and three | one ten and four | one ten and five | one ten and six | one ten and seven | one ten and eight | one ten and nine |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| two tens and zero | two tens and one | two tens and two | two tens and three | two tens and four | two tens and five | two tens and six | two tens and seven | two tens and eight | two tens and nine |
| 30 | 31 | 32 | 33 | 34 | | | | | |
| three tens and zero | three tens and one | three tens and two | three tens and three | three tens and four | | | | | |

Use this system for counting objects and repeat it when writing numbers. Whereas the traditional system overwhelms children with "so many different numbers to memorize," this system encourages understanding.

After several months, when you are certain the children have a firm understanding, you can link the traditional system to what the children already know. Relating "seventeen" to "one ten and seven" and "17" will make sense at this stage whereas teaching it initially guarantees confusion.

Measuring

SKILLS _____ Measurement
Problem solving
Comparing

MATERIALS _____ Unifix cubes,* Worksheet 58

ACTIVITY _____ Have the children suggest five items to be measured. Put a strip of masking tape at either end of the distance to be measured and write a word to describe the object on one of the pieces of tape. Do this in front of the children, as they make each suggestion.

Then, at another time, have the children measure these distances with trains of Unifix cubes, then break the trains into groups of ten, put them on a place value board, and record the total.

The children should check one another's measurements, signing their name under "agree" or "disagree" when they have obtained their own results.



When five children agree on each measurement, have the class suggest five new items to measure and repeat the activity as many times as desired.

Estimating and Checking

- SKILLS** _____ Connecting an abstract idea to the real world
 Counting
 Making and checking predictions
 Solving problems
- MATERIALS** _____ Common items from the grocery store,* place value board,* counting cups*
- ACTIVITY** _____ Bring in one item every two or three days for the children to estimate and count



Hold up a bag of peanuts and have the children estimate the number of peanuts inside. Help the children write their estimate on a slip of paper and then count the peanuts, placing each group of ten in a counting cup.

Now arrange these groups on a place value board, regrouping whenever possible and using a second place value board for hundreds if necessary.

When all the peanuts are on the board, count and record the total.



"One hundred, ten . . . one hundred, twenty . . .
one hundred, thirty . . . one hundred, thirty-one . . .
one hundred, thirty-two . . . one hundred, thirty-three!"

Repeat this activity many times and watch your children's skill in estimating improve as they have more and more experience. Anything in a familiar package can be used: a box of animal crackers, crayons or sugar cubes, a container of safety pins, paper clips or Q tips, a bag of marshmallows, candy, macaroni, or small toys.

Counting Jars of Objects

SKILLS _____

Counting
Making and checking predictions
Writing mathematical symbols
Solving problems

MATERIALS _____

Jars containing common items, place value boards,* counting cups,* Worksheet 58

ACTIVITY _____

The children work in pairs counting the number of objects in each jar onto their place value board. When the children finish, they write the total on a piece of paper and pin it to the wall. Other children check this total by recounting and then write their name under "agree" or "disagree."



Change the number of items in the jars each week or two so this activity can be repeated over and over again.

Peas in the Pod

SKILLS _____ Counting
Graphing
Solving problems

MATERIALS _____ Counting cups,* unshelled peas, place value boards*

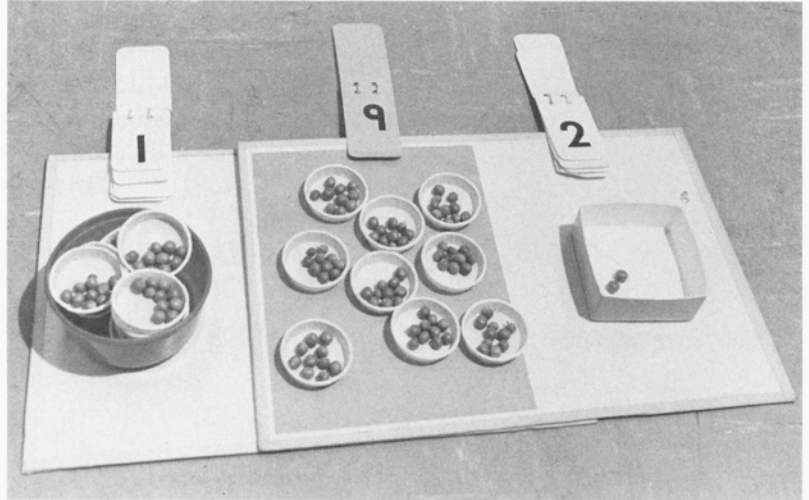
ACTIVITY _____ This is an enjoyable class project. Dump a bag of unshelled peas onto the floor. Have the children look at the pods without touching them. Make a graph of each child's predictions of the most common number of peas in a pod.

Now ask each child to open one pod and put the peas into a counting cup. Call one number at a time until all the children have placed their cup on the graph according to the number of peas inside. Have the children take a second pod, put the peas in a counting cup, and place the cup in the appropriate place on the graph. Repeat this until all the pods have been opened.



