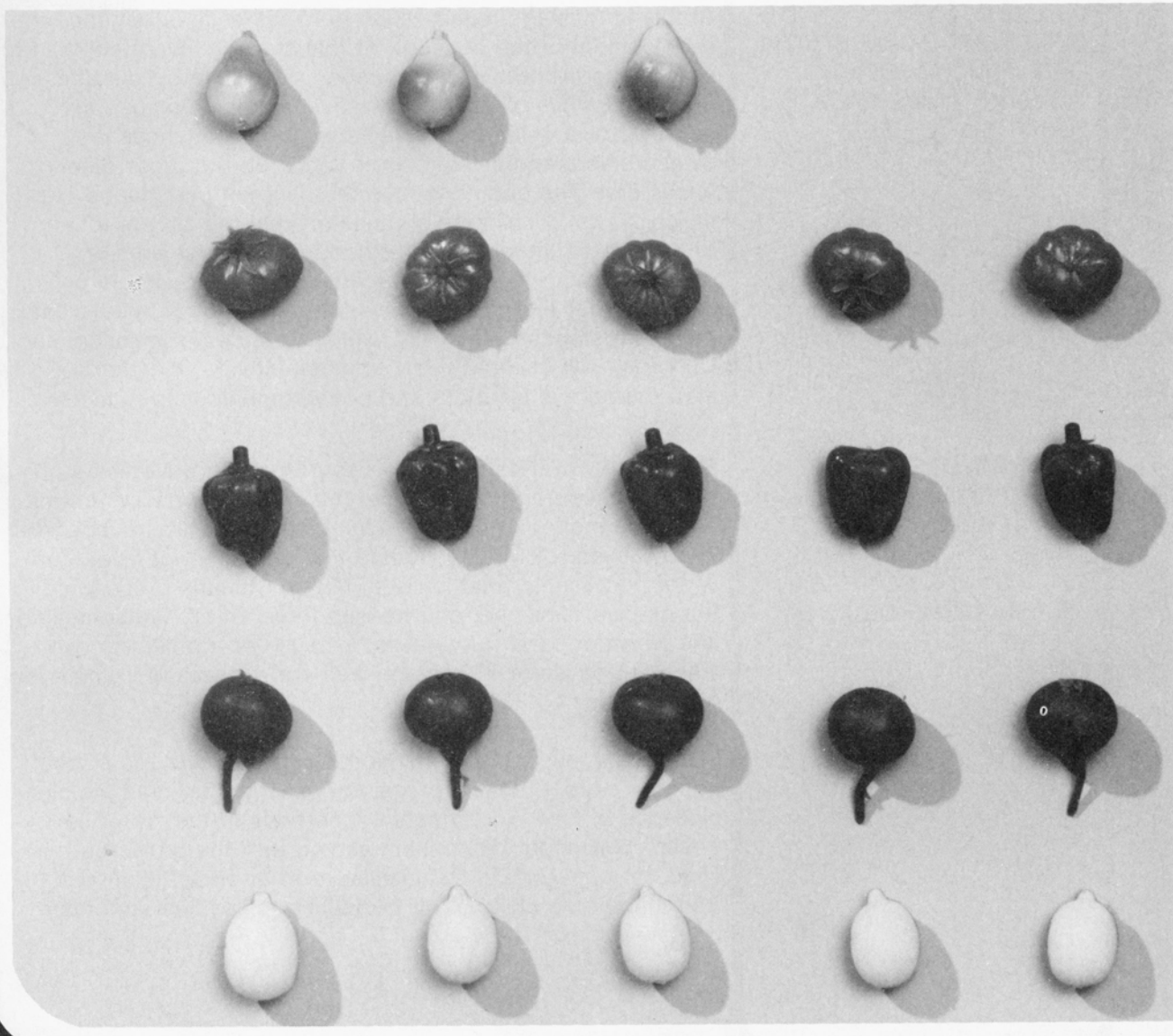
6 GRAPHING



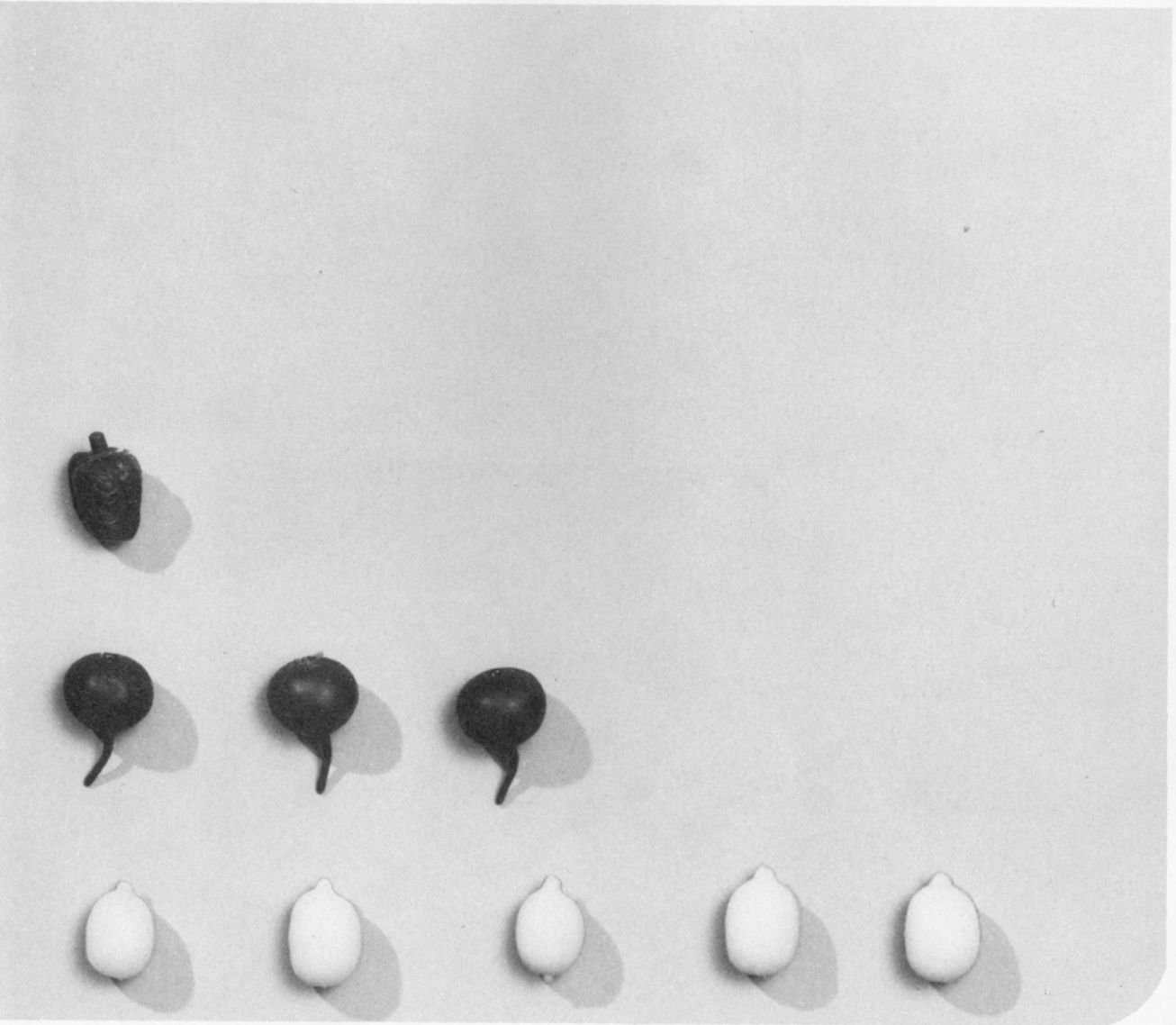
6

SKILLS AND CONCEPTS
Comparing
Counting, adding, subtracting
Organizing data in a systematic way in order to discover patterns

SELF CONCEPT AND SOCIAL INTERACTION
Making personal choices
Observing one's relationship to a larger whole
Relating a personal experience to mathematics

FUTURE APPLICATION
Problem solving
Functional relations
Logical thinking
Probability and statistics

PREREQUISITE CHAPTERS
Counting
Comparing



6

GRAPHING

INTRODUCTION

Graphing is a problem-solving tool used to help young children see relationships. This skill develops naturally from the children's sorting and classifying activities and from their interest in comparing groups of objects. These early comparisons are legitimate beginning graphs which enable the children to make rough estimates of which group has more and which has less.

