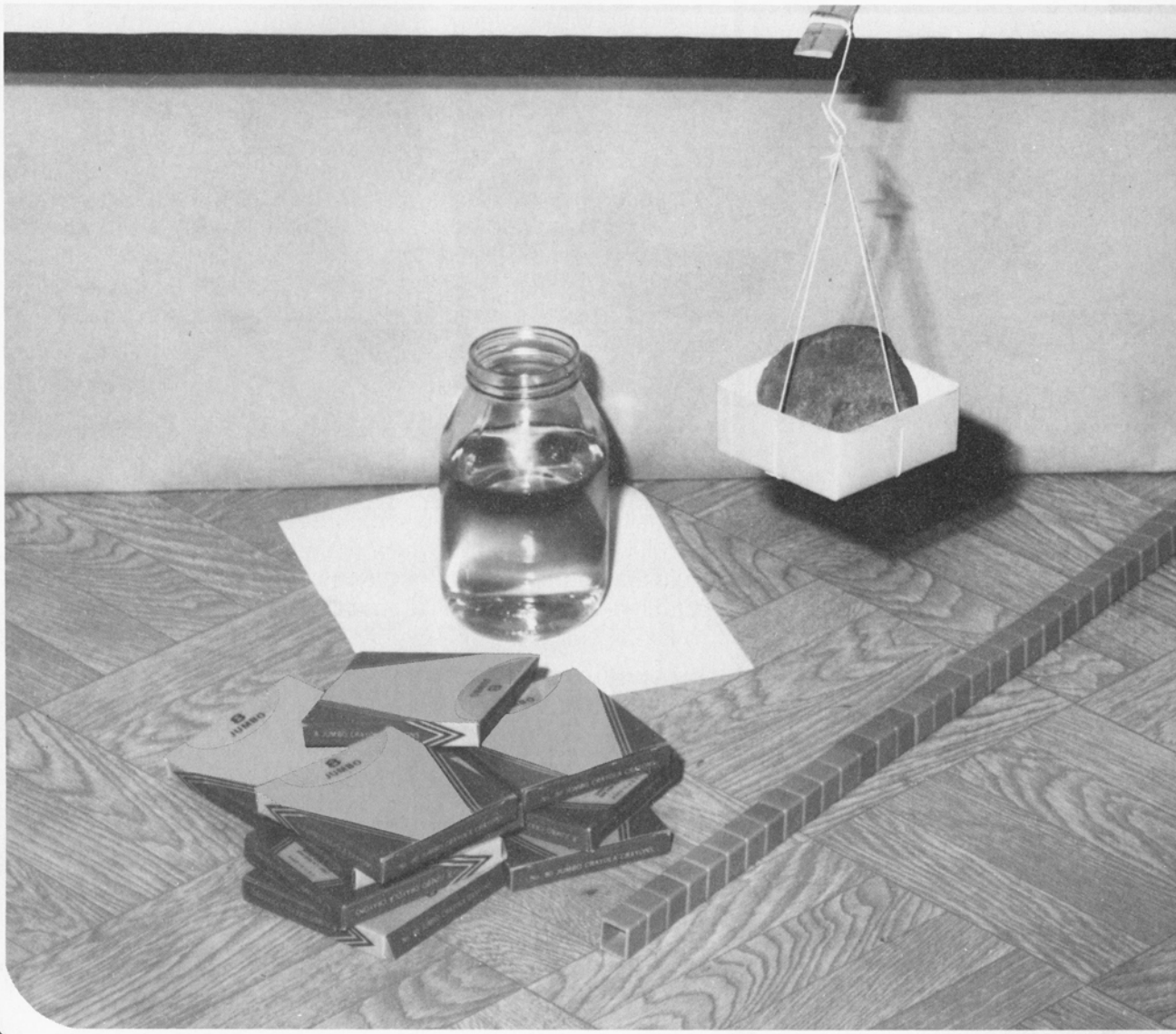
5 COMPARING



5

SKILLS AND CONCEPTS

Comparing lengths, masses, quantities, durations, and volumes
Measuring with non-standard units
Making and testing predictions
Developing language skills

SELF CONCEPT AND SOCIAL INTERACTION

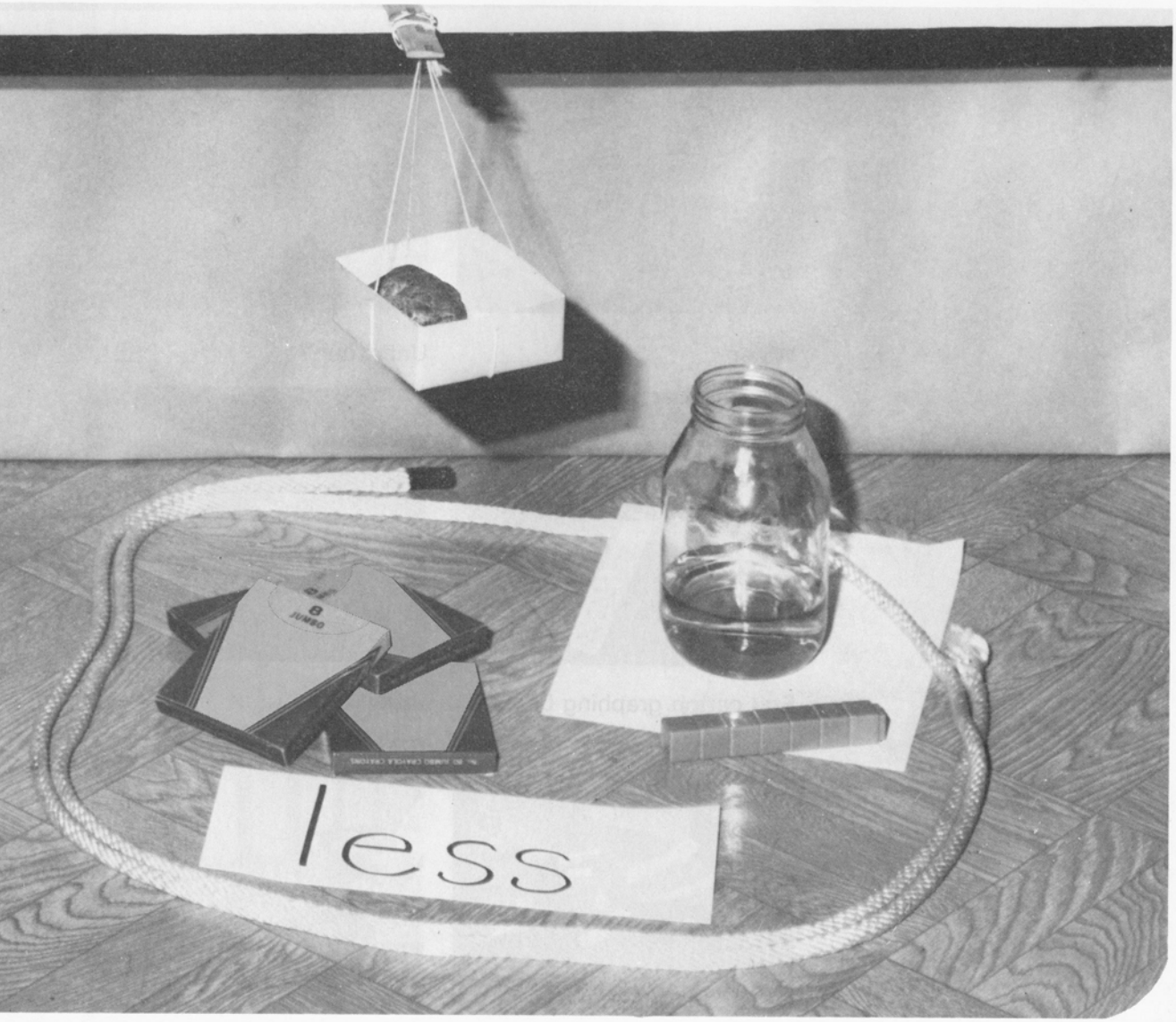
Developing greater awareness of self and others by observing comparisons of height, weight, one's name and body measurements
Realizing that "more" or "bigger" is not always best
Understanding that "less" or "smaller" can be valued equally with their opposites, and contribute equally to success