Compare the results with the children's earlier predictions and then pose the question, "How many peas do you think there are altogether?"

Have the children write their predictions on a slip of paper, assisting them as necessary. Then dump all the peas into a bowl and have those children who are interested count the peas in groups of ten into the counting cups. When this is accomplished, call the class back together and compile the groups on a place value board, regrouping when possible. Add another board if necessary and write the number describing the total.



The children may enjoy comparing their predictions and making a new graph to show if the majority of them guessed higher or lower than the actual count. The child whose prediction is closest might take the peas home for dinner!

Determining Prices

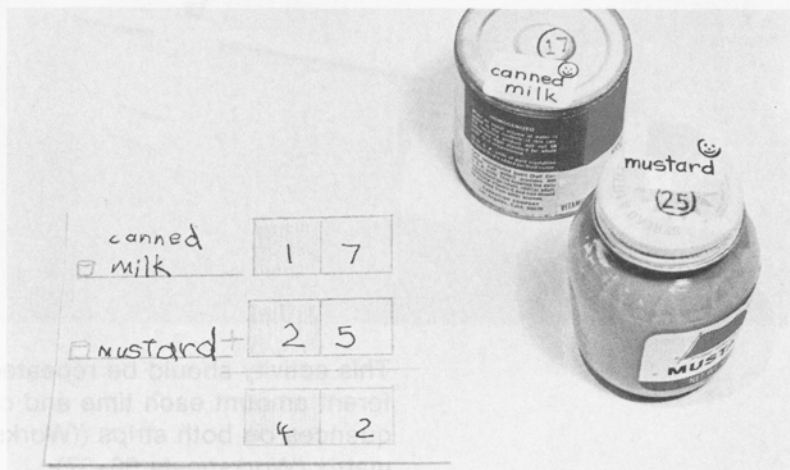
SKILLS _____ Problem solving
Addition
Connecting an abstract idea to the real world
Interpreting symbols

MATERIALS _____ Cans of food, Worksheet 59, place value boards*

ACTIVITY _____ Ask the children to bring cans of food to school that have the purchase price stamped on them. Have each child write his or her name with a permanent marking pen on the bottom of each can so they can easily be returned. Write a word to describe the contents on the top of the can.

In situations where bringing cans of food from home is inappropriate, the teacher can bring them in. In any case, it is far more effective to use cans containing food rather than empty cans. The former is motivating because it is real; the weight of the contents entices more of the child's senses and imagination.

The children look at two cans and write on paper the words describing the contents and the problem formed from adding the costs of the two cans.