6 GRAPHING

The activities in this chapter build on the children's understanding of more and less, showing them more sophisticated techniques of organizing information in order to help them focus on how *many* more objects there are in one group than in another.

The graphing experiences used in this chapter are carefully designed to lead children from the concrete to the abstract. As these activities progress, the number of groups the children compare is gradually increased. As the number of groups increases, children are introduced to more information and consequently to making more complex comparisons.

The following list outlines the steps in learning graphing concepts:

REAL GRAPHS:	Comparing two groups Comparing three groups
PICTURE GRAPHS:	Comparing two groups Comparing three groups
REAL GRAPHS:	Comparing four groups
PICTURE GRAPHS:	Comparing four groups
SYMBOLIC GRAPHS:	Comparing two groups Comparing three groups Comparing four groups or more

Real graphs are the most important of these graphing experiences for they form the foundation of all graphing activities. In this kind of graph children compare groups of real objects such as chocolate chip and coconut macaroon cookies.

Picture graphs use pictures or models to stand for real things. These graphs are more abstract than real graphs because a picture, even if it is drawn by the child, only *represents* reality. An image of a cookie is not the cookie itself. These graphs are important because they form a link between the real and the abstract and prepare the children for symbolic graphs.

Symbolic graphs use symbols to stand for real things. This is the most abstract level of graphing, because the symbols must be translated back into reality to have meaning. An "X" on a piece of graph paper can only stand, abstractly, for a real cookie which the child has eaten.

The graphs pictured on the following pages uses a wide assortment of materials and a variety of organizational methods. Children make graphs with food, their shoes, clay, geoboards, Unifix cubes, photocopied pictures, clothespins, and so forth, organizing their information vertically, horizontally, or scattered over a page. This variety encourages flexible thinking and enables the children to experience many different ways of arranging information which are equally valid.

Reserve a ten-to-fifteen minute period that is not part of your regular math time and try one idea each day. This will give you and your class an opportunity to make four or five graphs each week. When the children have made a graph, focus their attention on analyzing and interpreting the compiled information by asking the following questions:

Which column has the least?
Which column has the most?
Are there more _____ or more _____?
Are there less _____ or less _____?
How many _____ are there?
How many more _____ are there than _____?
How many less _____ are there than _____?
How many _____ are there altogether?
Are any columns the same?

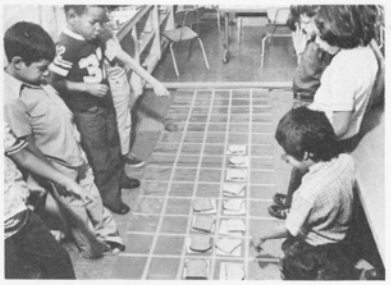
Although your class will have many worthwhile and enjoyable experiences graphing these ideas, the most valuable graphs will be those which evolve spontaneously. The goal of this chapter is to help you and your children learn to feel comfortable graphing so that you will be able to recognize the natural opportunities in the classroom for graphing. A scissor graph showing scissors that cut well and a pair that doesn't cut well might evolve during an art lesson. A book graph might result from the children's comparing the subjects of the books they check out on library day. A pollywog graph might be made during science as a result of a child's noticing some pollywogs with developed feet and others with less developed feet.

Use the ideas in this chapter as catalysts for other ideas. As you try these activities, ask yourself, "How else might I use this idea? What other question could I ask in order to generate a similar graph? How else could I organize this information?"

Each idea can be equally successful at other levels of graphing. A real graph idea can be used just as well as a picture or symbolic graph. Furthermore, ideas which are repeated many times in different ways will have the greatest impact on the child's learning.

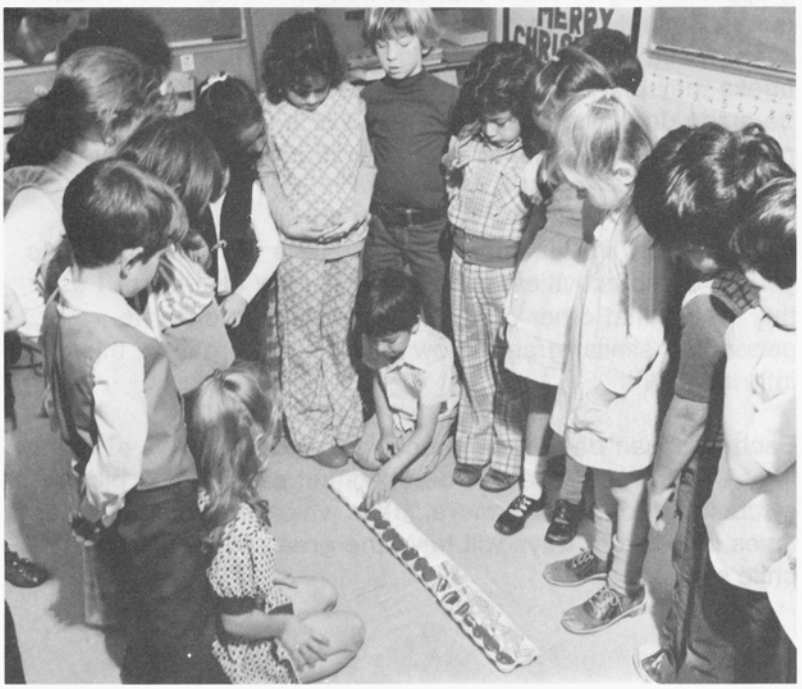
Real Graphs Comparing Two Groups

"Are you wearing a scary or a friendly mask on Halloween?"



"Do you want to use white or wheat bread for your cinnamon toast?"

"Are you wearing boots or shoes?"



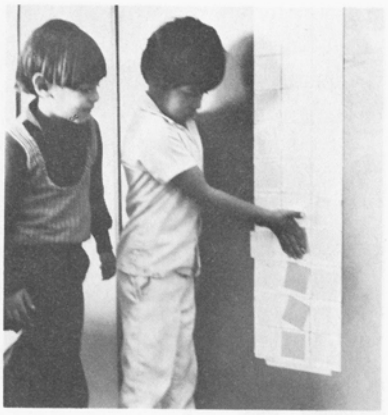
"Do you choose a chocolate or vanilla cookie for a treat?"

"Which paste jars need filling?"

"Are the soles of your shoes smooth or bumpy?"

Real Graphs Comparing Three Groups

"Which type fingerprint pattern does your index finger have?"



"Which of these three colors do you prefer?"

"Would you rather have grape juice, orange juice, or lemonade?"

"Do your shoes have laces, buckles, or are they plain?"

"Did you bring an apple, an orange or a banana?"

"Did you write your name with a pen, a pencil, or a crayon?"

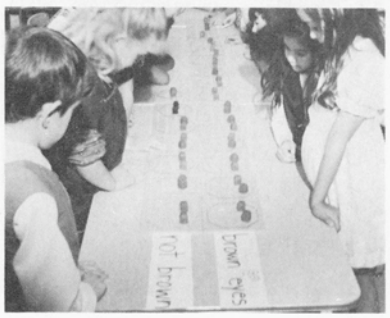
Picture Graphs Comparing Two Groups

"Are you right or left handed?"