FUTURE APPLICATION

Making graphs
Measuring with standard units
Understanding more formal presentations of ratio and proportion
Understanding arithmetic operations

PREREQUISITE CHAPTERS

Free Exploration

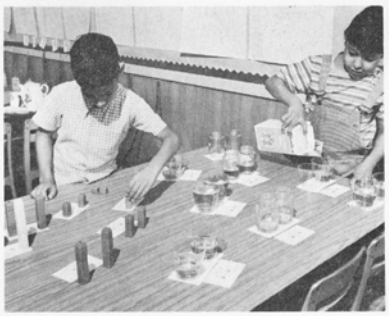


INTRODUCTION

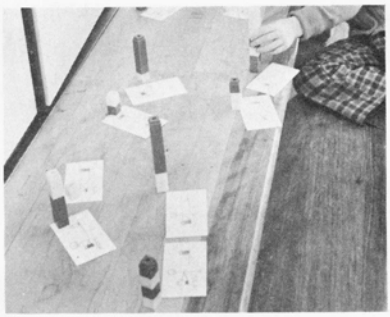
The skill of making comparisons contributes an important step to the child's growing mathematical understanding. Children begin by comparing familiar objects, as numbers are too abstract. Eventually they will be able to apply this knowledge to the relationship between one number and another.

In order to comprehend this concept fully the child must first understand *equal* groups. By comparing two groups and focusing on making them the same, the child creates a standard by which sheorhe can make future comparisons of more and less.

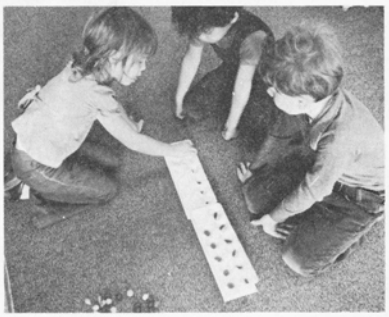
When the child is ready, sheorhe compares two unequal groups of a variety of materials and labels each group as more or less than the other (see Worksheet 24).



Water



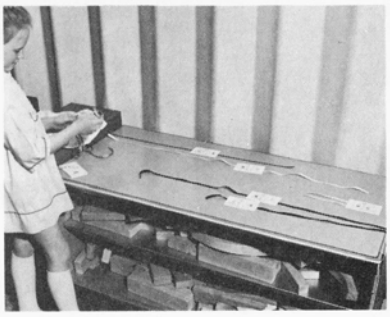
Unifix cubes



Egg carton graphing boards

Junk

Weights



Ribbons or string

Things in the Room

SKILLS

Comparing
Matching
Drawing conclusions

MATERIALS

"Things in the room" cards,* Unifix cubes,* paper, crayons

ACTIVITY

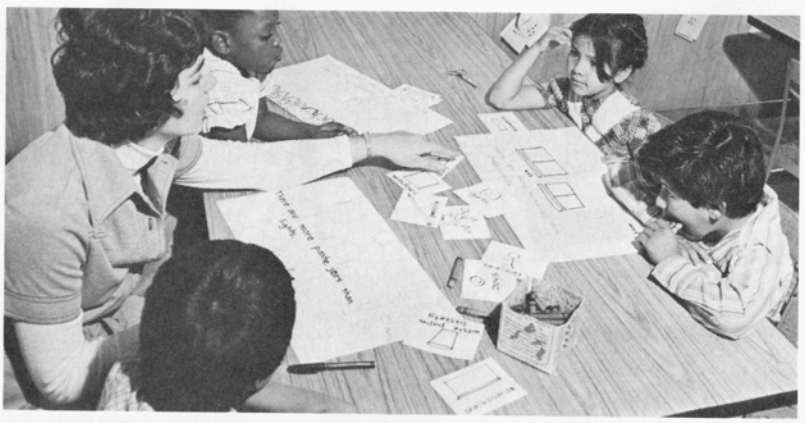
The children compare objects in the room and decide what there is more or less of.

Turn the "Things in the room" cards face down. Ask a child To turn over two cards: pencils and windows, for example.

Work with the class to determine if there are more pencils or more windows in the room. When it is not obvious visually that there is more of one item than another, match Unifix cubes one to one with the objects being compared and use the stacks of cubes to help determine which is more and which is less.

This enables children to compare large numbers of objects which cannot be brought into one-to-one correspondence with one another. If asked to make this comparison without the cubes, the child would have to count and compare numbers, a very abstract skill which few children at this stage would understand or find relevant.

Make a book with, "In our Room" or "In Room Five" on the cover and include the records the children make of their discoveries. The children can either make contributions to a class book or make their own books.



Extend this activity over several weeks, making three or four comparisons a week. It is more useful for children to watch a book grow over a long period of time than it is to fill up the pages in one or two days.

Comparing Names

SKILLS

Comparing
Seeing relationships

MATERIALS

Graph paper cut into two-row strips; Worksheets 24 and 55

ACTIVITY

The children team up in pairs. Each child writes hisorher name on one line of the worksheet.

