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ABSTRACT

The Minnesota School Mathematics and Science Teaching (MINNEMAST) Project is characterized by its emphasis on the coordination of mathematics and science in the elementary school curriculum. Units are planned to provide children with activities in which they learn various concepts from both subject areas. Each subject is used to support and reinforce the other where appropriate, with common techniques and concepts being sought and exploited. Content is presented in story fashion. The stories serve to introduce concepts and lead to activities. Imbedded in the pictures that accompany the stories are examples of the concepts presented. Several of the activities outlines in this unit on measurement closely resemble some of the experiments conducted by Piaget in his original research. The concepts presented include the principle that liquid volume is unchanged by the size or shape of its container and that a solid mass has the same displacement, regardless of its shape or form. The treatment of measurement is approached in comparative rather than absolute terms. The questions of "how much" and "how many" have been deferred until later and the usage of the terms "more than" and "less than" are presented. Worksheets and commentaries to the teacher are provided and additional activities are suggested. (JP)

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MINNE

Math And Science Teaching project

UNIT III
MEASUREMENT

MINNESOTA SCHOOL MATHEMATICS AND SCIENCE CENTER 1965

MATHEMATICS

FOR THE

ELEMENTARY SCHOOL

UNIT III

Measurement

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MINNESOTA MATHEMATICS AND SCIENCE TEACHING PROJECT

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Introduction

Man has been measuring things since time began. Perhaps earliest measures were made by using parts of the human body. That meant that a convenient measuring device was always at hand. The thickness of a man's thumb was about an inch; a fathom was the distance between fingertips when the arms were outstretched. Horses are still measured by "hands". Grandmother measured a yard by extending material from her outstretched hand to her nose.

The infinite variations in human anatomy have forced man to seek more precise measures. Our present measuring system is based on standard measures to be found at the U.S. Bureau of Weights and Standards at Washington, D.C.

The United States, Great Britain and Canada have, in the main, retained the use of the yard, foot and inch as a measure of distance. Scientists the world over, however, use the metric system, which has the distinct advantage of being a decimal system.

We measure all sorts of things. Distance, time, weight, value and volume are some of the things commonly measured. Perhaps the most important thing that children can be helped to understand is that our measures are, at best, inaccurate.

How tall are you? Is it 5 feet 6 inches, 5 feet $5\frac{7}{8}$ inches, or somewhere in between? Measurement is an approximation - correct only within certain limitations. We carry stopwatches for races that measure to the hundredth of a second. They are necessary in determining the winner in close races. Yet the distances to stars may be correct only to one hundred light years.

It is our ability to tool machines to thousandths of an inch that has enabled the factory production of changeable parts and made mass production of machines possible. Our technological age has been the result.

The introduction of measurement at this time, as presented here, was influenced by research on intellectual development by the Swiss psychologist, Jean Piaget. The emphasis here (begun in Unit II) is the children's discovery of the principle of conservation.

Simply defined, conservation refers to those properties which do not change in the midst of change. This concept applies to a wide range of areas - set, number, volume, length, etc.

The child's discovery of conservation - what Flavell* refers to as a common denominator across areas, enables the child to discover the constant properties of objects, thus making the classification of these objects much easier. This principle is a vital girder linking science and mathematics.

Several of the activities outlined in this unit closely resemble some of the experiments conducted by Piaget in his original research. The concepts presented include the principle that liquid volume is unchanged by the size or shape of its container and that a solid mass has the same displacement, regardless of its shape or form.

The treatment of measurement here, as in previous units, is approached in comparative rather than absolute terms. The questions of "How much" and "How many" have been deferred until later and the usage of the terms "more than" and "less than" continued.

*Flavell, J.H. The Developmental Psychology of Jean Piaget, D. Van Nostrand, 1963.

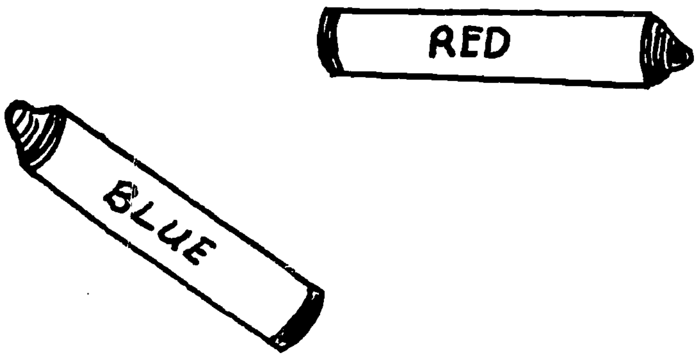
Suggested Activities on Linear Measurement

1. Read the following story to introduce linear measurement.

The Children's Problem

Judy and Jimmy are twins. Mother gave each of them a crayon, so that they could draw a picture. Soon they were quarreling. Judy said, "It's not fair! Jimmy's crayon is longer than mine!" She threw her crayon down.

Jimmy cried, "No, it isn't! Yours is longer than mine!" He threw his down, too. Their crayons looked like this:



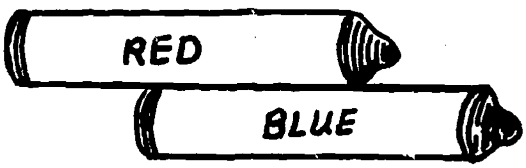
Display models on flannelboard or blackboard

Mother didn't like the way the twins were behaving. No, indeed, she did not! "Stop it at once!" she told them. "This is no way for children to act. Stop and think a minute - how can we tell which crayon is longer?"

Have the children make suggestions

Judy and Jimmy tried putting them next to each other. At first they did it like this:

Demonstrate on flannelboard or blackboard

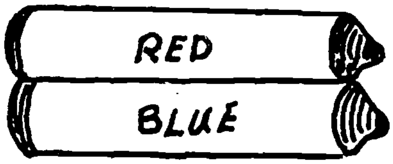


Judy said, "See! Yours sticks out past mine. Yours is longer. It is longer than mine!"

Jimmy replied, "Yes, but yours sticks out past mine at the other end. Doesn't that make yours longer than mine?"

Ask: Can you help the twins compare their crayons? How should they do it?

Have the children demonstrate with the flannelboard cut-outs or with two crayons until the following arrangement is suggested as the answer.



This is just what the twins did. Then Judy said, "Now they are the same length!"

"Do you think that moving them changed their length?" Mother asked.

Judy answered, "No, they must have been the same length before."

Mother continued, "Now then, when you wish to compare the length of two objects, what must you remember to do?"

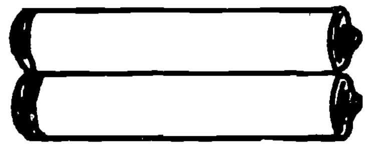
Pause to allow children to discuss this. Expected response:

Put them side by side, with the end of one object even with the end of the other.

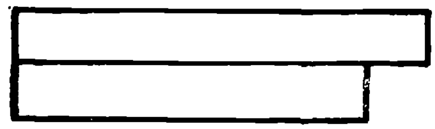
This was the way Judy and Jimmy learned to measure (compare) the length of two objects.

Other strategies to be explored:

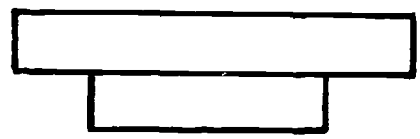
If two crayons or other objects are the same length then they can be put next to each other sc that there is no overlapping at either end.



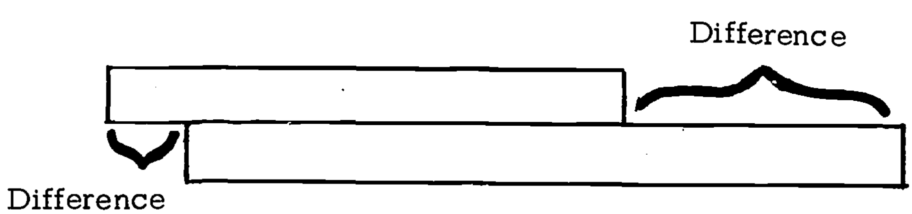
If the two objects are of differing lengths, they may be arranged so that the longer one will extend beyond the shorter one at one end.