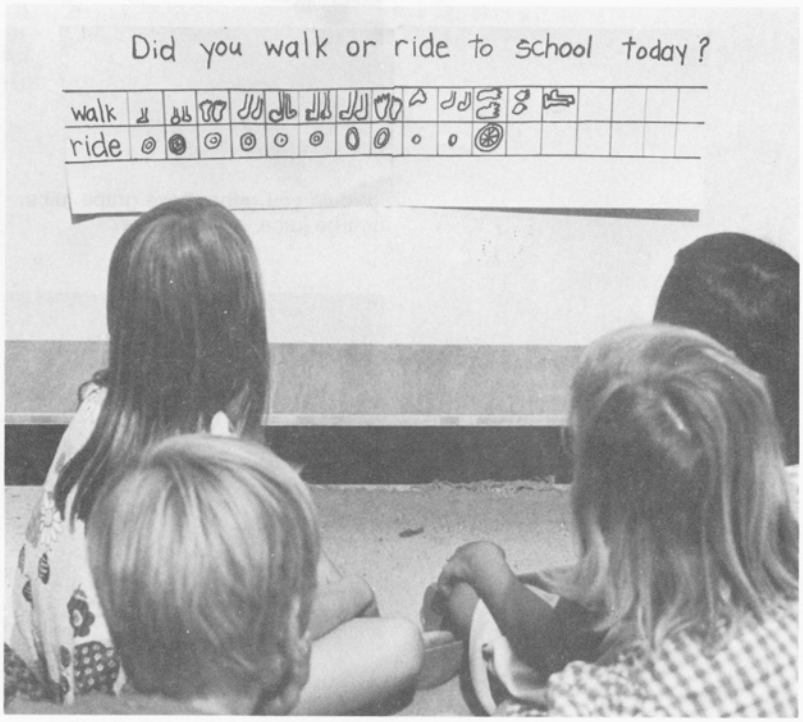
"Are you a boy or a girl?"

"Did you eat breakfast this morning?"

"Are you wearing blue?"

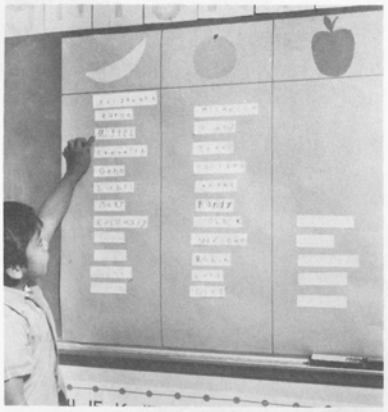


"Are your eyes brown?"

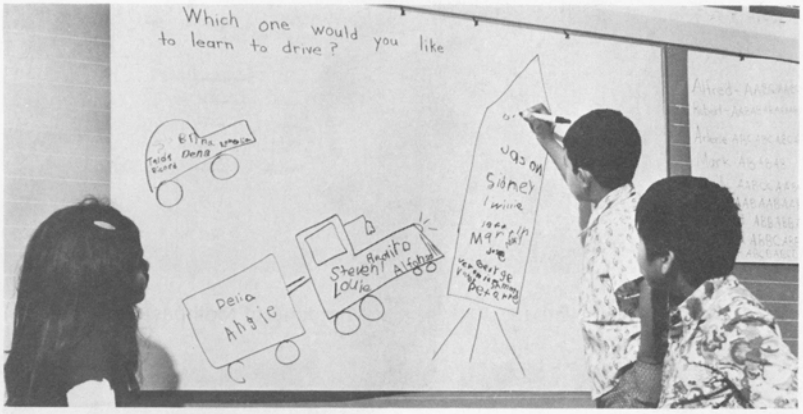


"Do you walk or ride to school?"

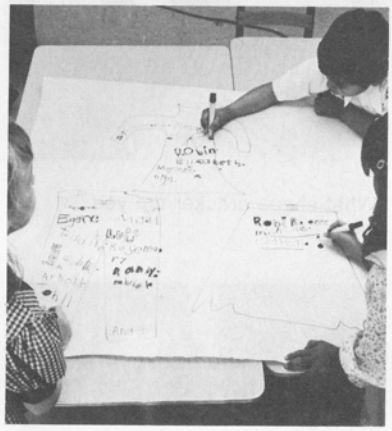
Picture Graphs Comparing Three Groups



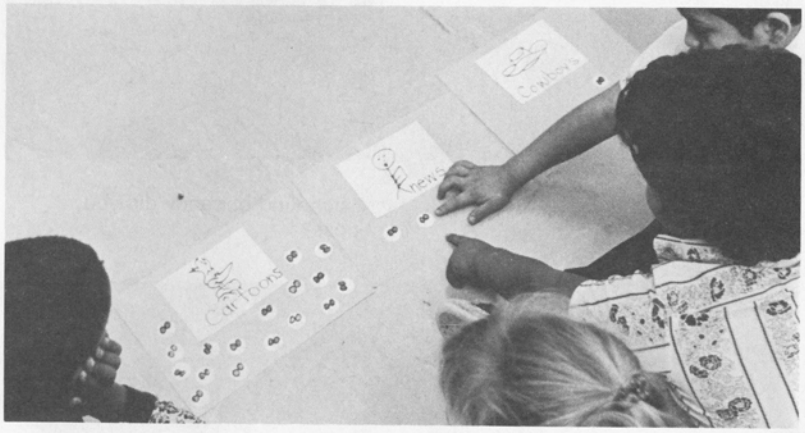
"Did you bring a banana, an orange, or an apple?"



"Which one would you like to learn to drive?"



"Are you wearing pants, a skirt, or a dress?"



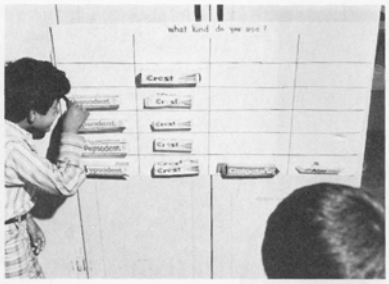
"What do you like to watch on TV?"

Do you like chocolate, strawberry, or vanilla ice cream better?"

"Do you go home for lunch, bring your lunch, or buy your lunch?"

Real Graphs Comparing Four Groups

"What color are your shoes?"



"What kind of toothpaste do you use?"

"What shape cracker did you choose?"

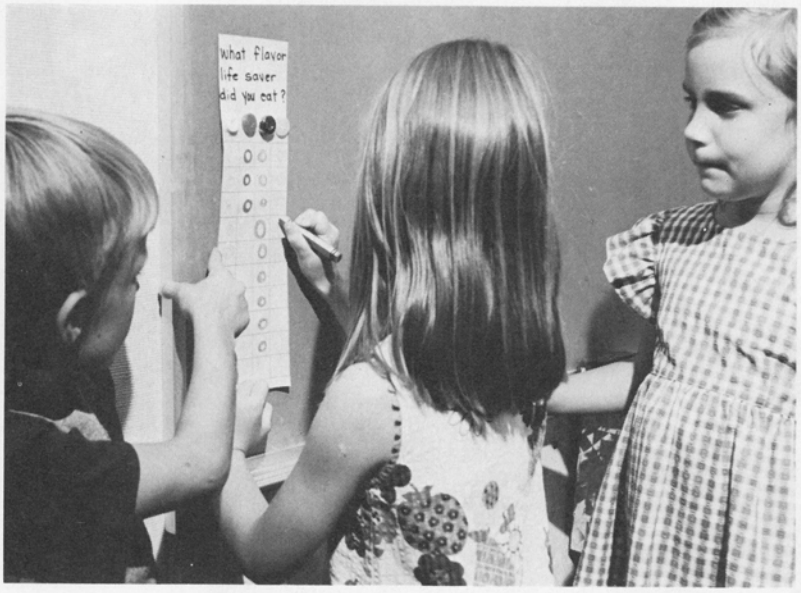
"Did you choose a black, red, green, or blue crayon?"

"Which kind of candy did you choose?"

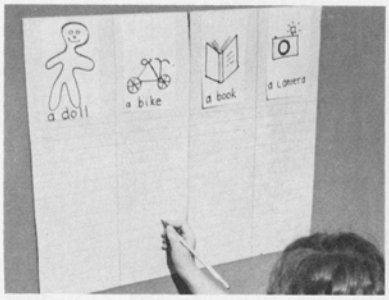
"Which kind of snack would you like?"