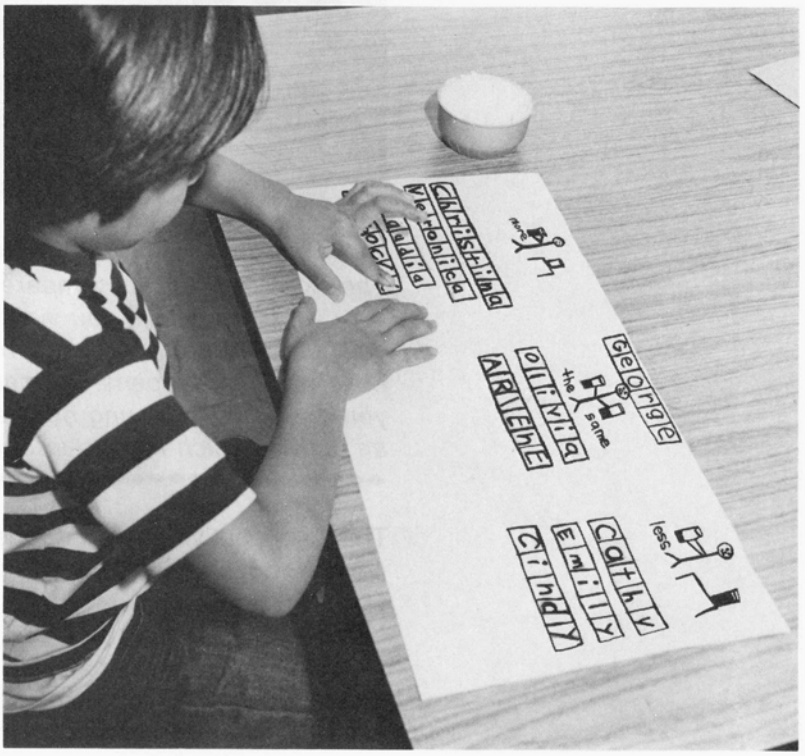
Now each pair compares the names on their paper and decides whether the name at the top has more, less, or the same number of letters as the second name.

As each pair of children finishes comparing names, each child looks for another child to team up with and repeats the activity.

Talk with the children about how they might decide who is to write hisorher name first. Role play the different methods used by the children and get them to share their feelings about these methods.

This same activity can be repeated to compare each child's first and last names.

For variation of the activity, have the children write their names on a duplicator master. When this is run off, each child can have a copy of everyone's name in the class and compare it with hisorher own name.



Height Records

SKILLS

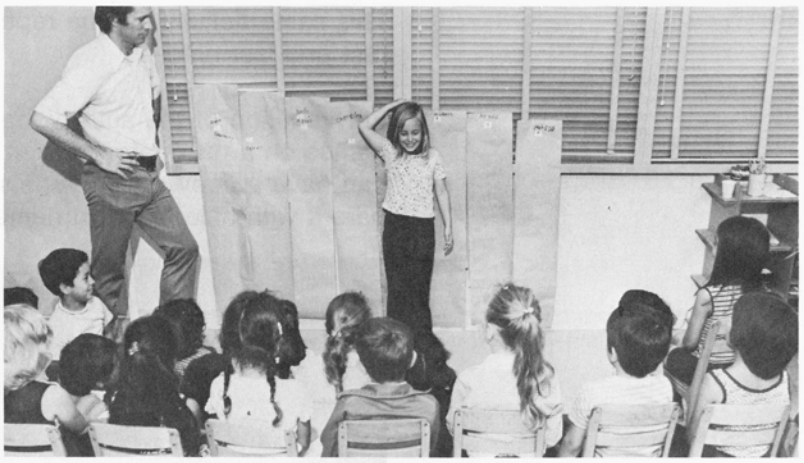
Solving problems
Ordering
Comparing
Seeing relationships

MATERIALS

Butcher paper cut in 23 cm or 9″ strips

ACTIVITY

This activity extends over several weeks. Begin with two children the first day and have them stand against a strip of butcher paper to be measured, one at a time. Cut off a separate piece of paper indicating each child's height. On each following day one additional child is measured while the group watches and the new height is compared to the earlier height measurements. In this way, at the end of several weeks, every child has been measured and hisorher height recorded, compared, and then arranged in order with the rest of the class.



The skills required to compare and order children's height are very sophisticated. If you want to see how sophisticated, ask your class to get in order by height and stand back and observe what happens. By making the comparisons gradually, you are enabling young children to experience success with an activity which if done in one day is an utter disaster.

This same activity can be done to compare the weights of several rocks, grapefruit, or similar-sized toys. It can be done to determine the volume of several similar-sized jars or bottles, to compare and order children's handprints and footprints, or to determine the time duration for different songs. The secret is to make one or two additional comparisons each session, gradually completing the whole series.

Body Measurements

SKILLS
Measuring
Comparing
Seeing relationships

MATERIALS
String, scissors

ACTIVITY
The children measure the circumference of their head with a piece of string and cut off this length. Experimenting with the string, the children measure other parts of their body and try to find some part that is the same measurement. The children should be shown how to fold their string in half and search for a body part of this measurement. The same thing can be done by folding the string in thirds or fourths, and so on, although this is more difficult and will need to be done in smaller groups.

Once the children have explored body measurements with their piece of string they can look for things in the room to measure and compare. They might make a record of the things they find that are longer, the same size, and shorter than their string.

This activity should be repeated many times, each time changing the part of the body that is measured. The children might measure the circumference of their wrist, knee, ankle, waist, neck, or big toe. They might measure the length of their foot, their middle finger, their nose, their height, or their arms and legs. Each child can keep track of each of these measurements by folding a piece of masking tape around the string and writing hisorher name and the body part which this length measures on the tape.

Teeter-Totter

SKILLS

Matching
Comparing
Solving problems
Predicting
Seeing relationships

MATERIALS

A long board and three pieces of wood nailed together to make a crude teeter-totter, photocopied pictures*

ACTIVITY

Select one child to be the standard for comparison. This child gets on one end of the board. The other children volunteer one at a time to get on the other end of the board. Each child's weight is compared to the first child's and a record of the results is compiled for reference.

Repeat this activity on another day, using a different child for comparison.

It is important to respect a child's right not to participate if sheorhe chooses not to. An overweight child might feel embarrassed in this situation or another child might be afraid to be lifted off the ground. Repeatedly asking for volunteers rather than taking turns allows children to exercise free choice.

APPLICATION AND EXTENSION OF COMPARING

The following activities allow the children to explore duration, weight, length, volume, and height in various ways. Several of the games turn the tables on the usual form of competition where more is always best and, hence, the winner. In these activities (Stack, Tell, Spin and Win; Tic Tac Toe; and Squares) the children spin their more-less spinner to determine the winner. Sometimes the child with more wins and sometimes the child with less wins. These activities may be explored at any point during the year. Their value increases when they are repeated, for as the children bring greater understanding and experience to them, they are taken to greater depth. A thread of comparing should run through the entire year rather than having a bunched-up period of time devoted exclusively to this concept.