They may also be placed next to each other so that the longer one extends beyond the shorter one at <u>both</u> ends.

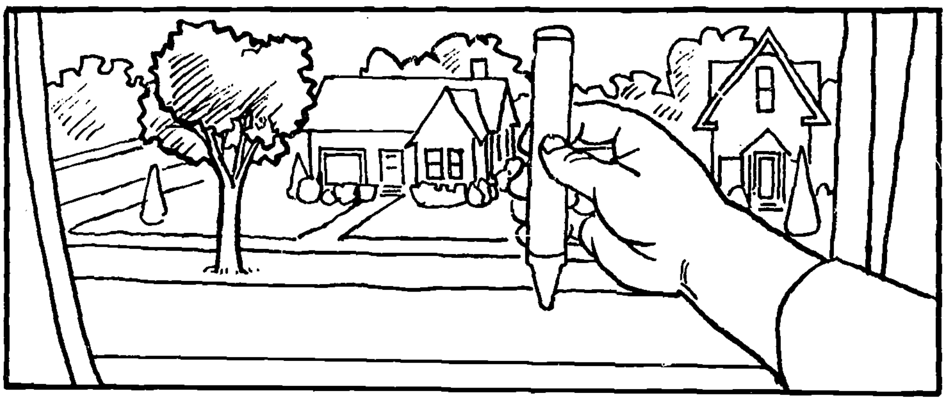


If the two objects are arranged so that one protrudes at one end and the second object extends past the first at the other end, we then observe the differences. The longer object will be the one that protrudes the farthest. This strategy is effective only if the lengths differ appreciably. If they are nearly the same, comparing them by sight is not sufficient.



2. Experiments in Perspective

Read:
One morning when Jimmy was drawing with his crayon, he happened to look out of the window. He looked at the tree across the street. He looked at the crayon he was holding in his hand. Then he looked back at the tree. Suddenly he had an idea. He held his crayon straight up, so it was in line with the tree. "Look," he cried, "my crayon is longer than the tree across the street!"



"Was it really longer or did it just look that way?"

3. Have the children go to the window and compare their crayon with a tree or building as Jimmy did.

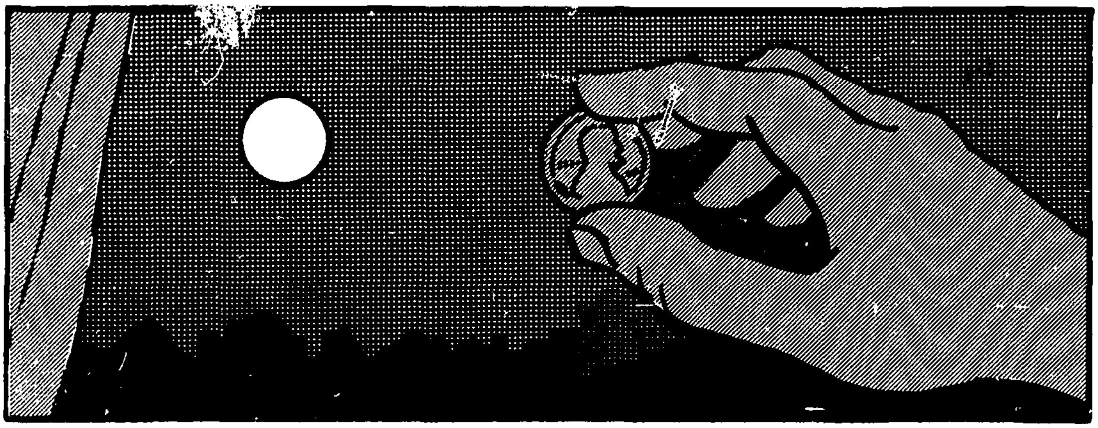
4. Have them discuss what happens when they do this. Discuss whether this is really so, or if it just look that way. Bring out the point that the comparisons made this way are not accurate because:

a) the objects were not actually placed side by side and
b) objects farther away always appear to be smaller

5. For reinforcement, have children (or a child) go outside and hold a crayon side-by-side with the object first viewed from inside.

6. Pose problems such as "When does a penny seem larger than a clock (or moon)". Have them hold a penny up toward the wall and close one eye. Have them compare what happens or what they see when they are looking at the clock from the back of the room and when they approach it close up. Discuss why the penny seems larger from a distance and why it seems smaller when compared at a short distance.

7. Suggest that for homework they can, if they like, repeat the penny-clock experiment some night using the moon instead.



8. Play the game "Giant or Dwarf"

Select two children to demonstrate the game, before the class participates. Give each child a sheet of paper and have him cut it into six strips of varying lengths. (It may be more expedient to present each child with a set of six strips of paper, of varying length.)

At a signal, each child secretly chooses one of his strips and then matches it with one of his opponent's strips. The child with the longer strip wins both strips of paper and places them in a separate pile. The game continues through the six matchings, with the child with the most strips of paper in his possession declared the winner.

After the demonstration game, the entire class should have an opportunity to play the game in groups of two.

The story "The Soda Pop Party That Lost Its Fizz" and the activities which follow illustrate conservation of liquid volume. The teacher is urged to tell and act out the story, rather than merely read it. Individual copies of the story are provided for an addition to the children's home mathematics library.

the Soda Pop Party that lost its fizz

THE SODA POP PARTY THAT LOST ITS FIZZ

It is a lovely fall afternoon. The sun is shining, the breeze is playing with the leaves, the birds are chirping, and the kitten is curled up in the warm grass. Everything is so peaceful and pleasant. Then loud voices are heard! "Julia has more soda pop than I have."

"Bert has even more than Julia, and I have less than anybody. It isn't fair! I want more!"

"So do I!"

"So do I!"

"What's going on?" asks Mrs. Wright as she comes hurrying out of the house to see what the fuss is about.

"You know those bottles of soda pop you gave us for our tea party? I poured them into the glasses you told us we could use, and now some children say that they have less soda pop than others. I don't quite understand it myself," says Kathy as she looks at the children's glasses on the table.

Bert has a tall, narrow glass that has soda pop in it almost to the top. Julia also has a tall glass, but it is not quite as narrow as Bert's; her drink does not go quite up to the top. David has a tall, wide glass, and the soda pop in his glass seems lower still.

"Julia has more pop than I have. It isn't fair!"

"It doesn't seem fair that some should have more than others."

"Yes," says Mrs. Wright. "It is important to share and to be fair, so let's give this some thought. You each started out with one bottle of soda pop didn't you? Were all the bottles the same size?"

"Yes," the children agreed.

"Then you all had the same amount to start with. What happened next?"

"I emptied each bottle into a glass," said Kathy, "just as you told me to."

"All right," says Mrs. Wright. "Let's experiment. Kathy, would you carefully pour your glass of soda pop back into this bottle? (Pause) Now! Do you have as much as you had before?"

"Yes," says Kathy. "The soda pop bottle is full!"

"Good! Now pour it back into your glass. (Pause) Bert, you pour your soda pop back into the same bottle Kathy used."

"All of your soda pop is in this bottle now. I didn't take any away and I didn't put more in. Do you have the same amount as you had before?"

"Yes," says Bert.

"Does your soda pop fill the bottle as full as Kathy's did?" Mrs. Wright asked.

"It comes to exactly the same place," answers Bert.

"Is it my turn next?" asks David, who loves to experiment, too.

"Is it my turn next?" asks David, who loves to experiment, too.

Note: At this point stop reading and say, "You like to experiment, too, don't you? Well, let's try to solve this problem ourselves."

Then have the children re-enact the story, experimenting as Kathy and Bert did. Lead them to discover that the amount does not change even though the shapes of the glasses make it appear to have changed.

When ready, return to the story.

Mrs. Wright and the children are still experimenting at the soda pop party. Mrs. Wright really wants to help the children understand that they all really have the same amount.

"David, run inside and bring out a carton of paper cups." Mrs. Wright places one paper cup beside each child's glass. "Now, please empty the pop from your glass into the paper cup." The girls and boys don't quite know what to expect, but they do what Mrs. Wright asks them to do.