Picture Graphs Comparing Four Groups

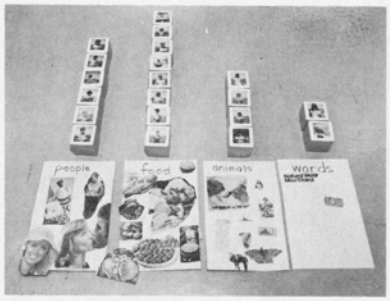
"Would you prefer a peanut butter sandwich, a hot dog, a hamburger or spaghetti for lunch?"



"What color Lifesaver did you eat?"

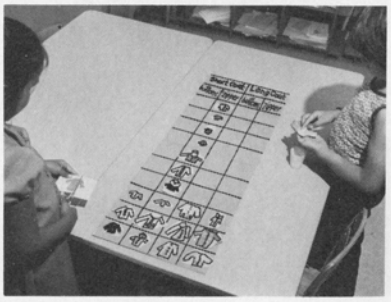


"What would you like best for a birthday present?"



"Which type of picture did you cut out?"

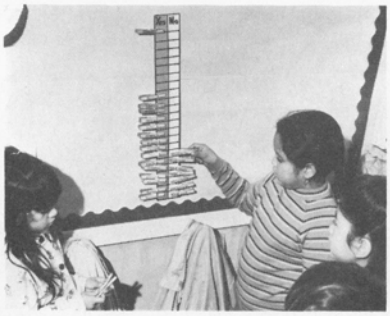
"Which game shall we play during PE?"



"What kind of coat do you have?"

Symbolic Graphs Comparing Two Groups

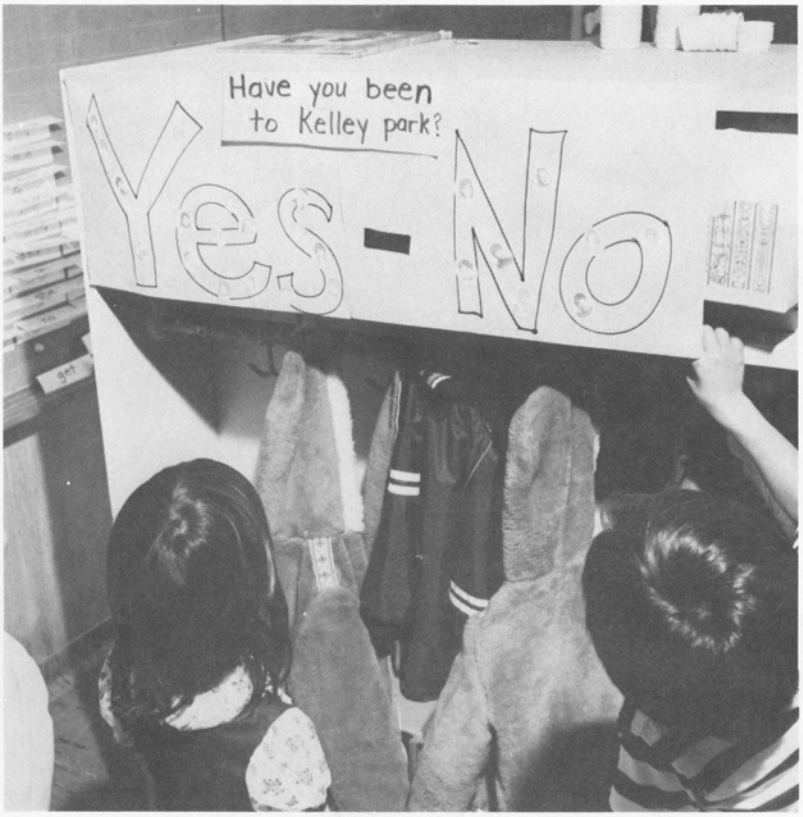
"Do you have a pet at home?"



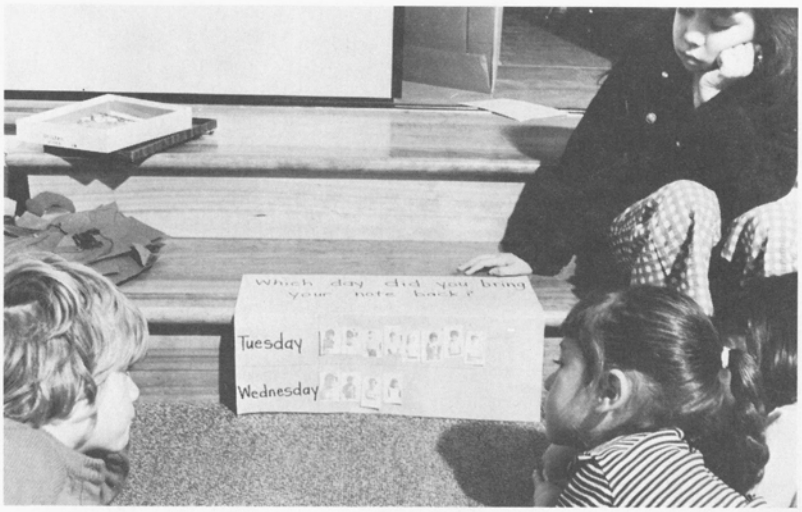
"Do you like spinach?"

"Are there more one-door or more two-door cars in the parking lot?"

"Are you saving money at home?"



"Have you been to Kelley Park?" (Glue your photocopied picture down.)



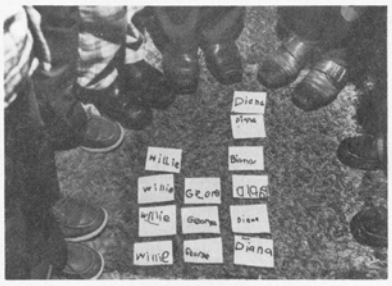
"When did you bring your note back to school?"

Symbolic Graphs Comparing Three Groups

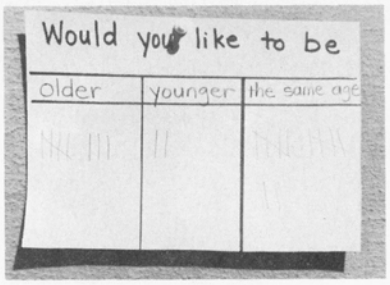
"What kind of juice bar did you choose at lunch?"

Are there more regular cars, more station wagons, or more trucks in the parking lot?"

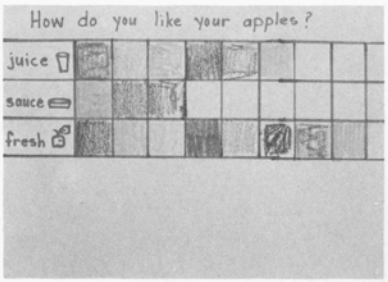
"Which book would you like to hear after lunch?"



"Who do you want to be kickball captain?"



"Would you like to be older, younger, or the same age?"

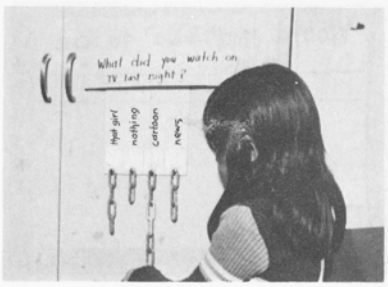


"What kind of apple do you like best?"

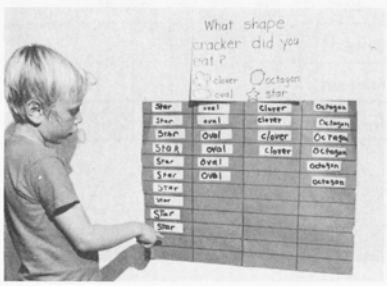
Symbolic Graphs Comparing Four Groups

"Which kind of these sandwiches do you like best?"

"What direction do you walk to go home?"