Water Timer

SKILLS

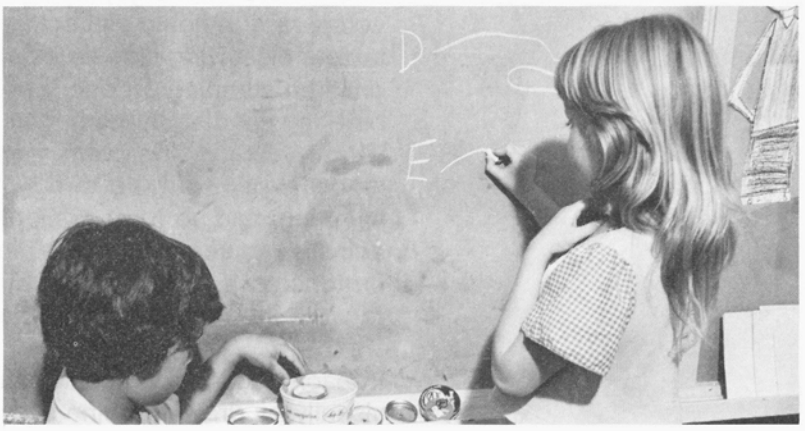
Comparing
Predicting
Seeing relationships

MATERIALS

Jar lids with a nail hole in the bottom, labeled so they can be told apart; buckets of water; Worksheet 22

ACTIVITY

The children experiment with the length of time each lid takes to sink, working in teams of two. One child places a lid in the water and the other child makes a visual record of how long it takes to sink. If these lines are labeled with the symbol from the lid, the durations of different lids can be easily compared.



Children enjoy having water timer races. Each child selects a lid and the children see which lid is the last afloat.

Duration

SKILLS

Comparing intervals of time
Seeing relationships

MATERIALS

Chairs

ACTIVITY

Two children hold their legs outstretched while sitting on a chair. The rest of the class watches to see who holds hisorher legs up longer. When the children understand the activity, they break into smaller groups so more children can be compared at one time.

The children will enjoy trying many similar activities that compare durations: two soft drink frizzies or Alka Seltzer tablets dissolving side by side, two ice cubes melting, two children standing on one foot or sucking on Lifesavers, two birthday candles burning, two wind-up toys running down, two toy cars sliding down ramps set at different heights, two model airplanes flying, two water timers sinking, two spinners spinning, and so forth. Children can also compare two unlike activities to see which takes longer: Is it faster to button buttons on a jacket or zip up a zipper on a jacket? Is it faster to write the numbers from one to ten or to say the abc's?

In each case, the children can record the two durations visually by drawing a line slowly and evenly during the event.

Handfuls

SKILLS

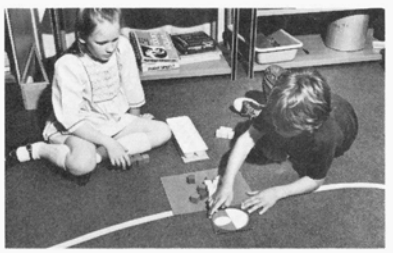
Predicting
Comparing
Matching
Seeing relationships

MATERIALS

Wooden cubes in two colors, more-less spinner,* egg carton graphing boards*

ACTIVITY

The children work in pairs taking handfuls of colored cubes and predicting which color they think there are more or less of. Whether the focus is to be on more than or less than is determined by spinning the spinner.

CHILDREN	RESULTS
John takes a handful of blocks from a pile of yellow and red cubes.	
Susan adds her handful of blocks to John's.	
John spins the spinner and, if the arrow lands on "less" says, "I think there are less red."	
John puts the red blocks into one side of the egg carton graphing board and Susan puts the yellow blocks on the other side to find out whether John predicted correctly or not. Then the blocks are dumped back into the original pile and Susan takes her turn.	

Now, for her turn Susan takes the first handful, spins the spinner, predicts which color she thinks there are more or less of (depending on where the spinner lands) and puts the color blocks she chose in the egg carton.

The children alternate turns for as long as they remain interested.

In time, as the children's skill in estimating grows, switch to smaller objects; this will require the children to compare larger groups. The children may prefer to arrange these smaller objects in pairs to compare them, making each pair "kiss," rather than using the egg carton graphing boards. Either method is acceptable. Having three colors or kinds of objects to compare forces the children to order the amounts before comparing and is another good extension of this activity.

Stack, Tell, Spin, and Win

SKILLS

Comparing
Matching
Seeing relationships

MATERIALS

Unifix cubes,* more-less spinner,* work space,* more-less cards*

ACTIVITY

The children play this game in pairs. Each child snaps a train of cubes together. The trains' lengths are matched with one another so each child begins with the same number of cubes. Then each child breaks hisorher train into smaller stacks. There are no rules for making these smaller stacks; they can be of any length and result in any number of different stacks. Each child makes hisorhers independently. To begin the game, each child puts one stack on the work space.

To play the game, the stacks must be different heights. If by chance they are of equal height, each child must make hisorher stack again until the two stacks are unequal.

At that point each child tells if sheorhe has more cubes or less.

One of the children spins the spinner. If the spinner indicates "more," the child with more cubes in hisorher stack wins. If the spinner indicates "less," the child with less cubes in hisorher stack wins. The winner takes both stacks from the work space.

Expect your children to be disoriented at first when the "winner" has less cubes. Our culture has given them the idea

that *more* of anything is better and always wins. Talk with the children about these values and about situations in life when you may have less and still be a "winner" or at least content.

The children repeat the activity over and over, placing a *stack* on the work space, *telling* if they have more cubes or less cubes than their partner, *spinning* the spinner, and determining the *winner* of the two stacks. The game is over when one child runs out of stacks.