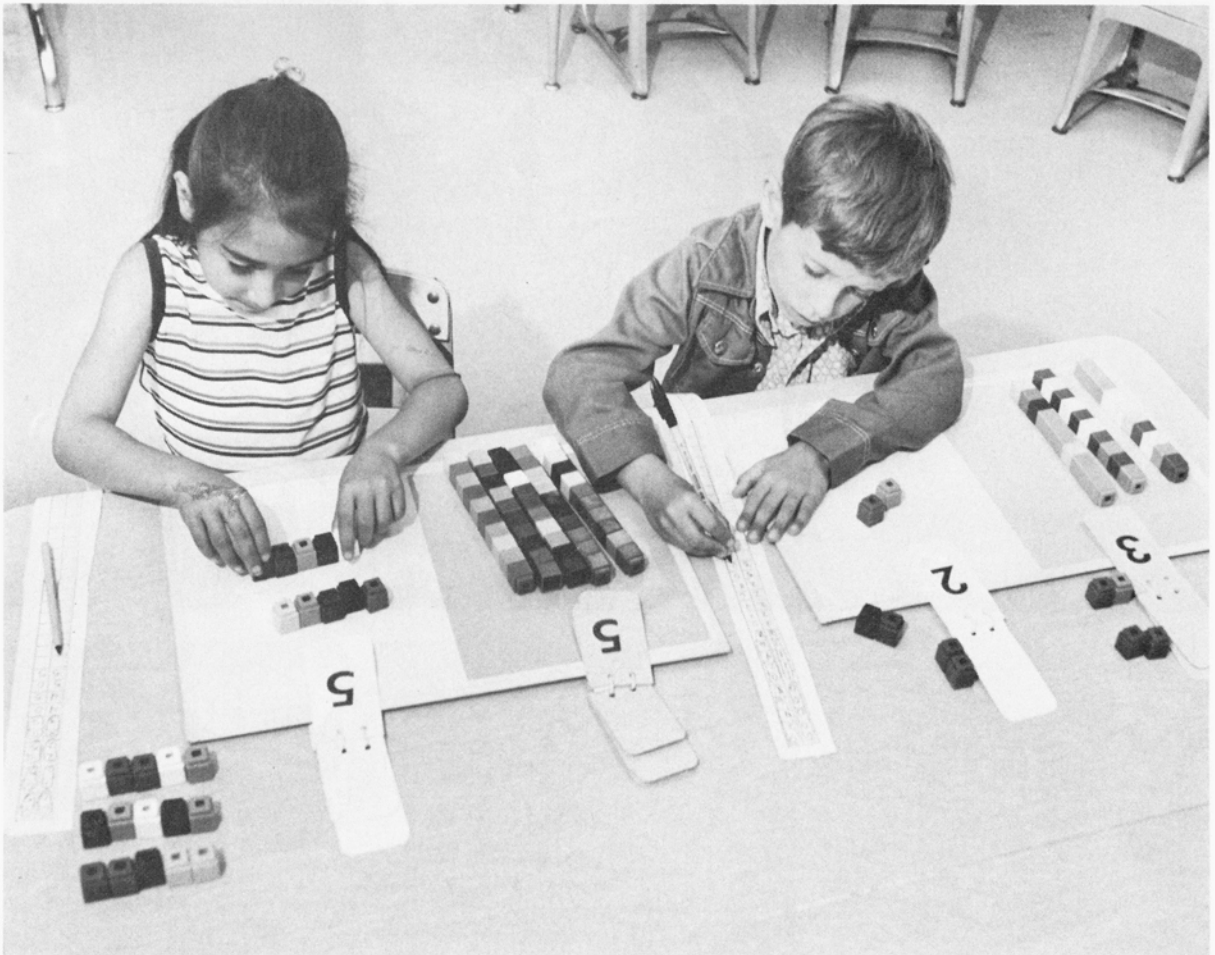
Base Ten Unifix Patterns

SKILLS _____ Pattern
 Addition
 Multiplication
 Writing mathematical symbols

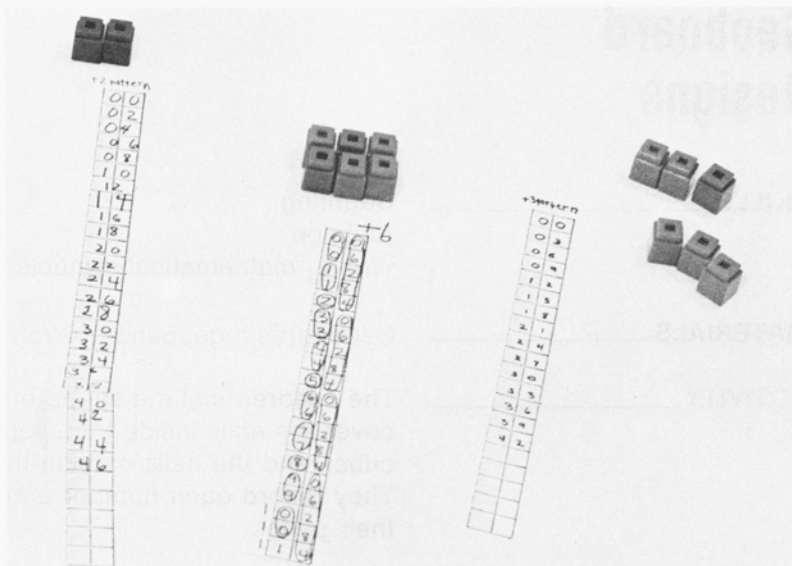
MATERIALS _____ Unifix cubes,* place value boards,* Worksheet 60

ACTIVITY _____ Have the children arrange their Unifix cubes in twos, threes, fours, or whatever number the children want to explore. Do not snap these groups together. This arrangement allows the cubes to be picked up and added to the child's place value board quickly.

Now the children make a record as they work independently adding one of their groups at a time.



This activity should be repeated many times, adding a different amount each time and coloring in the repeating sequences on both strips ((Worksheet 60) and on a square matrix (Worksheets 56–57).

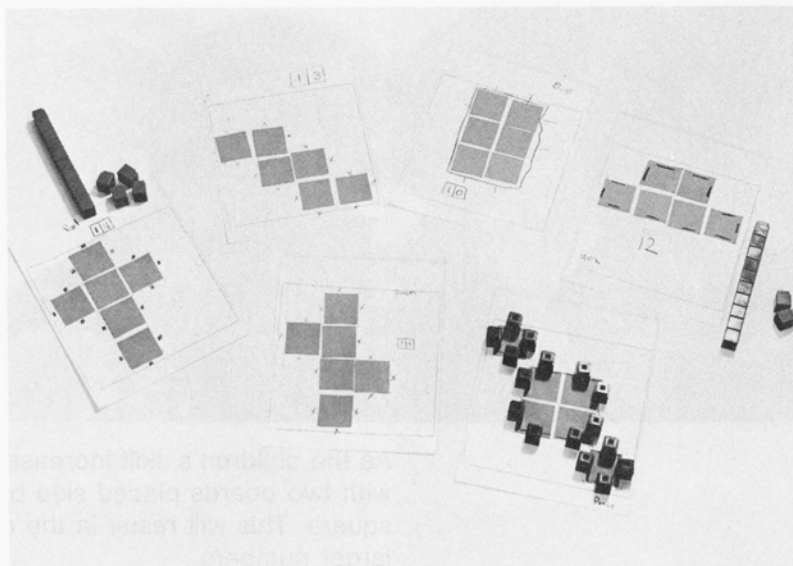


Perimeters

SKILLS _____ Solving problems
 Comparing
 Counting
 Writing mathematical symbols

MATERIALS _____ Records of tile and geoboard designs from exploring six, seven, eight, nine, and ten at the number stations.