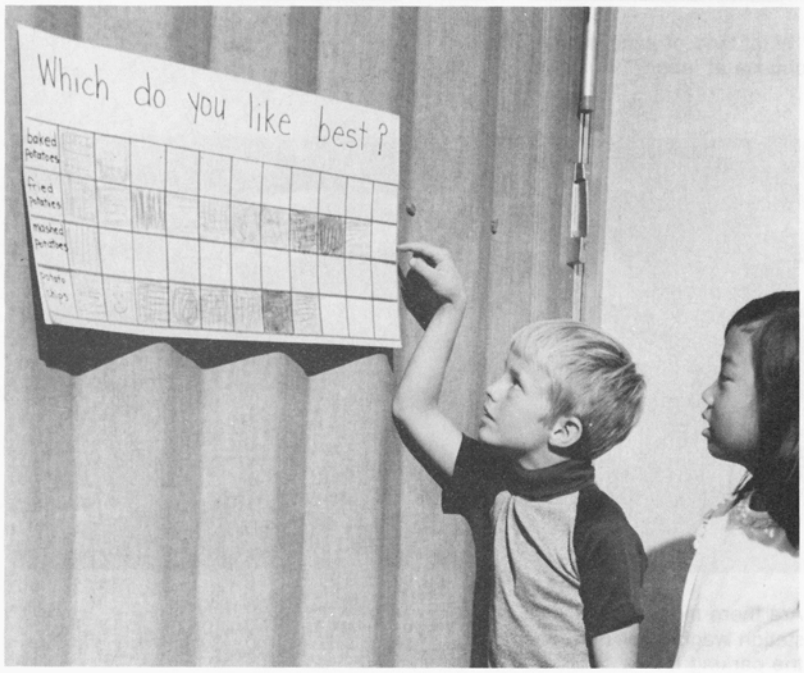


"What did you watch on TV last night?"



"What shape cracker did you eat?"

"How far did you throw the beanbag?"



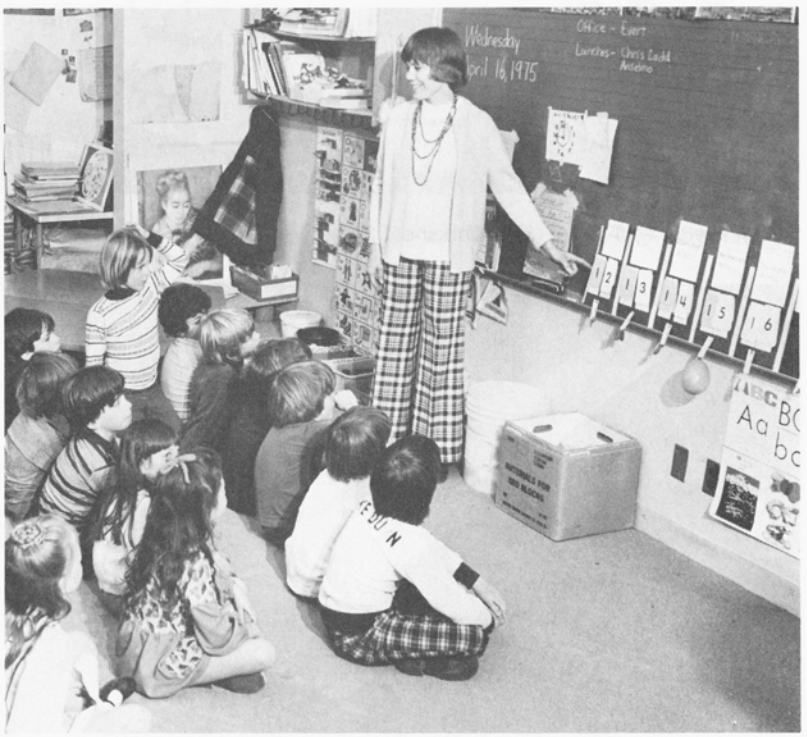
"Do you like fried potatoes, mashed potatoes, baked potatoes, or potato chips best?"

Other Graphs

The following graphs differ from the preceding ones in that they develop slowly over the entire year rather than in one ten or fifteen minute session. The goal of these activities is not the analysis and interpretation of information but rather to give the children an opportunity to *observe* data accumulate over a long period of time. These activities can be introduced early in the year, long before the children acquire the necessary skills to interpret the graphs fully, if the focus is kept on observing the emerging visual patterns.

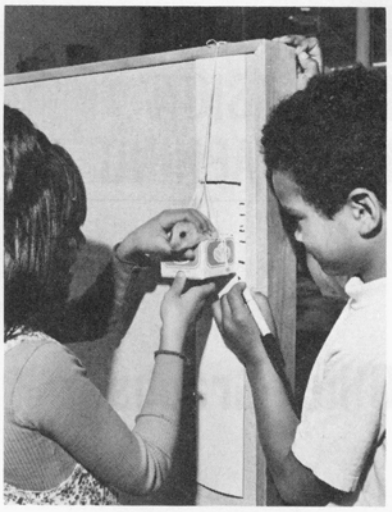
The real benefit of these activities is the child's exposure to the concepts of time and duration in a natural way. This idea is an abstract one which develops slowly as children recall events that they remember happening in the past.

"How much has our sweet potato grown since Friday?" (Place the string from each week's measurement side by side for comparison.)

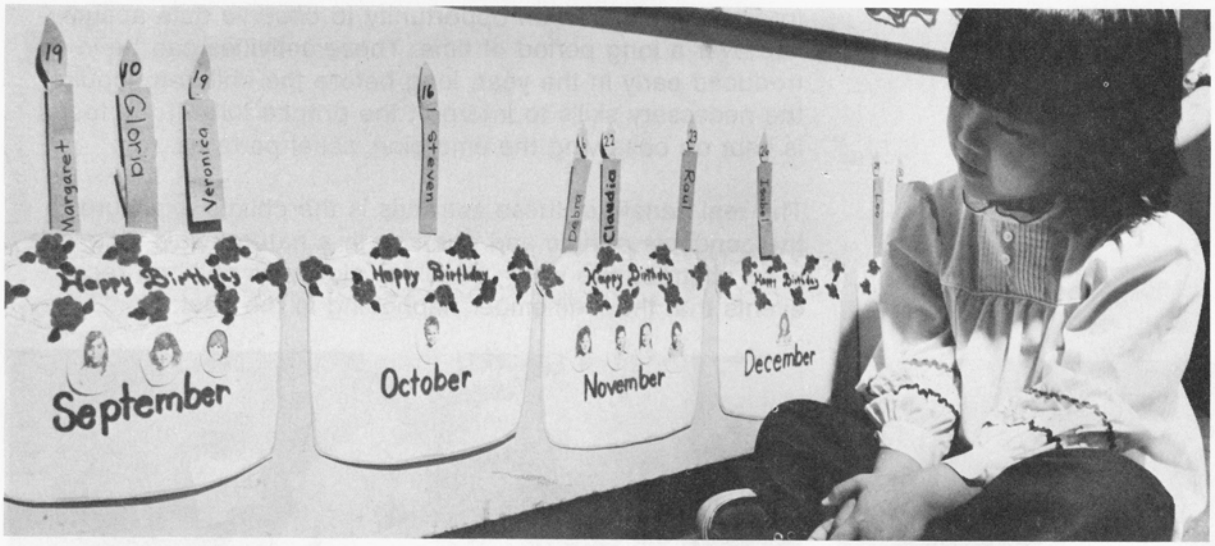


"What day is today?" (Each morning, pop yesterday's balloon, add the date, and blow up a new balloon.)

"Who lost a tooth?" (See Worksheet 26.)

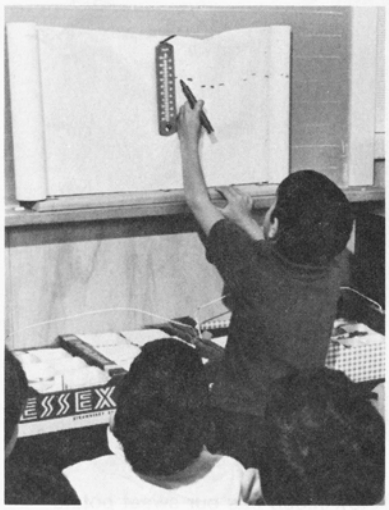


"How much does Howard weigh each month?"