Mrs. Wright and the children are still experimenting at the soda pop party.

THE SODA POP PARTY THAT LOST ITS FIZZ

"I have a whole cupful!" exclaims Mary, happily.

"I have a whole cupful!" exclaims David.

"So have I. I have a whole cupful!"

"So have I!"

"Do you know what? We all have one whole cupful! We all have exactly the same amount," says David, who has noticed that every child's cup is filled to the top. "We each have the same amount. Don't you see that?"

"Yes, I see we each have the same amount of soda pop," says Bert, not nearly so happy as the others because he thought he really had more than anyone else.

"I have one full cup," says David, "the same as the others! Why didn't I think of it before! The drink only looks more or looks less when it is in glasses or cups of different shapes. But......wait, let me figure this out! How could this be?" thinks David.

Then Bert exclaims, "I know! Each boy and girl had one whole bottle of soda pop."

"Now we all have one whole cupful!" cries David.

"Yes," agrees David. "We all started with the same amount, and now, no matter what shape glass or cup we put it in, we must still have the same amount. Is that right, Mother?"

"Yes, that's right," smiles Mrs. Wright.

"Can we have another experiment please?" asks Bert.

"Kathy," says Mrs. Wright, "run into the house and bring me two smaller paper cups." When she has the cups, Mrs. Wright pours Bill's soda pop into the two smaller cups.

"Bill, how much soda pop do you have now?"

"Two small cups -- both full."

"Do you still have the same amount you had just before?"

"Well, I'm not sure....."

Then Mrs. Wright pours the drink from the two smaller paper cups into Bill's large paper cup and asks, "How much soda pop do you have now?"

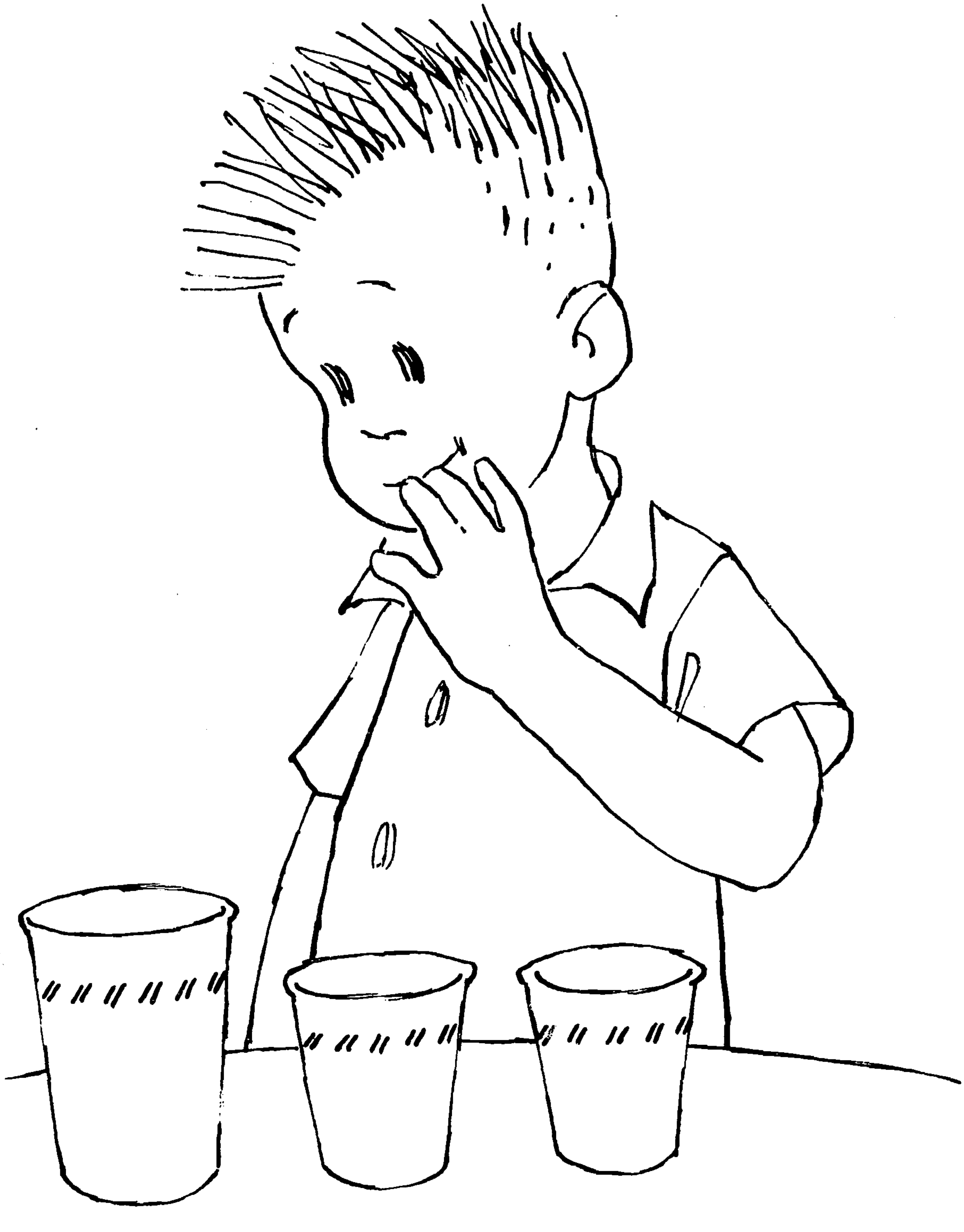
"One large cupful."

"Do you have more or less than you had when it was in your glass or in the two small cups?"

"I still have the same amount."

"Are you sure?"

"Yes."



Does Bill still have the same amount he had in his one large cup?

THE SODA POP PARTY THAT LOST ITS FIZZ

Then, would you believe it, Mrs. Wright pours the soda pop into the bottle again! Can you guess how high up the drink came in the soda pop bottle? (Pause) It came right up to the top again.

"Do you mean," asks Bert, "that if we take a certain amount of soda pop and pour it into a bottle, or a cup, or a glass, we have the same amount that we had at the beginning?"

"Yes, Bert. You are quite right. It just looks like more or less because of the shape of the container."

The children still look just a little puzzled. Kathy tastes her drink. "Oh, Mother," she cries, "I may have the same amount of soda pop as the other children, but now it's warm and all of the fizz has gone out of it!"

THE SODA POP PARTY THAT LOST ITS FIZZ

"Oh, Mother, all the fizz has gone out of the soda pop!"

THE SODA POP PARTY THAT LOST ITS FIZZ

Mother smiles, "I can't put more fizz in your soda pop, but I do know where there is something cold for you. Can you guess what it is?"

"I'll bet I know," says Bert, smacking his lips.

Soon Mother and the children are happily eating strawberry ice cream cones."

"Even if the pop did lose its fizz," says David, "this turned out to be a pretty good party after all!"

"This turned out to be a pretty good party after all!"

Suggested Activities on Liquid Measure

The following have been designed as problem-solving situations to promote discovery of the fact that the quantity of a liquid remains the same, regardless of the shape or size of the container in which it is placed.

1. Suggest the following experiment. Collect several different sizes of glasses or tumblers. Unbreakable ones are best and the children may be asked to bring some from home.

   Before starting class participation, arrange about four of the glasses (assorted sizes) in a row and fill each with one cup of colored water, to resemble soda pop. Keep the one-cup measure available for repeating the experiment.

   Ask the children which of the four glasses they would choose, in order to get the one with the most pop. Let them explain their choices.

   After the choices have been made, transfer the contents of each glass into the one cup measure, noting the level it reaches by marking the liquid level with a rubber band or felt pen marker. Do this with each of the four demonstration glasses. Let the children discover for themselves that each glass has the same amount of "soda pop" in it. Encourage them to give reasons why there seemed to be more pop in some of the glasses, less in others. Give as many children as possible the opportunity to participate in this experiment.