ACTIVITY _____ The children place Unifix cubes around the perimeter of the base design, snap the cubes into tens, count them, and record the total. This activity can be repeated many times.





Geoboard Designs

SKILLS _____ Counting
Addition
Writing mathematical symbols

MATERIALS _____ Geoboards,* geobands,* Worksheet 61, Unifix cubes*

ACTIVITY _____ The children make a shape on their geoboard. Then they cover the nails inside the shape with one color of Unifix cubes and the nails outside the shape with a second color. They record each number and the total number of nails on their paper.



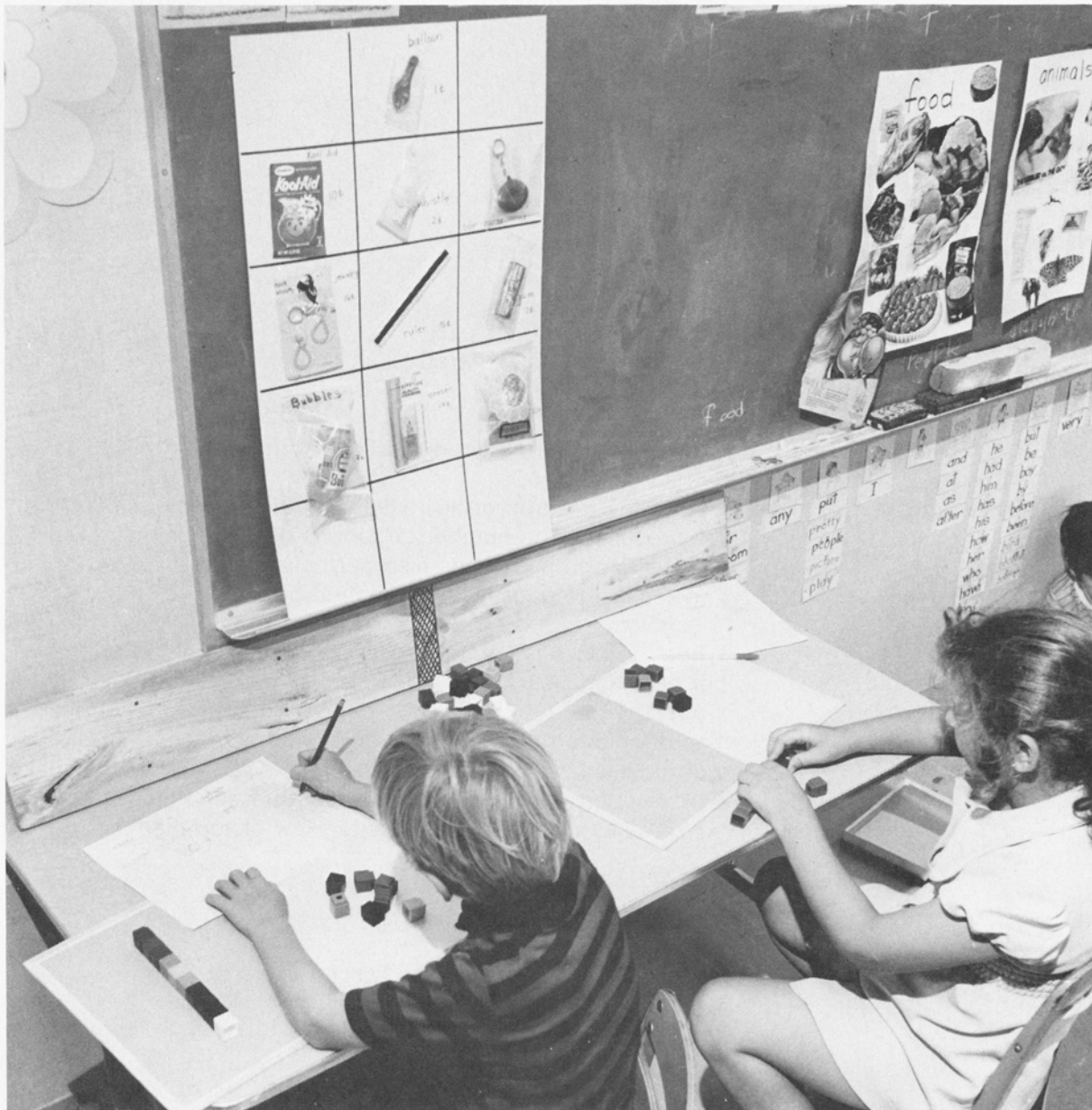
As the children's skill increases, they can repeat this activity with two boards placed side by side or four boards in a square. This will result in the children having to deal with larger numbers.