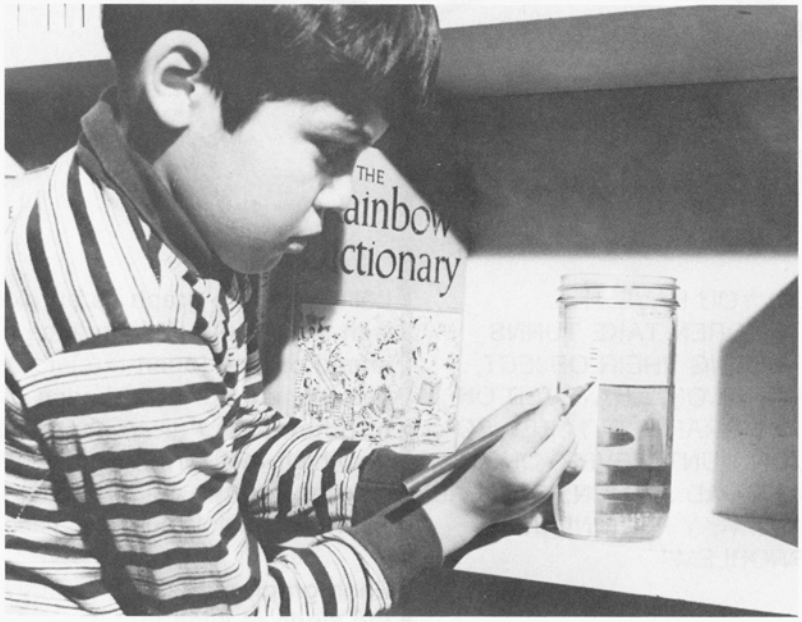


"When is your birthday?" (See Worksheet 25.)

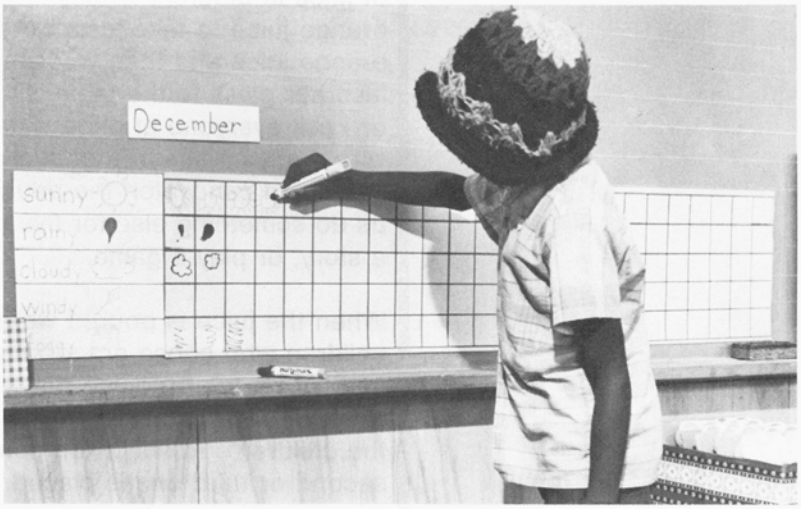
"How many school days have there been since September?" (Add one number each day to an adding machine tape.)



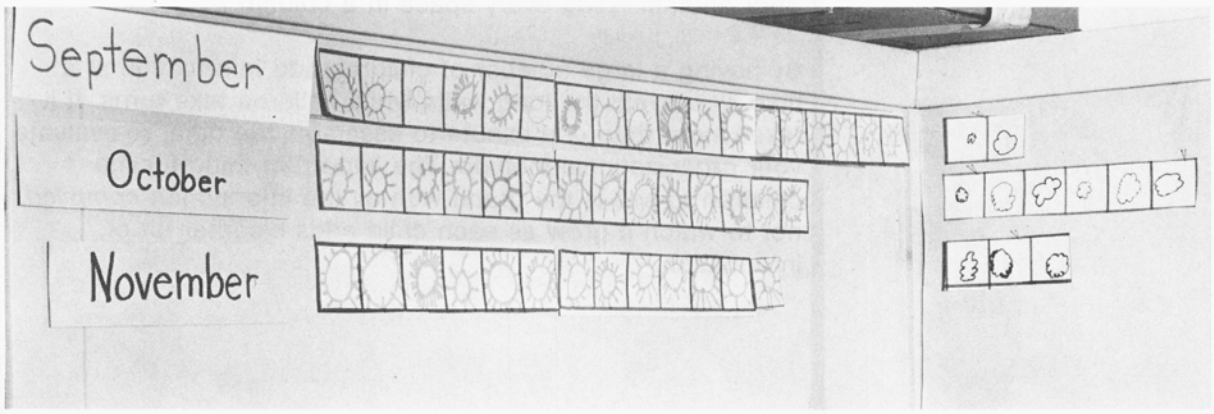
"What's today's temperature?" (Mark the height of the mercury.)



"How much water is left each Friday?" (Mark the water level.)



"What's the weather like today?"



"What has the weather been like all year?"

QUESTIONS FROM TEACHERS

DO YOU HAVE THE CHILDREN TAKE TURNS PLACING THEIR OBJECT, PAPER OR WHATEVER ON THE GRAPH? IT TAKES SO LONG UNTIL EVERYONE HAS HAD A TURN. IS THERE ANY WAY AROUND THIS PROBLEM?

Let's take one graph as an example. I use the same strategy with any graph: For the juice graph, I get everything ready ahead of time (open the jars or cans of juice, set out the glasses, etc.). If I want each child to be able to identify hisorher glass I give each child a little piece of masking tape on which they write their names. Then I pass out the plastic glasses and the children peel their names off the table or floor and stick it on their glass.

Each graph starts with a motivating discussion. We talk about the kinds of juice that are available for selection and talk about the source of each. We ask for six volunteers (two per kind of juice) to pour juice and situate the three cans or jars of juice in different places in the room. I ask whoever wants orange juice to take hisorher glass to the table with the orange juice and then whoever wants grape juice to take hisorher glass to the table with the grape juice, and so on, or I ask everyone at once to take hisorher glass to the table with the juice sheorhe chooses. Those children who are interested can watch the pouring process and the rest of us do something else for five minutes. We go to recess, read a story, or play a game.

When the juice is poured we gather together and I ask *all* the children who chose grape to get their glass and carefully place it on the graphing plastic. This allows the children to observe one column at a time develop completely. It focuses the children's attention on comparing two columns, as the second or third one is placed. It also helps to "fill up all the spaces" of one column. (When I let children add to the graph at random I am more likely to get children placing their contribution *anywhere* on the graphing plastic rather than one after another filling every space in a column.)

By having a large number of children add information at a time, you avoid the long waits while children take turns. If it takes more than *one* minute to assemble the data, re-evaluate your organizational method. The important thing for the children to see is the graph with all the information *compiled,* not to watch it grow as each child adds hisorher bit of information.

WITH THREE-COLUMN GRAPHS MY KIDS SEEM TO BE "ROOTING FOR THE COLUMN WITH THE MOST," PLACING THEIR CHOICES WITH THE HIGHER COLUMN (WHICH MAKES THE WHOLE CLASS CHEER) RATHER THAN MAKING THEIR REAL CHOICE. THIS WASN'T A PROBLEM WITH TWO COLUMN GRAPHS. WHAT'S HAPPENING?