2. For this experiment you will need two jars, differing in both height and width and two glasses (identical size) full of water. Pour one glass of water into one of the jars. Note the water level. Ask the children to predict what the water level will be in the second jar after the second glass of water is poured in it. Let the children comment and speculate on the reason why the quantity of water seems less in one jar than in the other.

   Tell the children that you are now going to pour the water back into the original glasses. Ask which one of the two glasses will have the most water in it. Encourage the realization that they will have equal amounts.

The activities which follow have been included to help, by analogy, to further demonstrate the principle of conservation of liquid. This is done by activities which emphasize the conservation of set. The teacher should do whatever she can to make this analogous relationship as obvious as possible.

3. Give each child a set of 10 blocks. Ask the class to construct a building with their blocks. Encourage them to be original and to make a building which is "different from all the rest". After the buildings are constructed, have the children show and discuss their buildings. Stimulate comments regarding the sizes of the building.

   Select any two buildings for discussion. Ask the children which took more blocks to construct. Some of the children may think that there would be more blocks used in constructing the taller building. Ask how they could check their answers. Have them compare other pairs of buildings, matching the blocks to check their answers.

   Now ask them to make another very different kind of building with the same set of blocks. Have them try to make a tall building that looks like it took more blocks or a smaller one that looks like it took less blocks to construct. Discuss the results. Ask what they have discovered through this experiment. Expected answer: In changing the shapes of the buildings they did not use more blocks or less blocks than were originally used.

4. A supply of plastic containers, of varying shapes and sizes is needed. They should be transparent or semi-transparent so that articles placed in them will be at least partially visible. Plastic tumblers, freezer cartons, etc. are excellent.

   The children should be asked to bring a favorite marble from home. It is important in this experiment that each child is able to identify his own marble. (If the number of marbles brought by the children is too unwieldy, the teacher may limit the number used in the experiment.)

Have each of the children participating in the experiment place his marble in the tall, narrow container. Discuss with the children whether these are the same marbles even though they have taken the shape of the container. Repeat the experiment by transferring the marbles to a short, wide container and then to a square plastic container. Before and after placing the marbles in the different containers have each child identify his marble to remind the class that it is the same set of marbles that is being rearranged each time. Also, before transferring the marbles have the children make a prediction. Will the marbles reach a higher or lower level in the new container as compared with the old?

Follow the above activity with the one listed below. The children have already discovered the principle of conservation of set in the case of discrete objects and have some experience with conservation of the quantity of a liquid. The objective of the following activity is to help the child see that it is a similar principle which holds for both sets and liquids.

5. Ask some child to bring a container of soda pop or any other drink for the experiment. This liquid quantity may then be referred to as "Mary's soda pop". The teacher may make use of the differently shaped containers she has previously gathered in the classroom. As before, have the children predict the level which the liquid will reach before pouring it into any of the containers. Ask "Mary" to pour the soda pop into the tall, narrow container; into two short containers; into the wide, low container; into any other size or shapes she has available, and finally back to Mary's container. While doing the experiment discuss with the children their observations. "Was any pop added to Mary's? Any taken away? Was any soda pop replaced by any other child?" Lead up to the final discussion points, "Did Mary get back the same soda pop she had to begin with? How was this experiment like the one we did with the marbles?"

   As much as possible, provide each child with the opportunity to perform these experiments individually.

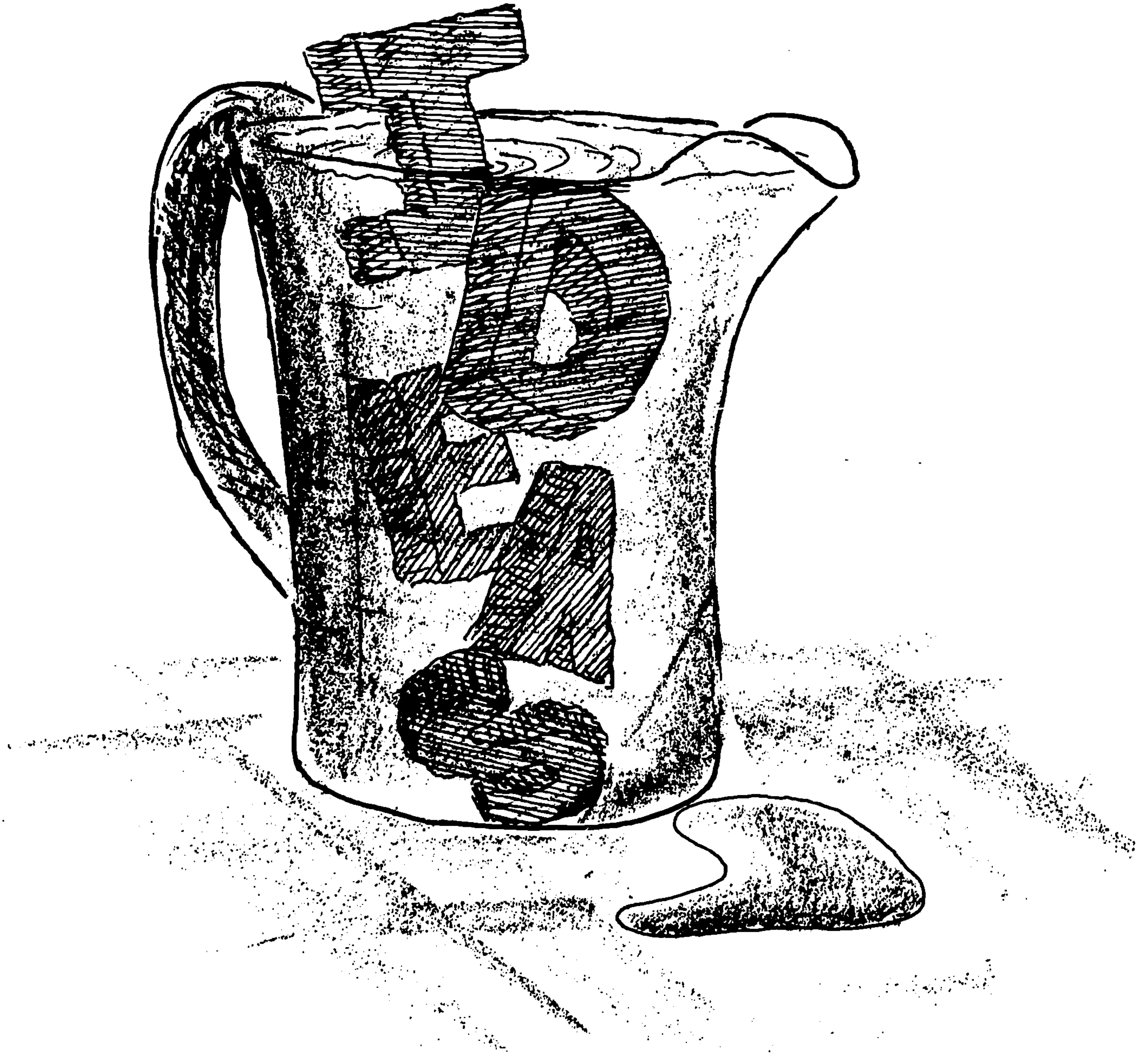
6. Collect jars of assorted shapes and sizes. The ideal would be for each child to have 3. Present a measured quantity of sand. (Beans, split peas, or seeds could also be used.) Have the children predict in which jar the quantity of sand will reach the highest mark. Encourage them to explain and elaborate on their choices. Have them predict in which jar the quantity of sand will reach the highest mark. Encourage them to explain and elaborate on their choices. Have them predict in which jar the sand will register the lowest mark. Have them verablize their reasons. Ask for suggestions in which they may check their predictions.

   If no one suggests the need to mark the height of the sand, as it is poured from one jar to another, do not mention it. It will be instructive for the children to progress through the experiment and learn by experience that they are not able to agree on the height reached by sand, after it has been removed from the jars.

   Discuss the accuracy of the predictions that were made. Have the children who predicted correctly give the reasons for their choices.

Present the story "A Cup Filled With Ideas". Again, it is suggested that the story be told and demonstrated, rather than read, with emphasis on class participation.