The Store

SKILLS _____ Connecting an abstract idea to the real world
Counting
Addition
Subtraction

MATERIALS _____ Ten to fifteen common store-bought items with the prices clearly marked, Worksheet 59

ACTIVITY _____ The children write down the names of two items and their prices. Then the cost is computed and this total recorded.



Children can imagine they have a dollar to spend and then subtract each item from the dollar to determine their change.

The Movie Theatre

SKILLS _____ Ordering
Matching
Pattern

MATERIALS _____ Two sets of numerals

ACTIVITY _____ The children arrange their chairs theatre fashion and number them in order, using one set of numerals. The second set of numerals is mixed up on the floor. The children draw a number and try to find the appropriate seat as quickly as they can.

Estimating and Graphing

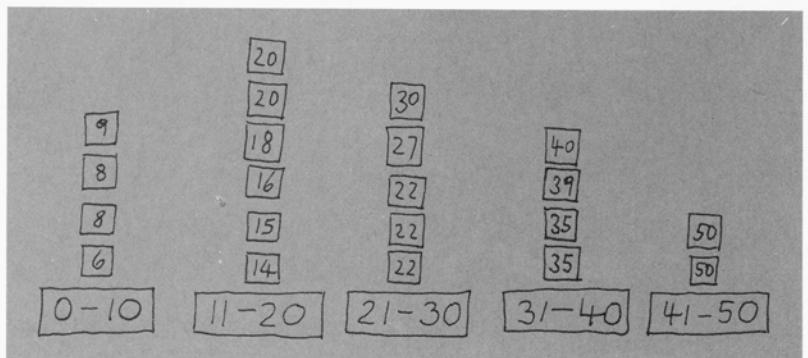
SKILLS _____ Counting
Making and checking predictions
Solving problems

MATERIALS _____ Jar, rice, measuring spoon, milk carton graphing boxes*

ACTIVITY _____ Before the children go to recess or during activity time, have them estimate the number of spoons of rice it will take to fill the jar. Each child writes his or her estimate on a piece of paper and the guesses are graphed by tens.

When the class is back together again, count aloud the number of spoons it takes to fill the jar.

Try to focus on the group's predictions rather than on the individual's, asking questions such as, "Did most people make a close guess (within ten)? Were *any* guesses right on the button? Did more people guess too few or too many?"





Repeat this activity every day for about two weeks, changing the size of the jar each time.

When the children improve their estimates significantly, change the materials: How many cups of water can be poured from a jar? (Write the number) How long a string would be needed to measure around the top of the waste paper basket? (Cut a piece of string.) If a toy car rolls down this ramp, where will it stop? (Write your name on a piece of masking tape and stick it to the floor.) How far up the jar do you think the water line will be in one hour, if we collect the drips from the faucet in it? (Mark a line on the duplicated outline of the jar.) How many people do you think will bring their note back tomorrow? (Write the number.) How many swings of the pendulum do you think it will take for each of us to stack up eight blocks? (Write the number.) Which one do you think will weigh more, the grapefruit or the soft ball? (Write the name.) How far do you think this pile of Unifix cubes will stretch when it is snapped together? (Cut a string and put your name on a piece of masking tape folded over the string.)