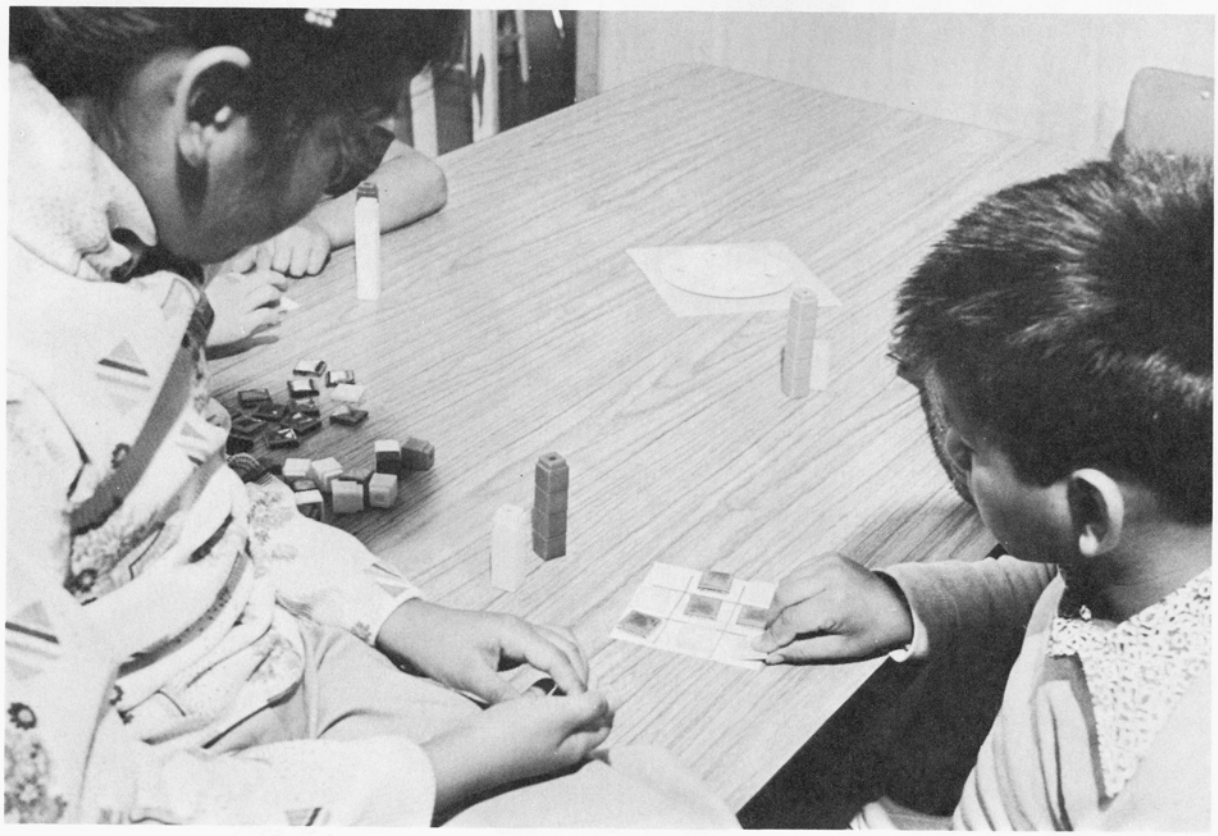
Children sometimes suggest using zero. Encourage them to try this! Putting out a stack of zero is pure power. Try it and see, but wait until your class has played this game many times before introducing this idea, unless, of course, it comes up naturally.

Tic Tac Toe

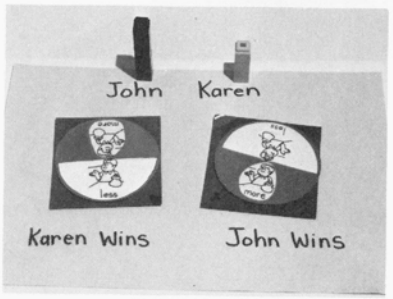
SKILLS
Logical thinking
Solving problems
Comparing

MATERIALS
Tic tac toe game boards, Unifix cubes,* more-less spinner*

ACTIVITY
The children keep score with Unifix cubes as they play successive games of tic tac toe. When finished each child snaps together the cubes which indicate the number of games sheorhe won.



Then one child spins the more-less spinner which identifies the overall winner.



The Hole in the Box Game

SKILLS

Solving problems
Comparing
Drawing conclusions
Predicting

MATERIALS

Five or six empty boxes, wooden cubes,* Worksheet 23

Do the following ahead of time: cut a hole in one corner of each box so that when the box is tilted one cube can be seen. Label the boxes so they can be distinguished from one another. Put different numbers of red and yellow cubes inside the boxes and seal them shut.

ACTIVITY

The children work in pairs, selecting one box to work with. They tilt the box so a block slides into the open corner and then put a cube of the same color on the table. Next they shake the box and tilt it so that another cube slides into the open corner. Again they record this with a cube of the same color. This is repeated over and over again.

When the children feel ready to make a prediction as to the color there is more of or less of in the box, they fill out a "guess" paper and put it in the guessing box.

At the end of the week open the boxes so the children can check their predictions. It is important not to focus on specific quantities—rather stress the *fact* that there is more of one color than another.

Let one of the children fill the boxes for the following week.

Squares

SKILLS

Thinking logically
Matching
Comparing

MATERIALS

More-less spinner,* geoboards and geobands,* Unifix cubes* in two colors

ACTIVITY

The children take turns making horizontal or vertical (no diagonal) line segments of any length on their geoboard. A child who completes a square with no nails in the middle places hisorher color Unifix cube within the square to claim it. The children continue playing until all the squares are claimed. When all possible moves have been made, the children remove their Unifix cubes, snap them together, and compare their trains. The more-less spinner indicates the overall winner.

Measuring with Jars

SKILLS
Solving problems
Comparing
Drawing conclusions
Seeing relationships

MATERIALS
Measuring set with jars,* Worksheet 23

ACTIVITY
The child takes two jars and fills one of them with rice. Then sheorhe puts the contents of the filled jar into the empty jar and records the results as follows: *too little, too much,* or *just right.*

The papers are sorted into three plastic bags which are labeled in the same way and are pinned to a nearby bulletin board. The children file their records in the appropriate place as they finish each experiment.

Weighing and Comparing

SKILLS

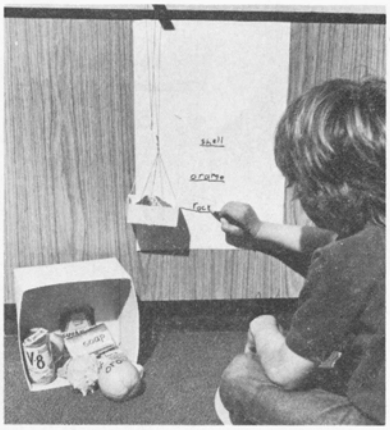
Comparing
Ordering
Solving problems
Drawing conclusions
Seeing relationships