A CUP FILLED WITH



A CUP FILLED WITH IDEAS

Mrs. Wright has been making cookies all morning. She has sifted the flour and measured the sugar and other ingredients that go into the cookie dough. Each time she bakes she does something which David and Kathy think is rather strange. To measure the shortening, she first puts some water in a measuring pitcher until it reaches the "one cup" mark.

When she puts exactly the right amount of shortening into the measuring pitcher, the water pushes its way up to the line which says "two cups".

"May I please measure the next time, Mother?" Kathy asks.

"Yes, dear," Mrs. Wright replies. When Kathy adds the right amount of shortening to the water in the measuring pitcher, the water shoots up to the "two cup" mark.

"May I measure some shortening too, Mother?" David asks.

"Yes, you may," Mrs. Wright replies. As David puts the right amount of shortening into the pitcher of water, the water again comes up to the "two cup" mark, and David feels quite pleased with himself.

A CUP FILLED WITH IDEAS

When Kathy adds the right amount of shortening to the water in the measuring pitcher, the water shoots up to the "two cup" mark.

Then, guess who is the next one to ask? Kenny, of course!

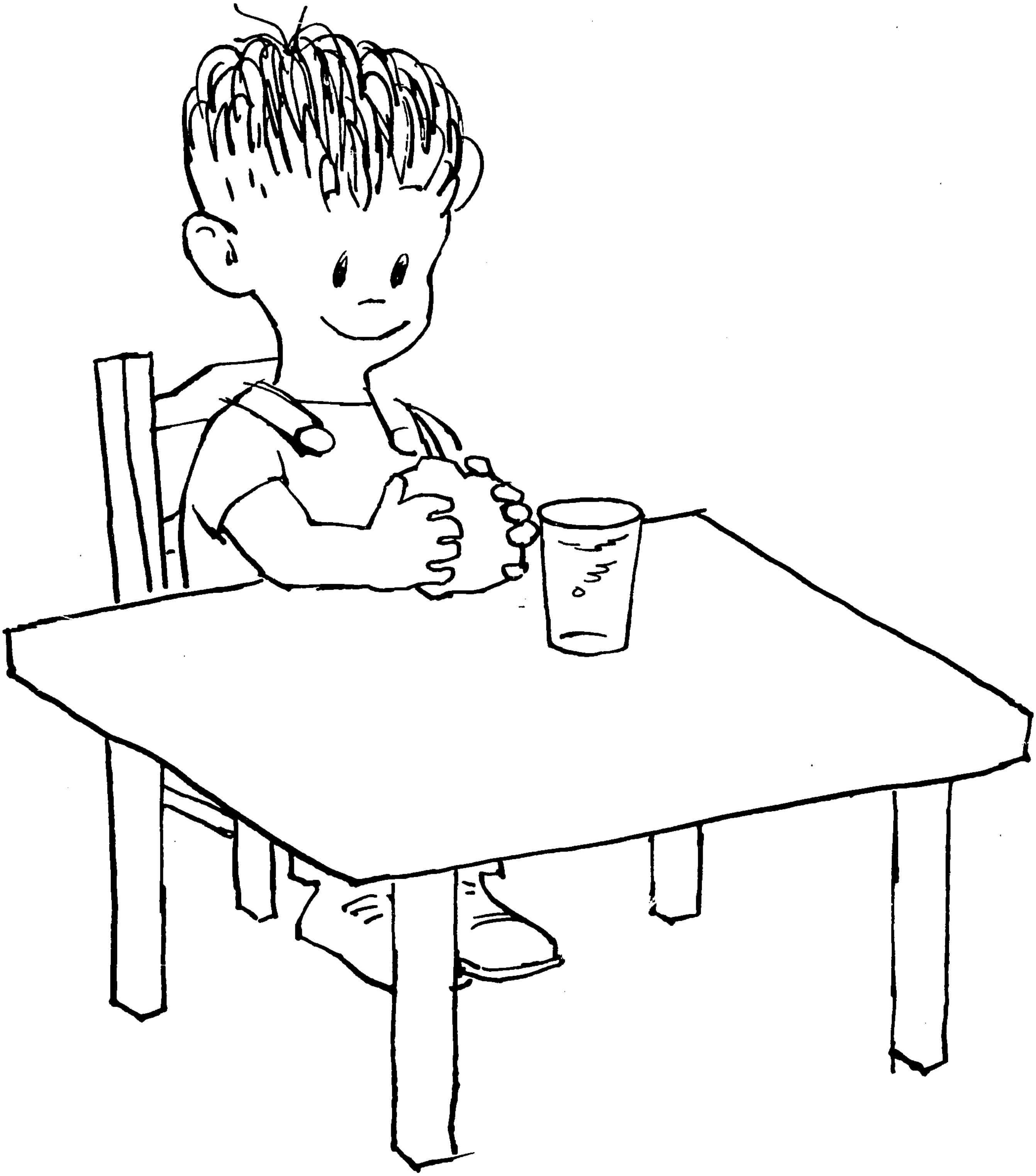
"Me, too, Mommy, please!" he begs, and before Mrs. Wright has a chance to reply, he dumps a big blob of shortening into the measuring pitcher. The water pushes up and up, until it runs over the top and onto the table, making quite a mess. The rolling pin, the pastry board, the baking tins all get wet. Mrs. Wright is very cross.

She picks up Kenny, takes him to the porch, and says as she sits him down on the floor, "Now you play here! The kitchen is no place for you when we are busy baking."

Kenny's face looks very sad. It soon brightens, however. "Mommy," Kenny calls. May I have a spoon and a glass with some water in it?" Mother sends Kathy out to give them to Kenny.

There Kenny sits with modeling clay, and a spoon, and the glass half full of water. Don't you wonder what Kenny is up to?

First he breaks off some of the modeling clay, rolls it together into a ball, and drops it gently into the water. The water pushes its way up to the top of the glass. Kenny is smiling now. He is pretending that the modeling clay is shortening and that he is measuring it for some cookie dough. Now what is he doing?



Kenny breaks off some of the modeling clay and rolls it into a ball.

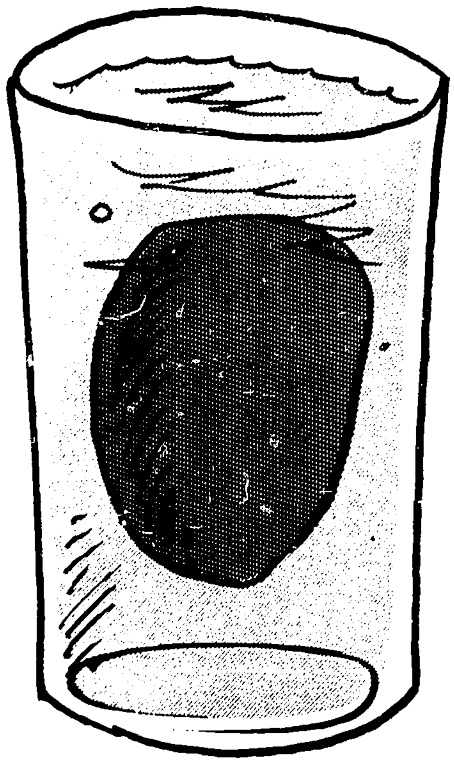
He is taking the clay out and making a long worm with it. He is stuffing the clay worm into the glass, and the water is pushing its way up to the top of the glass. Kenny is surprised to see how high it is again.

He takes the clay worm out with the spoon, and is wondering what to do next, when he hears David's footsteps behind him.

"Say, that's a clever thing to do, Kenny. Are you experimenting with shapes just to see how high the water will come each time?"

"Here, let me show you something else to do," says David, as he takes the clay worm, breaks it up into little pieces, and rolls each piece into a ball. He drops all the little balls into the water. Can you guess how high the water comes this time?

Next David takes out the little clay balls and makes many tiny little clay worms. When he drops these into the water, how high do you think the water goes?



Kenny makes the clay into different shapes to see how high the water will come each time.

Ruth Ann comes out to the porch and watches the boys.

"Are you boys making pancakes with your clay?" she asks.