Unifix Stacks

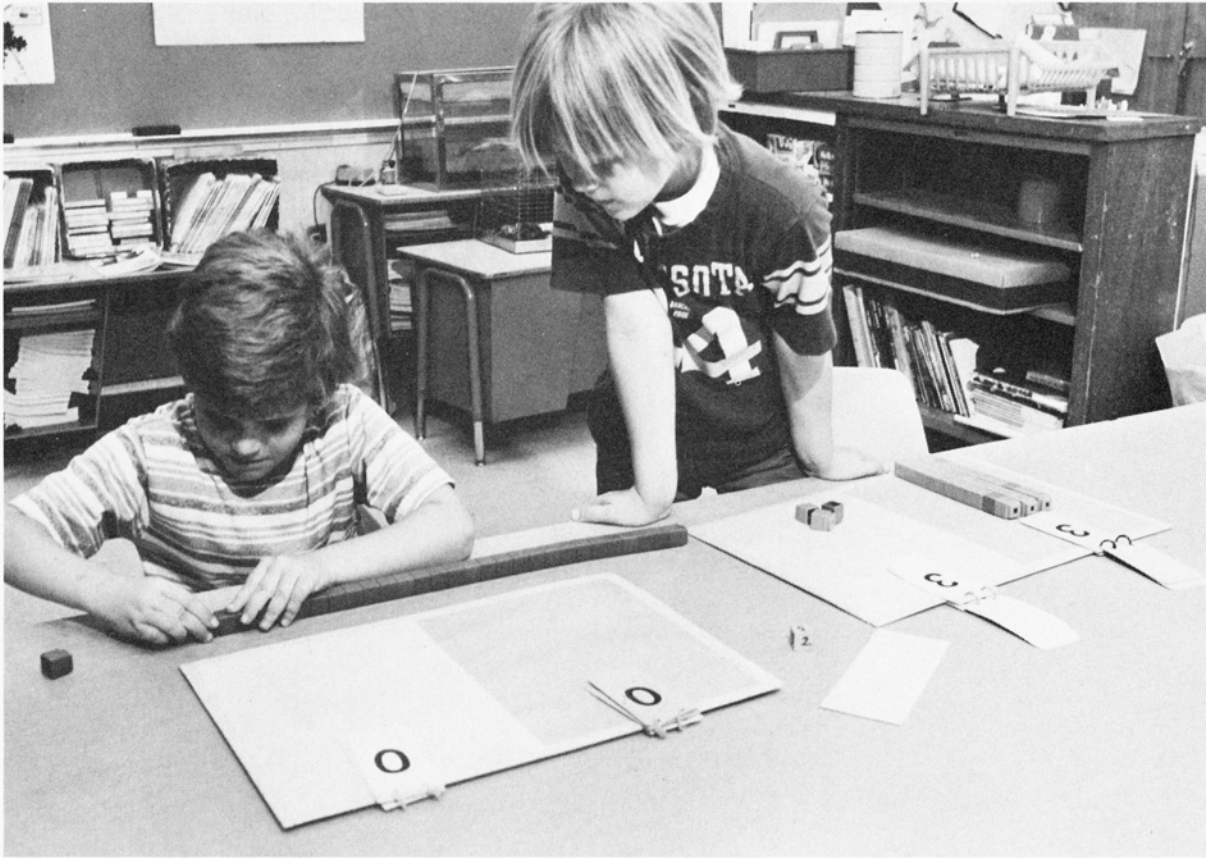
SKILLS _____ Comparing
Counting

MATERIALS _____ Two rows cut off the recording sheet for exploring six with Unifix cubes (Worksheet 29), dice, Unifix cubes,* more-less spinner*

ACTIVITY _____ The children work in pairs and take turns rolling a die and placing a stack of unifix cubes on their row of the gameboard.



When each partner has a stack of cubes in every position of his or her row, she or he snaps the Unifix cubes together into a long train. The train is broken into groups of ten and the children compare the cubes to determine who has more and who has less. The spinner indicates the winner and each child keeps score, circling the winning amount (see Worksheet 61).



Recording Number Patterns from Row, Column, and Diagonal Patterns with Unifix Cubes

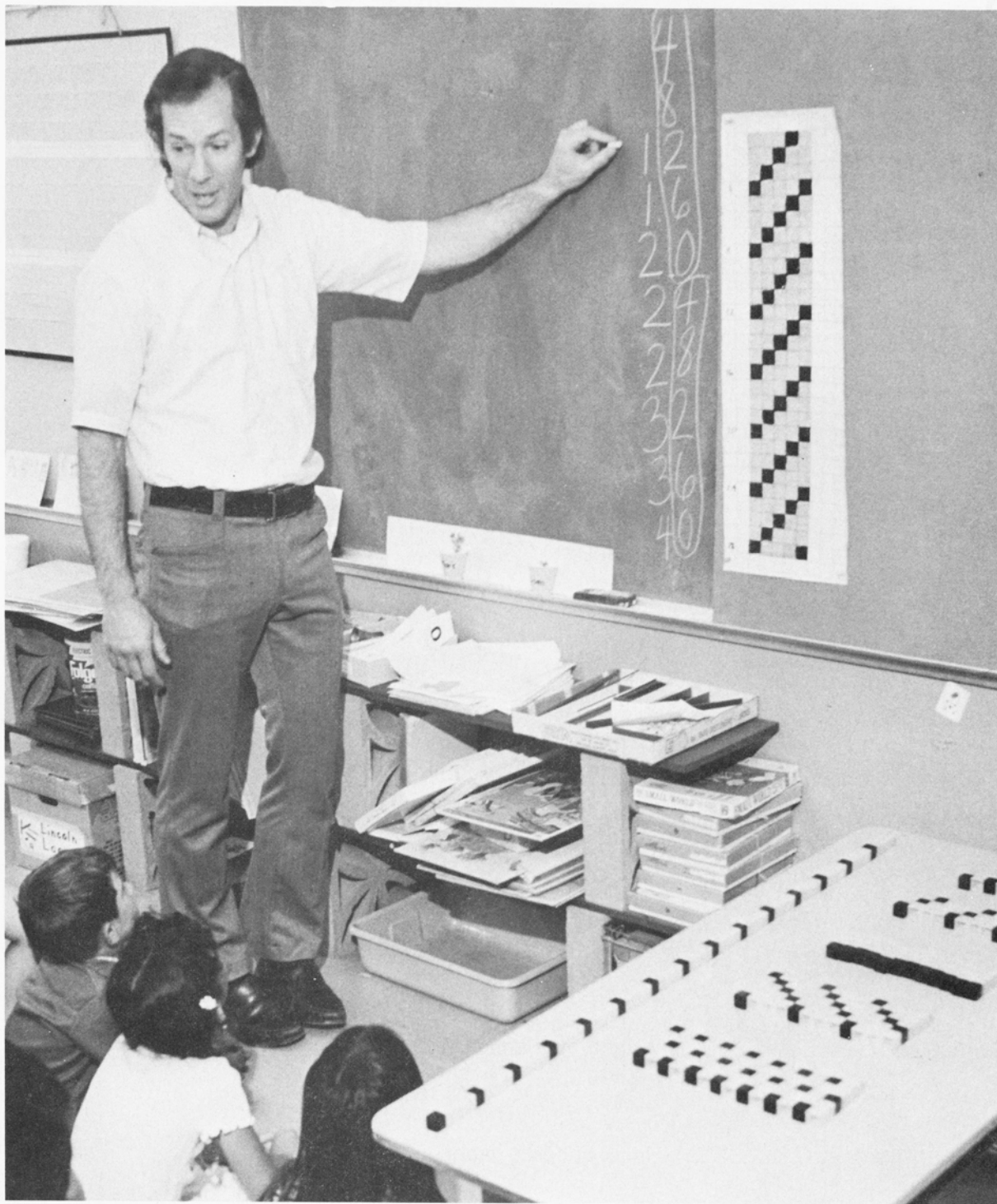
SKILLS _____ Writing mathematical symbols
 Pattern
 Counting