MATERIALS

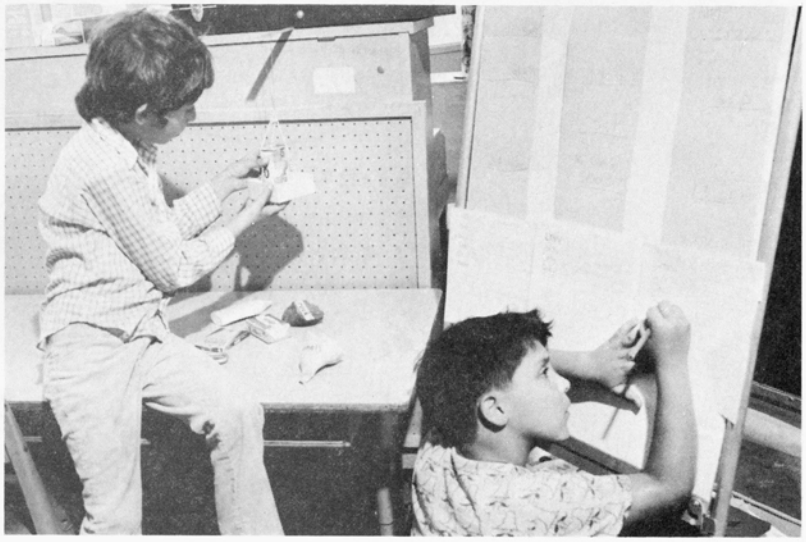
Common objects* to be ordered by weight, a milk carton scale,* paper

ACTIVITY

The children select three items to weigh on the milk carton scale. As each item is weighed, they record the name of the item on the paper behind the scale on a line with the bottom of the milk carton. When they finish, they have recorded the three items in order from lightest to heaviest on their paper!



Other children can check this by repeating the experiment and signing their name indicating if they agree or disagree. (See Worksheet 58.)



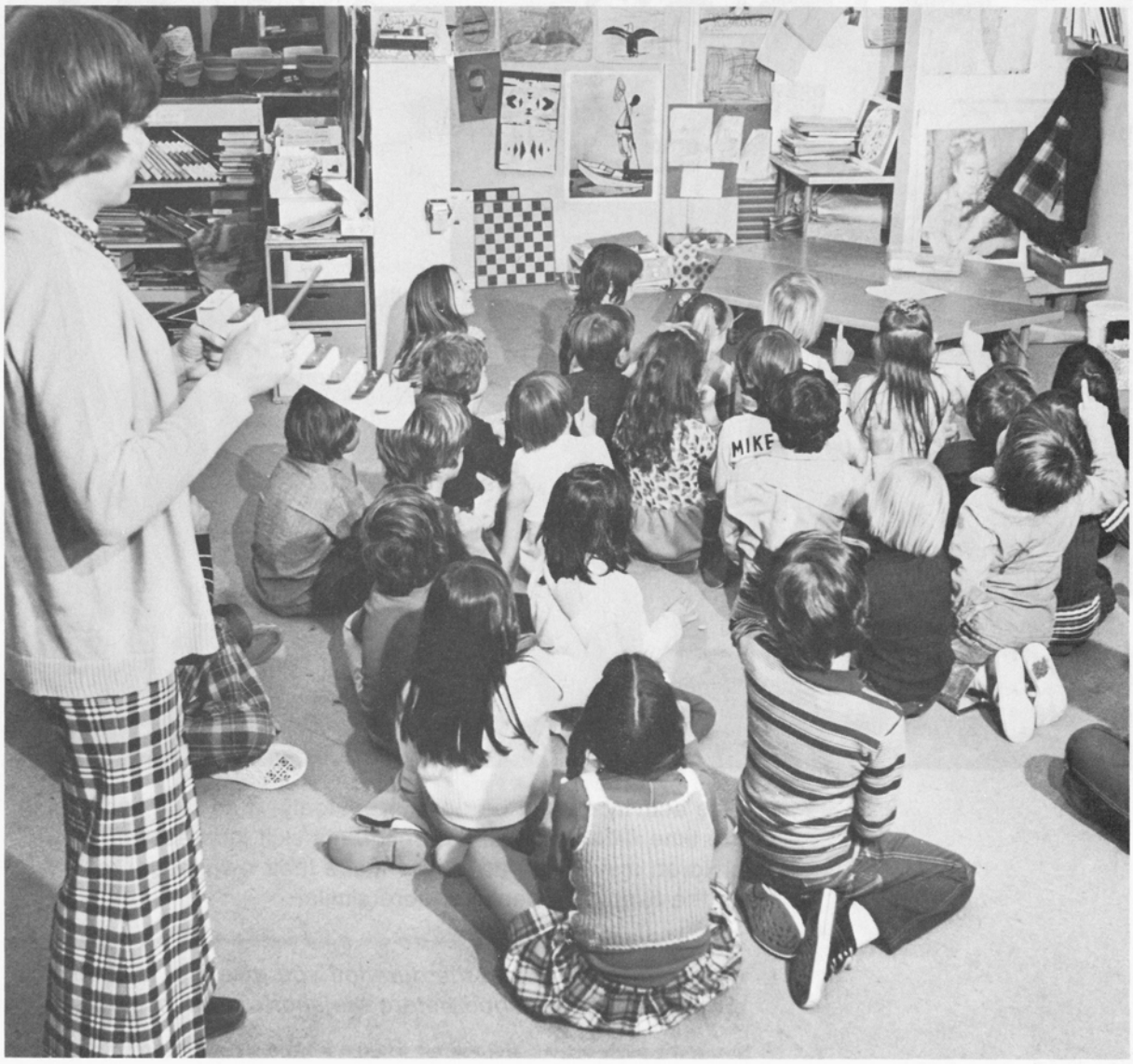
Natural objects from the child's environment are best for this activity: fruits and vegetables, old shoes, socks, cans of familiar foods, etc., because the child can relate more easily to things that are relevant to hisorher life.

Intervals of Time

SKILLS Comparing intervals of time
Drawing conclusions

MATERIALS Bell

ACTIVITY The children sit with their eyes closed and their backs to the teacher. The teacher watches a second hand on a clock and rings a bell each time ten seconds elapse. The children put their finger up when they think the time has elapsed, attempting to raise their finger simultaneously with the ring of the bell. It is important for the children to make this motion quickly so there is no overlap of movement to interfere with the duration.



Children need many opportunities to repeat this activity, experiencing both longer and shorter durations. During any one work period the duration should be kept constant to give children an opportunity to revise their sense of time repeatedly and improve their skill.

When the children are skillful with this activity, they will be ready to compare two different durations. They should again sit with their backs to the teacher, with their eyes closed. The teacher asks the children to focus on two different lengths of time and to tell if the first time period is longer or shorter than the second period. The teacher says, "First," and then lets ten seconds elapse before sheorhe rings the bell. Immediately following the bell the teacher allows five seconds to elapse. One child makes a visual record of each duration by drawing a line between bells. Then the rest of the children talk about which period was longer and which was shorter. The child who made the visual record shows this, and the children watch while this child traces over the lines as the teacher repeats the two durations.

This activity should be done repeatedly, gradually decreasing the time differential as the children's skill increases. The children may find it helpful to make their own visual record as the two times become more similar.

Be careful to alternate the duration you give first, sometimes giving the longer period before the shorter and vice versa.