"No, not yet," says David, "but we will now!" He takes all the clay worms out of the water, presses them together, and makes one pancake out of them.

"Into the water you go," says Kenny as he watches David slipping the pancake gently into the glass.

"Say," declares David, excitedly, "This is a very mysterious experiment! We made the clay into a big ball and then we made it into lots of little balls. Next we made one big clay worm and then we made lots of little worms. Now we made it into a pancake. We made the clay into many different shapes, yet each time we dropped these shapes into the glass of water the same thing happened. The water always came to the top of the glass. Can you explain why? I'd really like to know."

A CUP FILLED WITH IDEAS

Ruth Ann comes out to the porch and watches the boys.

"Well," says Ruth Ann, who is eleven years old and feels rather grown-up and clever, "when you made the different shapes with the clay, did you throw any of the clay away?"

"No," answers David.

"Did you add any more clay when you put it into the water?"

"No," says David.

"Did you use the very same clay each time you made it into different shapes?" continues Ruth Ann.

"Yes, we did. We didn't take any more clay. We didn't use any less clay. We used the same amount all the time," says David.

"Well, then," Ruth Ann explains, "why should you be so puzzled by what you saw? Does it make any difference what shape the clay is? When you change the shape, using the same amount of clay, does that change the amount of space it takes up?"

"Does it make any difference what shape the clay is?"

David still looks puzzled. Of course, Kenny doesn't understand any of it at all. In fact, he has slipped into the kitchen and has come back eating an apple.

Suddenly Ruth Ann gets an idea. She goes into the kitchen and comes back with an apple, a knife, and a bowl of water.

She drops the apple into the water, and the water rises until it reaches the orange circle on the bowl. She takes the apple out, cuts it into two pieces, and drops the pieces into the water. Now how high do you think the water goes? (Pause for children to reply.)

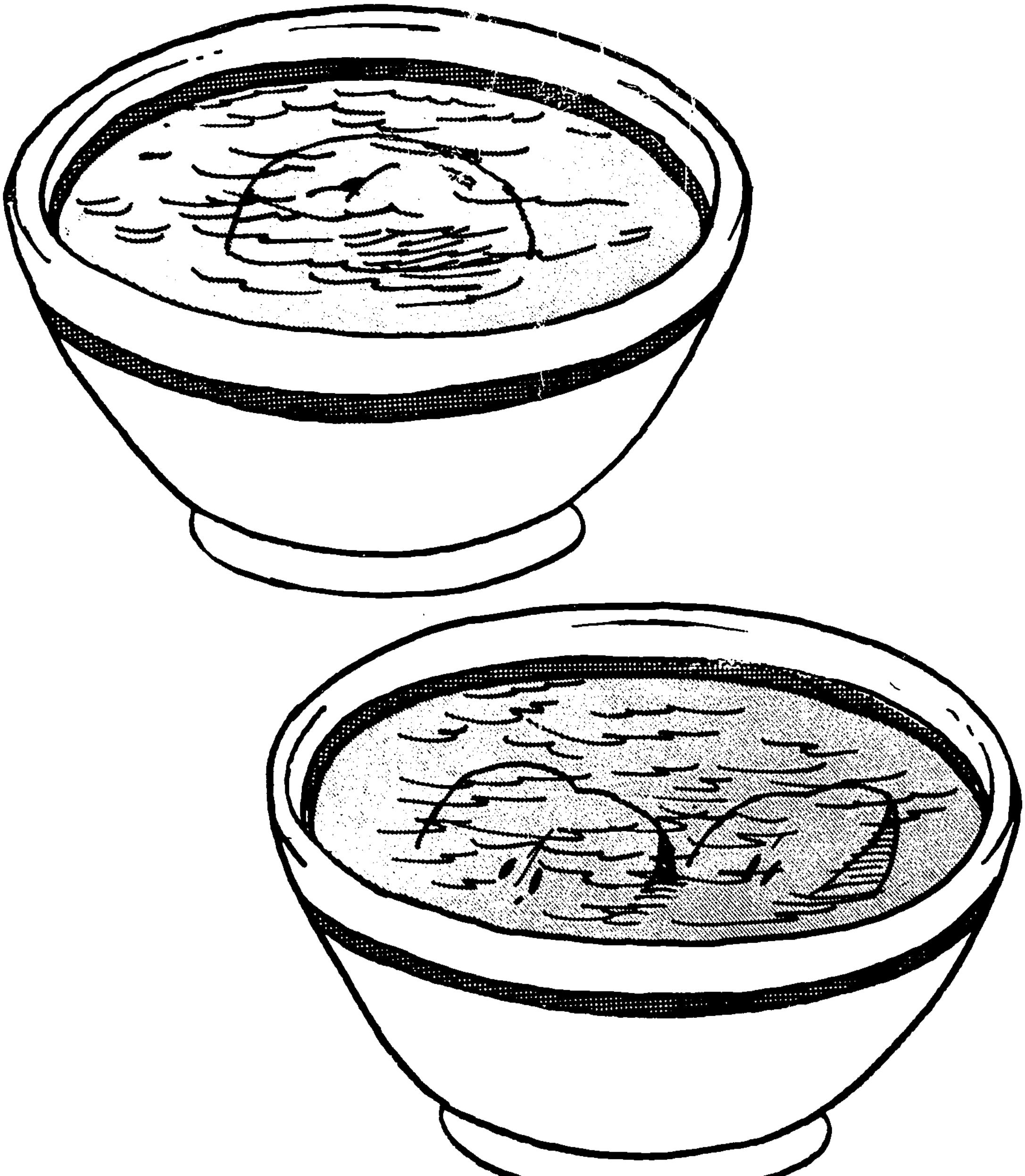
What do you think would happen if Ruth Ann cut the apple into many pieces and put them into the water? (Pause for answer.) Let's leave the Wright family for a while. We'll try this experiment ourselves and see if we come to the same conclusion that Ruth Ann does.

Ruth Ann goes to the kitchen and comes back with an apple, a knife, and a bowl of water.

READ THIS PART OF THE STORY AFTER THE EXPERIMENT HAS BEEN DONE AND THE CHILDREN HAVE DRAWN THEIR OWN CONCLUSIONS:

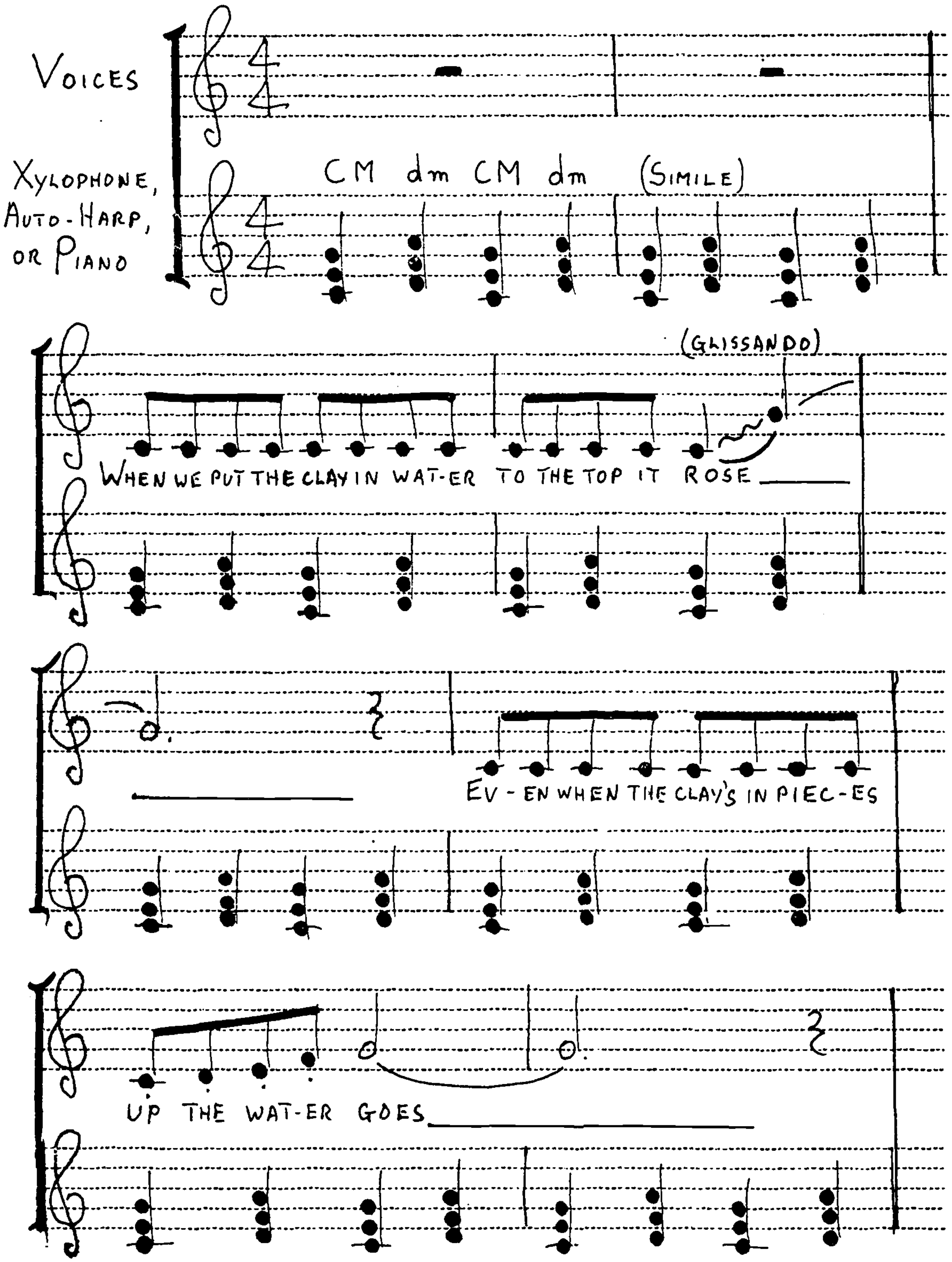
"You see, Kenny and David," says Ruth Ann, "it doesn't matter if the apple is whole, if it's cut into two pieces, or cut up into many pieces. It is still the same apple. It takes up the same space, and it will make the water rise to the same mark each time."

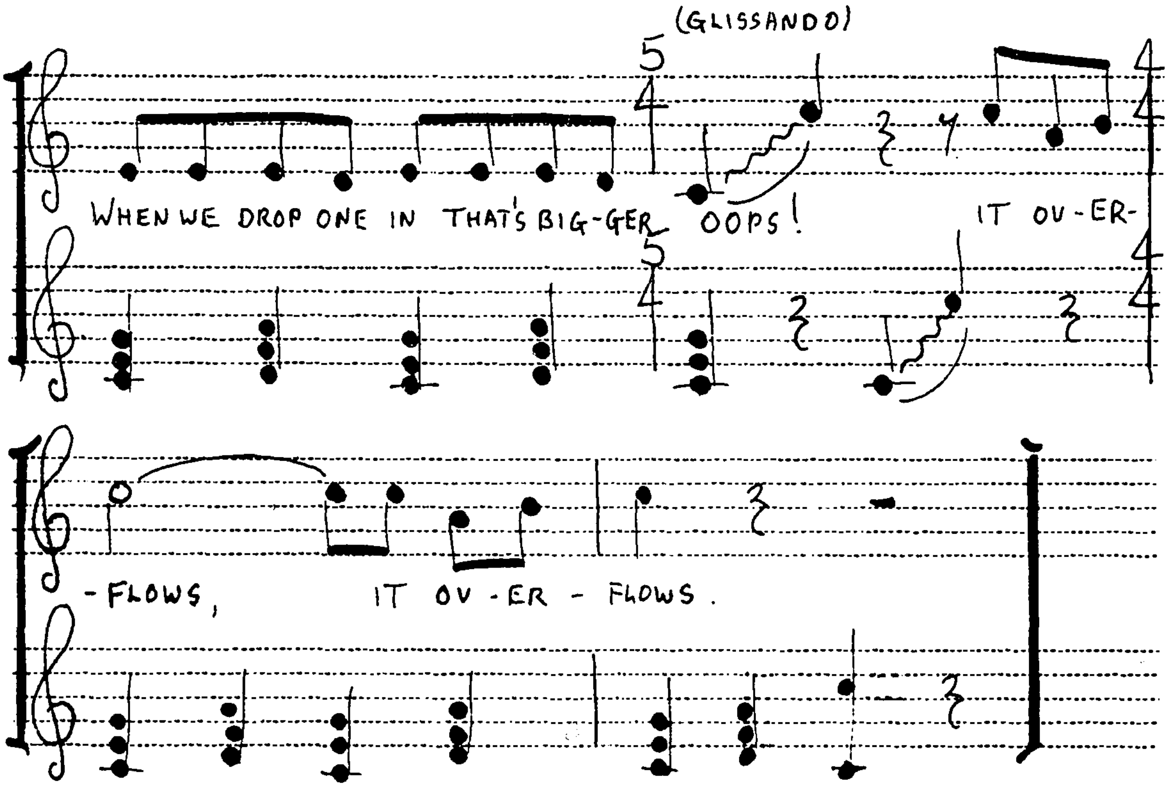
Kenny still doesn't understand about such things, but David is getting the idea. "Thank you, Ruth Ann," he says, "for teaching me something new." He quickly runs to show this experiment to his friends. Perhaps you would like to show some of these experiments to your family and to some of your friends.



"It doesn't matter if the apple is whole, if it's cut into two pieces, or cut up into many pieces."

Messy Measurement




(GLISSANDO)
WHEN WE DROP ONE IN THAT'S BIG-GER OOPS! IT OV-ER-
-FLOWS, IT OV-ER-FLOWS.

Additional Activities

1. Fill a glass or a transparent container half full of water. Mark the level with a rubber band or piece of marking tape. Show the class a piece of clay (smaller than 1/2 cup in volume).

   Ask the children to predict what will happen if the clay is dropped into the marked container. (The water will rise.)

   Have a child carefully drop the piece of clay into the water. Be sure no water splashes out. Mark the new level. Have the children determine whether their prediction was correct.

2. Ask the children to predict what will happen if the clay is removed. Lift the clay with the point of a pencil out of the water and note that the water returns to its original level.

3. Divide the lump of clay into many pieces. Have the children roll these pieces into balls. Have them estimate the level the water will reach if all the balls are dropped into the container.

   Then have the children drop the clay balls into the water, again being careful not to splash out any water. Have them determine whether their estimate was correct. Make sure they discover that the balls of clay will raise the water level to the same height as the single lump of clay.

Background for the Teacher on Larger, Smaller

The following activity and worksheets are designed to deal directly with the two connotations of the terms "larger than" and "smaller than". In Worksheet 1, the terms are used in relation to physical size of the object. In Worksheet 2, larger than and smaller than are used to refer to the sets - specifically to fewer or more members in a set.

For example, a set of 10 rabbits is a larger set than a set of 5 elephants. It is the intention to deal with these two concepts directly, to clarify the meanings (whether the objects or the sets are being referred to), and avoid later misconceptions or mis-use of the terms.