MATERIALS _____ Unifix cubes,* paper

ACTIVITY _____ (See page 267.) After the children explore a pattern and record it on a sheet of graph paper, allow them to extend these patterns on their own to twenty or thirty rows.



At a subsequent session, ask a child to point to the squares in one column one after another as the rest of the children count. Select one color to focus on and have the class say the numbers for this color out loud and the numbers for other colors silently. Then have the children repeat this with the same column of squares and this time write the numbers the children say out loud on the board. At the end, look for patterns and predict the continuation of the number sequence.



The children can try this on their own once they get the idea from the group record.

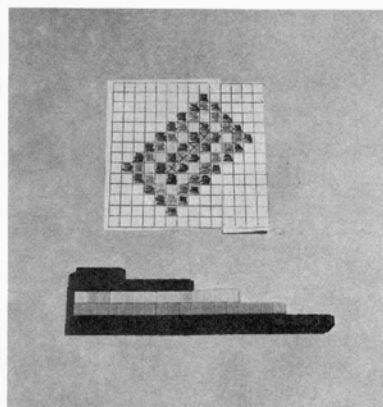
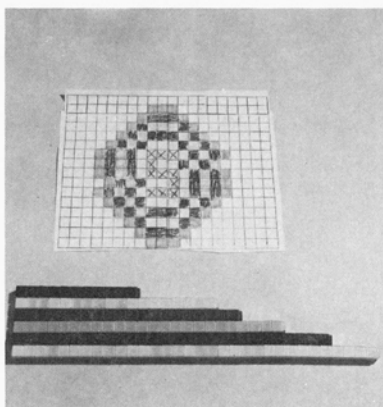
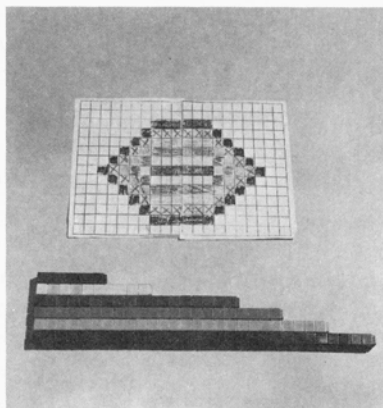
Recording Number Patterns from Surrounding Patterns

SKILLS _____ Writing mathematical symbols
Pattern
Counting
Comparing

MATERIALS _____ Records of surrounding patterns (see page 265) made by students, Unifix cubes*

The children surround the base designs with Unifix cubes of one color. Removing these cubes, they snap them together. Then they surround the next level, snap those cubes together, and compare the number of cubes with those used in the previous "surrounding." The children repeat this often looking for patterns. The patterns they discover are very surprising!

Once the children learn how to do this activity, they may enjoy sorting the designs by the number of steps required before the cubes increase consistently.



QUESTIONS FROM TEACHERS

IS THERE ANYTHING IN THIS CHAPTER THAT YOU WOULD TEACH KINDERGARTENERS? WOULD THE PLACE VALUE COUNTING GAME HELP CHILDREN UNDERSTAND NUMBER?