Measuring Strings

SKILLS

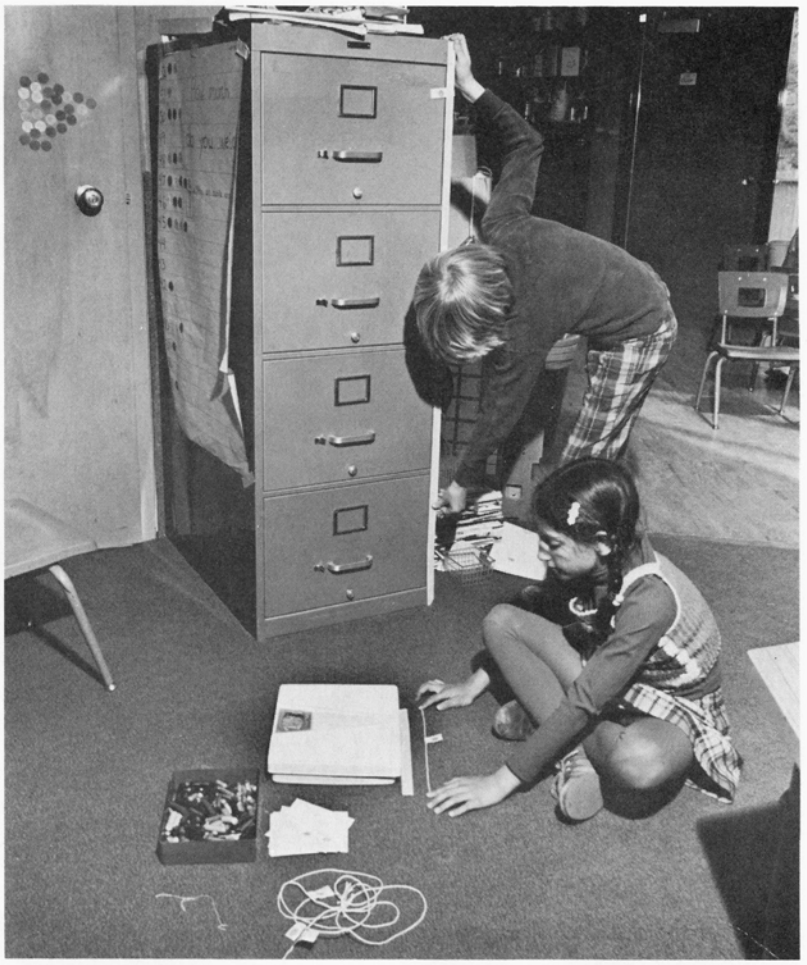
Measuring
Comparing
Matching

MATERIALS

Five lengths of string labeled with a colored dot on a strip of masking tape; five objects marked along one edge with a length of masking tape and a letter, Worksheet 22

ACTIVITY

The children take the strings and match them to the masking tape, trying to find the appropriate length of string to measure each object.



The children make a record of which string matches each item.

This activity can be repeated if you change the items to be measured. At the start the measurements should be quite different but as the children gain skill the measurements should become less differentiated, requiring more accurate measurement.