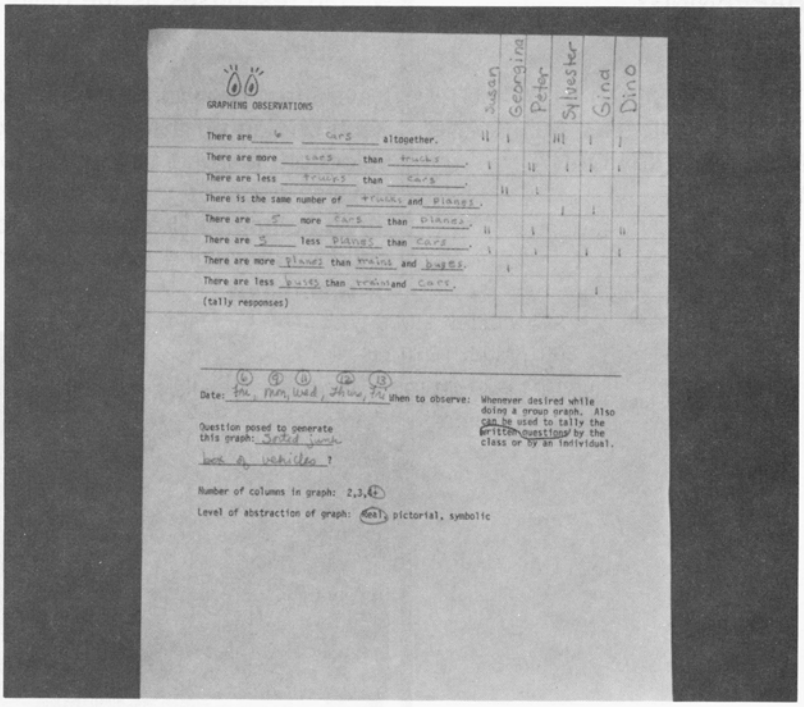
I have observed this same phenomenon. The way to avoid it is to give the children a small piece of paper and have them each *write* their choice. This can be placed in their milk carton or just brought along with them. For example, when doing a graph illustrating which of three TV shows are most popular, before the children add their mark or counter or name to the group of their choice, write the three words naming the three TV shows on the board and without anyone talking to anyone else, have the children write down their choice. *Then* talk about it together and allow the children to predict what they think will be the favorite and the least popular. Assemble the choices by having a child collect the written responses as the children add their cube or whatever.

THAT'S A GOOD IDEA, BUT I TEACH KINDERGARTEN AND MY CHILDREN CAN'T WRITE YET.

Have them draw a picture or you can prepare a picture of each choice on a worksheet from which they can make a selection. It won't be too much of a problem in kindergarten anyway because you probably won't do any graphs above three columns. The problem doesn't really appear until the children are using symbols rather than real things or pictures of real things.

I'VE ASKED THE QUESTIONS FOR THE GRAPHS FOR ABOUT SIX WEEKS NOW AND THE CLASS IS REALLY GOOD AT ANSWERING THEM, BUT I'M NOT SURE EVERYONE IS GETTING A CHANCE TO ANSWER *DIFFERENT* QUESTIONS. I'M SO HAPPY I'M HEARING THE "RIGHT ANSWERS" THAT IT'S HARD TO KNOW IF I'M HEARING THE ANSWERS FROM THE SAME OR FROM DIFFERENT KIDS EACH TIME.

I faced this same dilemma after about six weeks too, so I developed the following observation sheet. I only add to it from memory, *after* the graph is over, not during the graphing activity. Sometimes I ask an older student or a parent or whoever I can find to observe and tally the results for a few sessions. When I can't find anyone to help, I tape record the questioning period and refer to it after school, as I fill in the observation sheet, if I can't remember who answered what. In time a clear picture evolves of who is answering which level question, and I can focus my attention on those children who need encouragement to try a greater variety of levels of questions.


GRAPHING OBSERVATIONS

Susan, Georgina, Peter, Sylvester, Sinda, Dino

There are 4 cars altogether.
There are more cars than trucks.
There are less trucks than cars.
There is the same number of trucks and planes.
There are 5 more cars than planes.
There are 5 less planes than cars.
There are more planes than trains and buses.
There are less buses than trains and cars.
(tally responses)

Date: (M) (T) (W) (Th) (F) When to observe: Whenever desired while doing a group graph. Also can be used to tally the written questions by the class or by an individual.

Question posed to generate this graph: Sorted yards by color & vehicles?

Number of columns in graph: 2,3,4

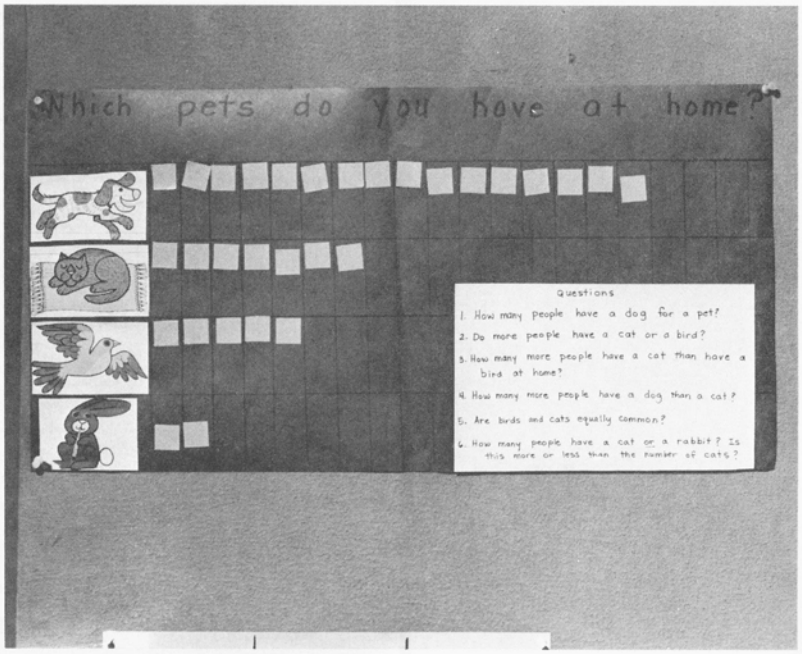
Level of abstraction of graph: real, pictorial, symbolic

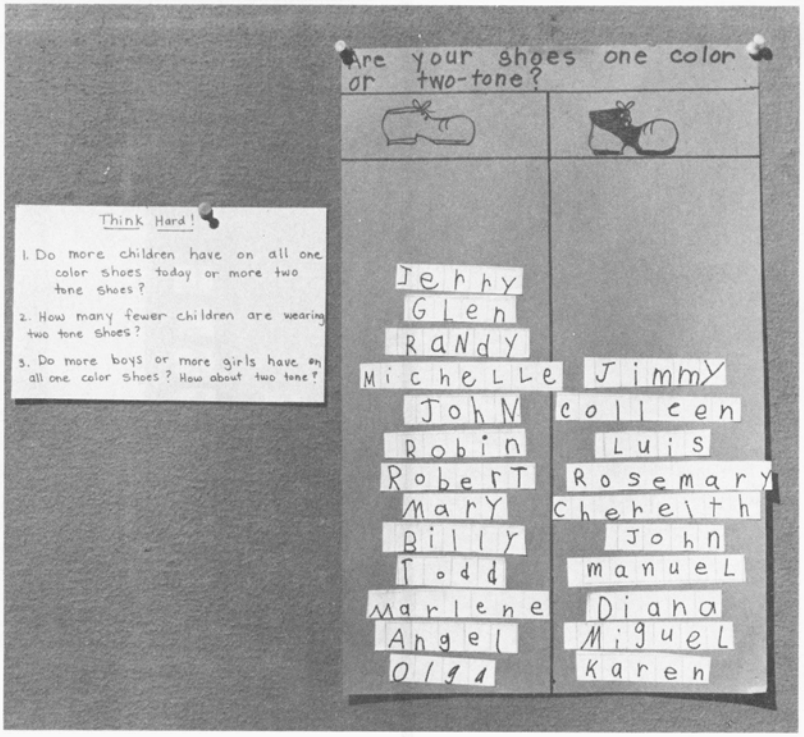
IT TOOK ME AWHILE TO GET GOOD AT ASKING THE QUESTIONS, BUT NOW IT'S EASY AND I WONDER, ISN'T THERE SOMETHING ELSE I SHOULD BE DOING? IT DOESN'T SEEM AS CHALLENGING AS IT WAS AT FIRST.