I'M A BIT SKEPTICAL ABOUT TEACHING "BASES" TO FIRST AND SECOND GRADERS. I HAD TROUBLE UNDERSTANDING IT IN COLLEGE!

I have used the place value counting game in kindergarten and feel it is inappropriate. A child who is working on counting activities has enough to deal with. It's confusing for a five-year-old to sometimes count "one, two, three, four, five," and sometimes count "one, two, three, four, burp."

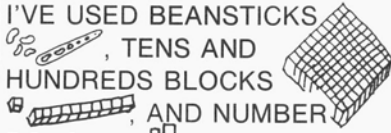
All children are better off working in greater depth rather than being rushed toward greater and greater abstraction. It is more worthwhile for a kindergarten-aged child needing additional challenge to explore tile patterns and Unifix patterns in depth rather than to get into the symbolic level of number concepts or even the concept level of place value.

Number one, you will not be teaching "bases" to your first and second graders. You will be teaching them a counting game which six- and seven-year olds find thoroughly enjoyable and easy to play. It is our adult mind's ability to abstract that labels what is merely a "game" to children as teaching "bases." The place value counting game gives children an opportunity, through play, to discover the structure of our number system. You and I found this concept difficult, not because it is a difficult *concept* but because we were taught the concept *abstractly*. We were given, if you will, the "symbolic level" rather than the "concept level" and to understand it, we were shown how to manipulate symbols rather than objects to get the right answer. In all likelihood you remember learning the theory of other bases and know you were able to work problems at the time but no longer remember how to go about those calculations. This is the typical problem with learning to manipulate symbols at the abstract level. Because the concept is not developed at the experience level we do not internalize the idea, we merely learn the appropriate "tricks" to get the right answers. This is not the model for learning that we want to go on perpetuating in the schools!

Your children, through the place value counting game, will deal with an entirely different activity. They play the counting game and look for patterns which group objects in a variety of ways.

This whole book of activities started with this game and more children are using this one activity than any other. Even so, this is one of the hardest for adults to accept before using it.

I'VE USED BEANSTICKS, TENS AND HUNDREDS BLOCKS, AND NUMBER RODS WITH MY CLASSES IN THE PAST. DON'T THESE MATERIALS DO THE SAME THING AS THE PLACE VALUE COUNTING GAME?



WHEN MY CHILDREN ARE PLAYING THE PLACE VALUE COUNTING GAME WITH BASE TEN, A FEW OF THEM DAYDREAM AND DON'T NOTICE WHEN THEY'VE COLLECTED TEN. HOW CAN I ENCOURAGE THEM TO ANTICIPATE THE REGROUPING STEP? THEY DID THIS BEAUTIFULLY WHEN GROUPING BY SMALLER NUMBERS BECAUSE THEY COULD SEE AT A GLANCE WHEN THEY HAD FIVE OBJECTS.

WHEN EXACTLY SHOULD I INTRODUCE BASE TEN? HOW DO I KNOW WHEN MY CHILDREN ARE READY?

All I can say is several hundred thousand children find it fun and place value easy to understand through the use of this game. Once you observe the *results* exhibited in your students' understanding, you may find place value one of the most fascinating concepts you teach!

I have used all these materials in my classes, too. The thing I like about them is that they represent a variety of approaches and ways of illustrating the concept of place value. A fellow teacher, Richard Cossen, pointed out one fundamental problem with these materials with which I concur. The problem Richard pointed out was that these materials *impose* structure on the child. Unlike the place value counting game, when using the former materials, there is no way of allowing the children to create the structure. The beans are already glued down to the beansticks, the tens and hundreds blocks (or multi-base blocks) are already stuck together in a definite way, and the number rods are of specific unalterable lengths. As such they help children interpret numbers in place value and are excellent materials later in the child's school experience, but they should not be used as the child's first place value experience.

I have two methods you can try. All that is required for most children is to ask *them* to suggest ways to help them tell when they are near ten. Your children will suggest things like, "I make two rows of five," or "I make three rows of three and then I know I have nine, and with the next one I regroup." For some children this suggestion of organization is all they need to start organizing themselves. For those children who persist in placing their cubes randomly on the plain side of their board so they never anticipate, "I need two more to make ten," etc., take a piece of paper, put ten spots on it, and tape it to the right side of those children's place value board's. (Arrange the spots in a pattern such as two rows of five.) Then ask these children over and over as they work, "Now, how many more cubes do you need before you have ten?" This focuses their attention on observing this pattern and as a side benefit will help them with subtraction. (If they have seven spots covered, that's $10 - 7 = 3$ as well as $7 + 3 = 10$.)

The first year you do this, introduce base ten after Easter in first grade and after Christmas in second grade. This, of course, is only a suggestion from which to *deviate*. Do whatever you feel comfortable with. You will learn through teaching this concept that you want your children to spend a long time looking for patterns in other groupings because it pays such dividends when you get to base ten.