Mark the Scoops

SKILLS

Comparing
Drawing conclusions
Seeing relationships

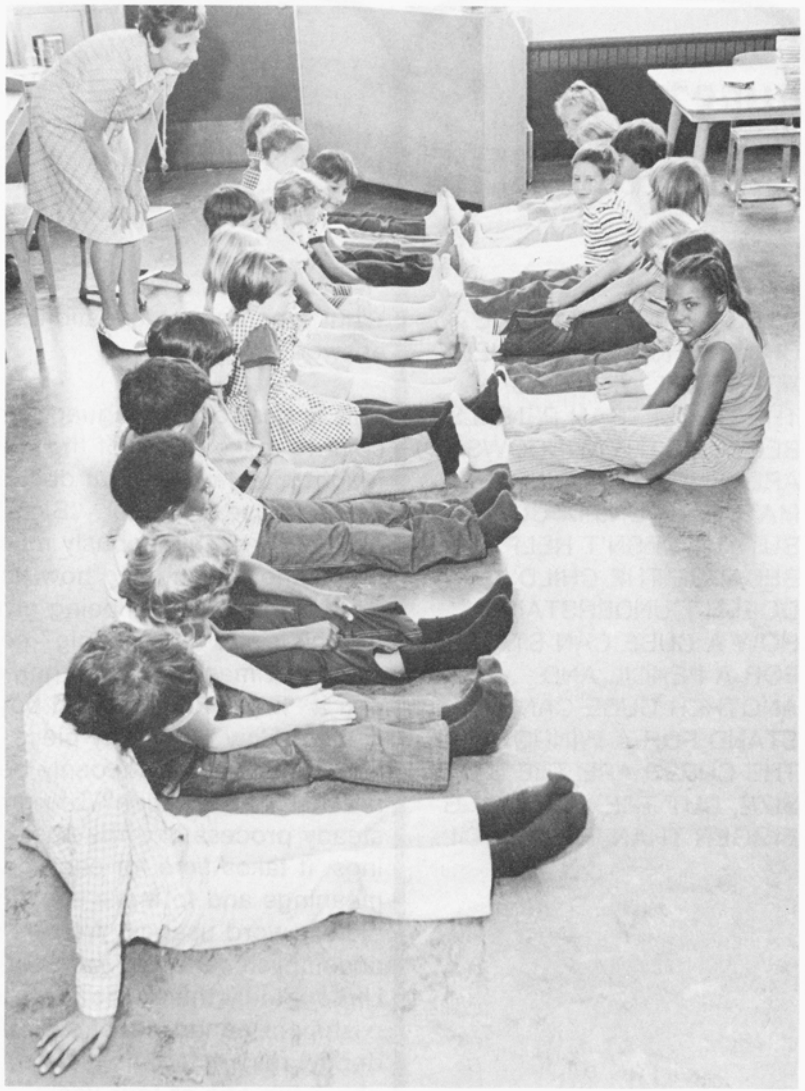
MATERIALS

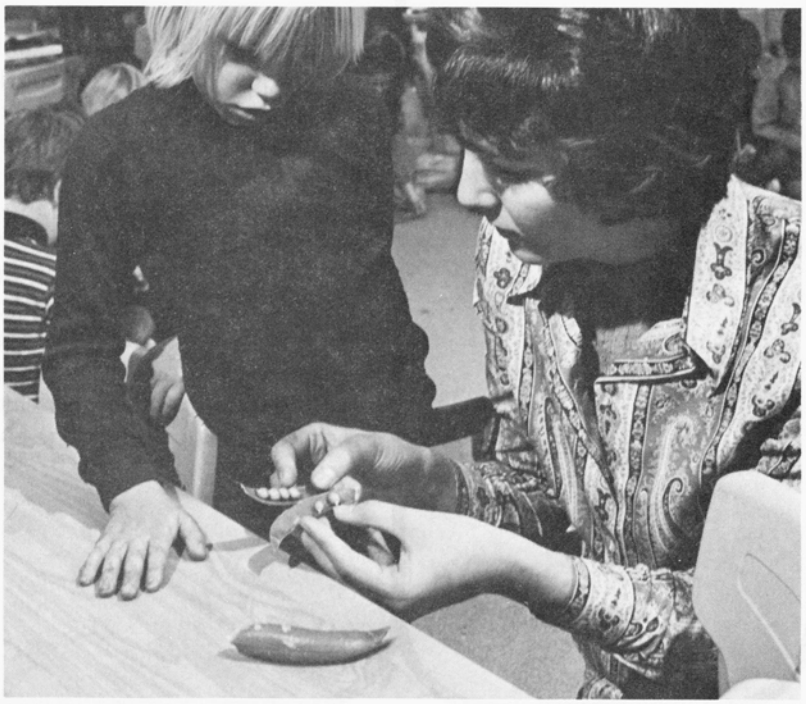
Assorted jars, 1 cm or ½″ strips of paper, tape, rice, measuring cup

ACTIVITY

The children take a measuring cup to experiment with. They tape a strip of paper to the side of each of the available jars. They put one measuring cup of rice in one jar, shake the jar to even out the rice, and mark the level on the paper taped to the side of the jar. As the children add each measuring cup of rice, they mark the level on the paper. This is repeated for each jar.

Encourage the children to discuss why the distance between each mark differs with some jars and does not with others. It is not necessary for the children to be able to explain the discrepancy; the goal is to allow them to puzzle over it and to discover that the discrepancy does not exist because of incorrect measurement.





QUESTIONS FROM TEACHERS

WHAT DO I DO FOR THE CHILD WHO THINKS THERE ARE MORE WINDOWS IN THE ROOM THAN PENCILS BECAUSE THE WINDOWS ARE BIGGER? I TRIED MATCHING UNIFIX CUBES BUT IT DOESN'T HELP BECAUSE THE CHILD DOESN'T UNDERSTAND HOW A CUBE CAN STAND FOR A PENCIL AND ANOTHER CUBE CAN STAND FOR A WINDOW. THE CUBES ARE THE SAME SIZE, BUT THE WINDOW IS BIGGER THAN THE PENCIL.

What a perceptive question! And what a challenging one to answer!!

This is basically a language problem. How difficult it is for a child to make sense of the word "big." Sheorhe has been taught many words that define things that don't change, a car, a house, the floor. "Big" seems contradictory. Four-year-old Bobby simultaneously must deal with his *father* as "big," his mother mentioning how "big" *he* has grown, and his disappointment over being given a small piece of candy bar that his sister says is "big" compared to her portion. Clearly, a six foot man *is* big compared to a four-year-old, but how can a "little" four-year-old boy be big at the same time he is little? How can a tiny piece of candy which is half of a "big" original bar suddenly become big when compared to another small portion? The growth of language is a slow steady process and the basis of many early misunderstandings. It takes *time* for each child to sort out the various meanings and to make sense of many potentially contradictory word usages. We rarely appreciate fully the marvelous accomplishment that the acquisition of language represents. Undoubtedly this is the most impressive and difficult accomplishment an individual ever faces, and it is done independently, reinvented, as it were, by each individual, and all by about the age of four years.

The problem with "big" is similar to the problem causing difficulty for this child comparing windows and pencils. The child is focusing geometrically on the problem and you want the child to focus quantitatively. Get some objects you can manipulate close to the child. Start with things for which the gross difference is very slight and compare only two and three objects: "Are there more crayons (2) or more pencils (3)." Then increase the size of the objects used: "Are there more books (3) or more toothpicks (2)?" When this kind of comparison is easy for the child, then increase the number of objects in each group. When you feel this is sorted out in the child's mind, then go back to objects at a distance that cannot be brought into one-to-one correspondence with one another.

WHAT DOES WEIGHT, TIME, VOLUME, AND LENGTH HAVE TO DO WITH HELPING THE CHILD LEARN NUMBER FACTS? COMPARING ALL THESE *DIFFERENT* THINGS COULD CONFUSE THE KIDS AND THESE ACTIVITIES TAKE TIME AWAY FROM THEIR STUDY OF NUMBERS.

The activities in this book encourage the development of *mathematical* ideas of which arithmetic (number facts) are only a *part.* (The title is *Mathematics* Their *Way,* not *Arithmetic* Their *Way.*) In real life the concepts of weight, time, volume, and length are of equal interest, value, and importance to that of quantity and do deserve our attention. Each of these ideas involves measurement—weight in kilograms or pounds, time in minutes, months and years, volume in liters or quarts, and length in centimeters or inches. The experiences in this chapter give children practice in measuring and making gross comparisons. These activities precede measuring and comparing measurements with numbers. Later each of these activities can be extended and the child asked to compare *how much more* one object weighs, holds, or measures than another.

WHY DON'T YOU HAVE THE CHILDREN COMPARE WITH FEET AND INCHES? WOULDN'T IT BE EASIER FOR THEM TO USE NUMBERS?

At this early stage numbers *interfere* rather than enhance the development of the concept. At this stage we want children to experience the *whole,* and numbers focus the child's attention on the *particular difference* in measurement. Comparing activities give children a wide variety of experiences in measurement and allow them to focus on the gross differences first. The goal is to help the children understand the process and to compare a variety of real things, not to learn to compare *numbers.* Using standard measurements of centimeters or inches is a much later step and should only be used after the children have had an opportunity to create their own standard and fully explore the idea of measurement. Only then will children really understand what standard measurement is all about and not just manipulate numbers.

SOME CHILDREN WON'T ACCEPT THAT LESS CAN WIN. WHEN THE SPINNER COMES UP "LESS" THEY GET MAD AND DON'T WANT TO PLAY. WHAT DO I DO?

Be patient. One of the disservices of modern advertising has been to encourage the attitude that "more" is always better: Get more money or buy more *things* and you'll be successful, happy, loved, etc. In life we find this is simply not true. More is *not* necessarily what is better. Often the little present is the one we remember and treasure most of all. We sometimes find we value having fought for a cause or a politician even when the cause or the person was not successful in the eyes of the world.

The child's reaction you mention must be allowed to encourage you more, not discourage you, for "getting mad" is clear evidence of how indoctrinated sheorhe is in the "more is better" philosophy. Be patient as you turn the tables on this child. You are cutting the familiar form of competition out from under this child and it takes time to readjust and take on new values.