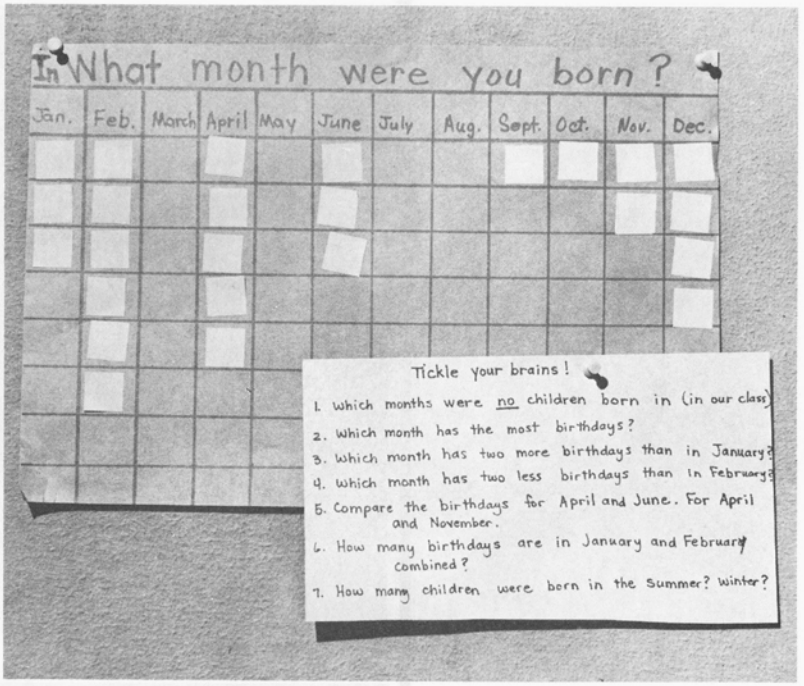
Yes. Now you are ready to merely step back from the graph and say, "Who can tell me what they notice about the graph?" You have modeled the questions; now let the children apply their knowledge. Call on volunteers to make statements such as, "There are five more red leaves than green leaves," and, "There are the same number of red leaves as yellow leaves," and "There are five less yellow leaves than red leaves."

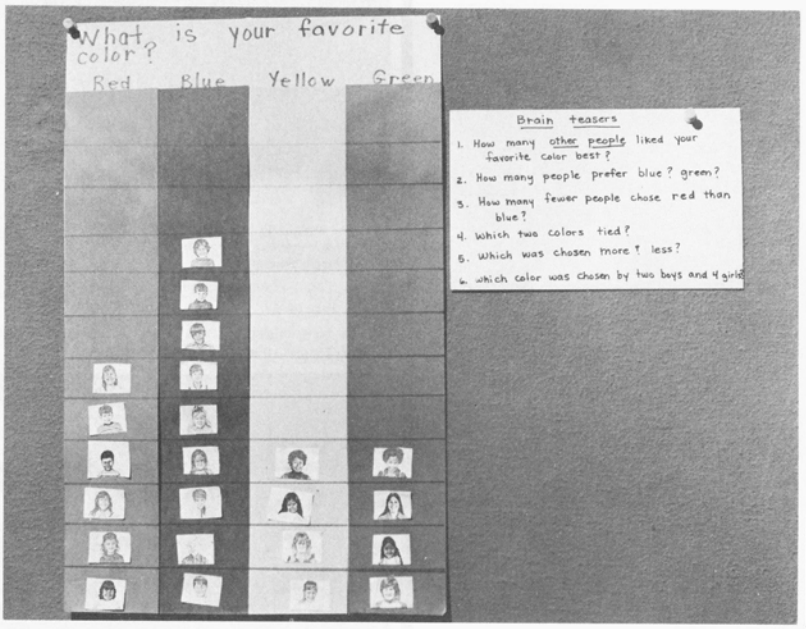
I discuss with my class the different formats for statements and even tally the statements of different types.

When I feel the children are ready for it, I *write* the questions that could have generated the statements. When the children are able, they write their own questions.


Which pets do you have at home?
Questions
1. How many people have a dog for a pet?
2. Do more people have a cat or a bird?
3. How many more people have a cat than have a bird at home?
4. How many more people have a dog than a cat?
5. Are birds and cats equally common?
6. How many people have a cat or a rabbit? Is this more or less than the number of cats?

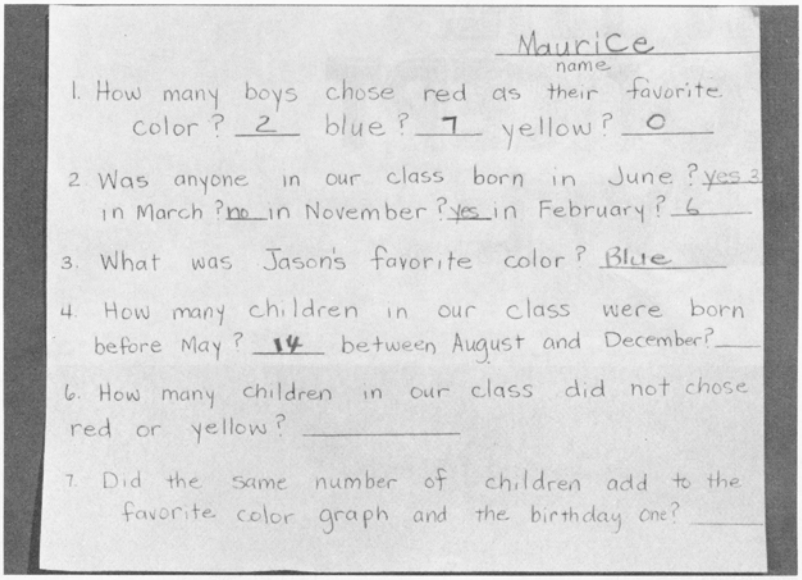

Are your shoes one color or two-tone?
Think Hard!
1. Do more children have on all one color shoes today or more two tone shoes?
2. How many fewer children are wearing two tone shoes?
3. Do more boys or more girls have on all one color shoes? How about two tone?
Jenny
Glen
Randy
Michelle
John
Robin
Robert
Mary
Billy
Todd
Marlene
Angel
Olga
Jimmy
Colleen
Luis
Rosemary
Chereith
John
manuel
Diana
Miguel
Karen





By writing questions rather than statements, it keeps the graph interesting to other children or adults who come into the room, for they see where they could fit on the graph. It also keeps the graph open-ended rather than closed because it forces the viewer to interact with the graph and answer the questions.

If you collect five or six graphs with written questions they can be used as learning stations, and children ready for the challenge can go from graph to graph, read the questions, and write down the answers.



Maurice
name

1. How many boys chose red as their favorite color? 2 blue? 7 yellow? 0
2. Was anyone in our class born in June? yes 3 in March? no in November? yes in February? 6
3. What was Jason's favorite color? Blue
4. How many children in our class were born before May? 14 between August and December? ___
6. How many children in our class did not chose red or yellow? ___
7. Did the same number of children add to the favorite color graph and the birthday one? ___

WHAT'S THE MATERIAL USED IN MANY OF THE GRAPHS THAT'S RULED OFF INTO SQUARES, SUCH AS IN THE HALLOWEEN MASK GRAPH?

That is the Graphing Plastic.* (see the Glossary of Materials, page 361, for how to make it). It provides a squared background for placing objects which guarantees accurate comparisons between the different columns. Both sides are lined off with masking tape (three larger columns on one side and five smaller ones on the other side).

WHAT ARE THE LITTLE BOXES MADE OF THAT THE FRUIT GRAPH (p. 147) AND CANDY GRAPH (p. 150) USE?

These are made from ½ gallon milk cartons which the children bring from home. (See the Glossary of Materials, p. 362, for directions in making the Milk Carton Graphing Boxes.) The square ones can be stacked up and clothespinned together in the back or laid flat. The child's "vote" can be placed on the shelf before it is brought to be added to the graph.

IT TAKES A LONG TIME TO PASS OUT EACH CHILD'S MILK CARTON GRAPHING BOX BEFORE WE DO A GRAPH. THE CHILDREN GET TIRED OF WAITING. BUT IF I LET EACH CHILD KEEP IT IN HISORHER DESK, THEY GET WRECKED. ANY SUGGESTIONS?

Here's what a friend of mine, Kathy Richardson, does in her class. Kathy keeps all the children's milk cartons together in a box. When it is time to use them, she dumps the whole box onto the rug and tells the children each to get a carton (taking the first one they touch) and deliver it to the owner. It takes less than a minute and each child is actively involved. It is fascinating to see how pleased the children in Kathy's class are when their box is delivered by a classmate. It is important for children to know who their classmates are and it is vital for children to experience that other children know them.