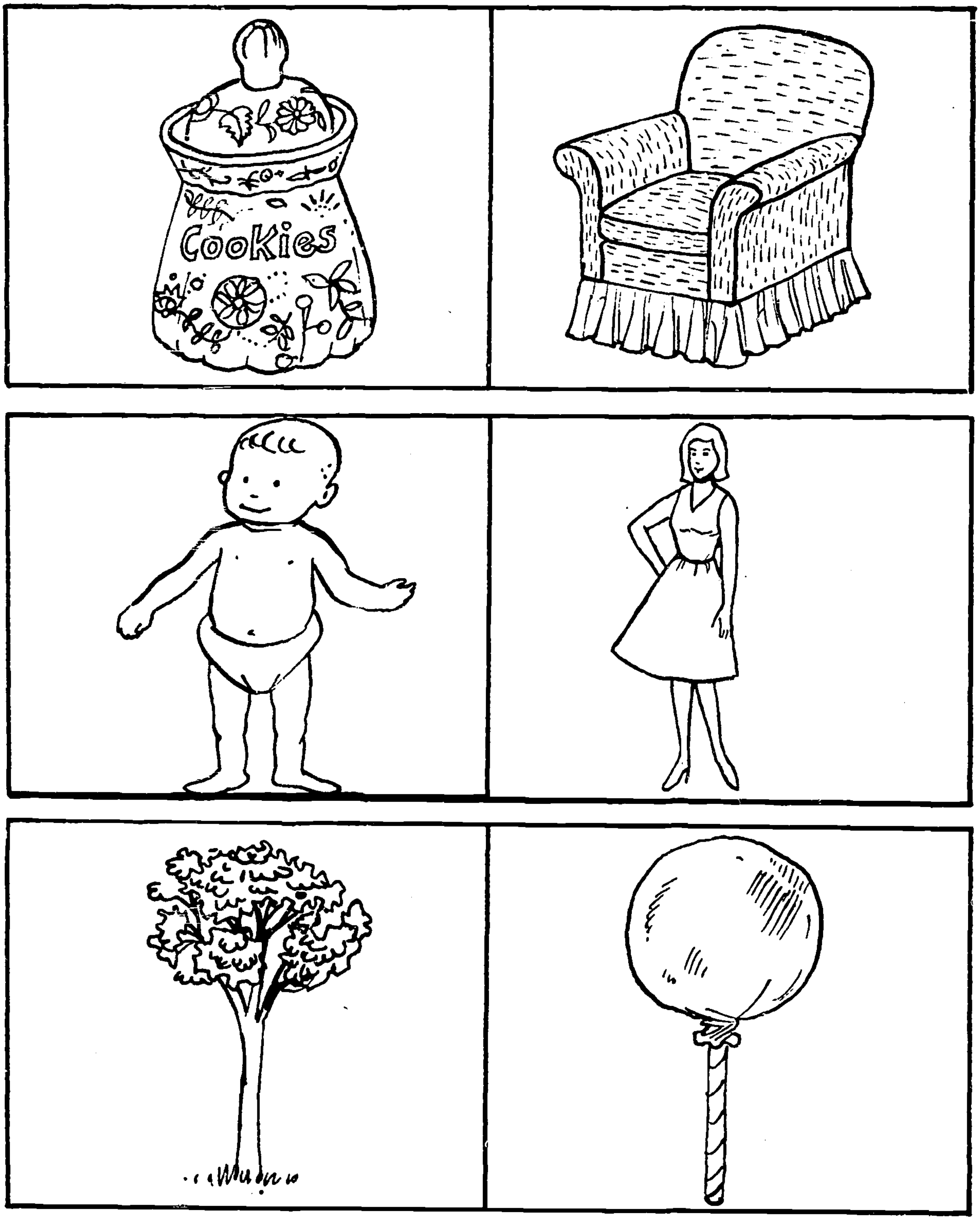
Suggested Activity on Larger, Smaller

Put all the boys in the room in one set and all the girls in another.

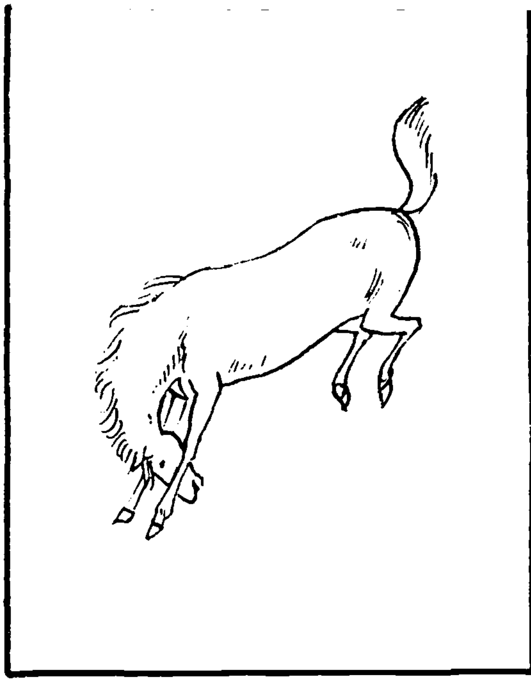
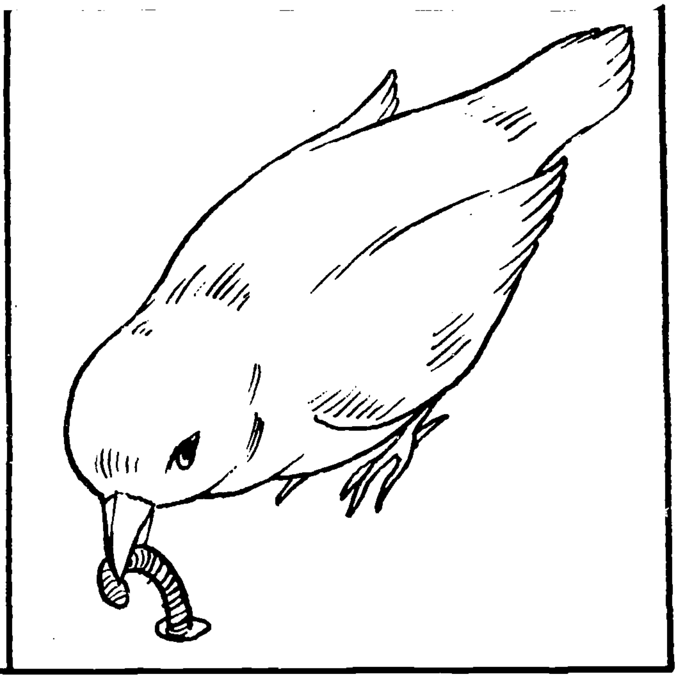
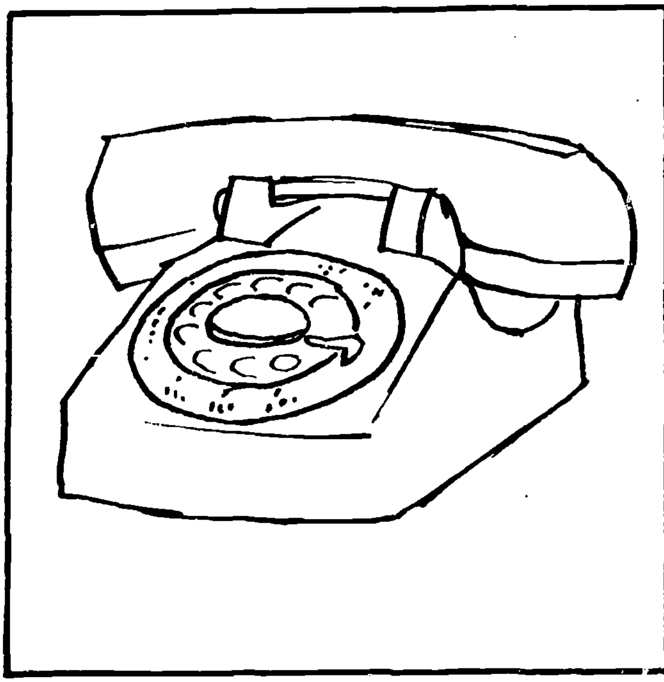
Ask the children what they see just by looking at the two sets. They will be able to see that the boys' set is larger than the girls' set and that the girls' set is smaller than the boys' set or vice versa.

Commentary on Worksheet 1

Worksheet 1 presents the terms "larger" and "smaller" in reference to the size of objects. The children are to compare the two illustrated items in each box and judge which object is larger than the other and which is smaller than the other. Read the directions on the worksheet to the class. Direct the worksheet activity for as independent work as possible. Any answer which the child can defend (such as it might be a toy chair) should be accepted. It is hoped that the children will respond on the basis of the objects without thinking of responding on the basis of the pictures. If a child is confused, it can be explained that the question asks about the objects rather than the pictures.



Draw a closed curve in the box with the larger object. Draw an open curve in the box with the smaller object.


Worksheet 2

Comparing Sets