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PRIMARY ONE

42780 VOLUME 2

TEACHERS' GUIDE

MATHEMATICS

Prepared
at the
Entebbe Mathematics Workshops

PRELIMINARY EDITION
REVISED

Educational Services Incorporated
Watertown, Massachusetts, U.S.A.

ENTEBBE MATHEMATICS SERIES

Primary One -- Revised Preliminary Edition
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Teachers' Guide: Two volumes

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Basic Concepts of Mathematics -- Preliminary Edition
An Introductory Text for Teachers

NOTE

The complete Teachers' Guide of Primary One consists of two volumes. This book is Volume 2.

TEACHERS' GUIDE VOLUME 2

MATHEMATICS PRIMARY ONE

Revised Preliminary Edition

Prepared at the
Entebbe Mathematics Workshops

African Education Program
Educational Services Incorporated
Watertown, Mass., U. S. A.

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UNIT 10

FRACTIONS I

Objectives:

1. To learn the idea of half as it relates to one of two equal parts of a whole.
2. To learn the symbol " $\frac{1}{2}$ ".
3. To use the idea of half.

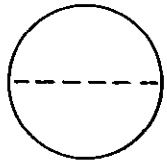
Background Information for Teachers:

Also see Part 2, "Arithmetic", of your Teachers' Handbook.

Whole numbers were introduced to describe a property of sets. Each set has a whole number of members. Fractions are introduced to describe parts of objects. For example, if an object is divided into two equal parts, each part is considered "one of two equal parts". The object is a "whole object", or the "whole". Each part is "one half of the whole object", which may be shortened to "half the whole" or "half". The symbol " $\frac{1}{2}$ " is used to describe a part obtained in this way.

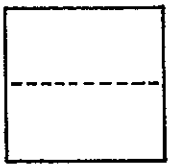
A fraction describes a part of an object, the whole. For example, the rectangular card shown below can be separated in two equal parts by folding along the dotted line. Each part is called "half" of the whole card.

A disc may be divided into two equal parts by folding it as shown below.



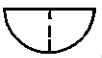
The disc is a "whole" object. Each part formed by folding, such as is called "half".

It may be that a part of an object in one exercise may be regarded as the whole object in a later exercise. For example, the following square card is separated into two equal parts by a fold.

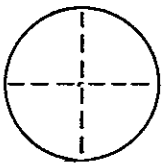


Each of the parts, such as , is half of the square. It may be that the square was one of the two equal parts formed by folding a larger object.

Note, the object which is the whole may be different from exercise to exercise. The parts will be different too. A part which is a half in one exercise may be a whole in another. However, in any single exercise the relation between the "whole" and the "half" is the same. The "half" is one of two equal parts of the whole. "Half" is never used unless the whole is defined.

For example, the half disc  is separated into two equal parts by folding as shown. Each part, such as , is half of a half disc.

To show the relation between a half of a half disc and the whole disc, first fold a disc into half discs, and then fold the resulting half discs into two equal parts. When the disc is unfolded, it will look like this:

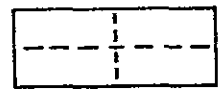


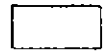
Note the folds. Each of the four equal parts of the disc, such as , is one of two equal parts of a half disc.

A part which is one of 4 equal parts of an object is called "one fourth" of the object or "one fourth" of the whole. The symbol for one fourth is "$\frac{1}{4}$". The example above shows that half a half disc is one fourth of a disc. Since a half disc is half of a disc, we see that half of a half disc is one fourth of a disc. This is also expressed as "half of a half of a whole is one fourth" or "half of a half is one fourth".

Since the half disc was separated into two equal parts, then two one fourths of a whole is one half of a whole. This may be expressed as "two fourths is one half".

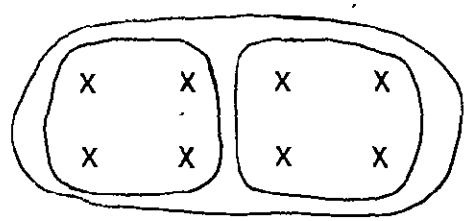
In the same way a rectangular card which is folded twice, as shown below, is separated into four equal parts.



Each of the parts, such as  , is one fourth of the whole rectangular card.

Similarly, if an object is separated into three distinct equal parts, each part is called "one third of the whole". The symbol for one third is " $\frac{1}{3}$ ".

The whole objects which are separated into parts may be sets themselves. For example, the set of eight marks shown below may be separated into two different subsets of four marks each.



Each subset is half of the whole set.

At this time, " $\frac{1}{2}$ " is the only fraction symbol introduced to the children. They see it and read it. They do not write it. The symbol " $\frac{1}{4}$ " is introduced in Unit 14.

In this book, fractions are used only to describe parts of wholes. The important fact that fractions are numbers which can be added, located on the number line, and so on, will be learned later.

Stage 1: The Idea of One Half

Vocabulary: whole, part, two equal parts, half, and one half.

Materials: materials of various shapes (rectangular, triangular, square, discs) and of different sizes for folding, string, containers, flannel board, flannel board pieces, spot cards with 2, 4, and 6 spots; pupil page 74.

Teaching Procedure:

Activity 1: Developing the idea of one half.

Put out several rectangular pieces of paper or cardboard, and some string.

Hold up a piece of paper, and fold the two opposite edges together firmly. Do not tear. Unfold and fold again in the same way. Say, "See this piece of paper; I fold it like this." Unfold the paper so the pupils can see the whole sheet with the fold. Say, "The whole piece of paper was folded into two parts." Ask which of the two parts is smaller. Allow the children to talk about this question. Guide them to decide that neither is smaller and that the two parts are the same size. You may need to ask which of the two parts is larger. Tell the children that the paper was folded into two parts that are the same size and shape.

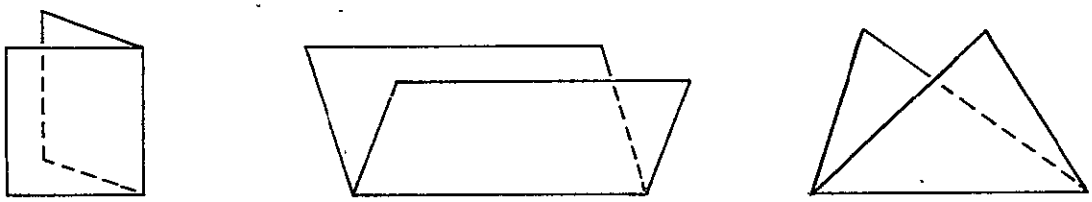
Ask the children if they can show that the two parts are the same size and shape. Allow them to talk about this question. Some children may fold the paper again to show that the two parts are the same size and shape. Others may suggest that the paper be torn along the fold. They should see that the two parts are alike because one part will fit exactly on the top of the other.

Show one of the parts and say, "This part is a half of the whole piece of paper." Let the children repeat the word "half" several times.

Repeat the above activity with rectangular pieces of paper of sizes different from the one just used. Stress that: you had one whole sheet of paper; it was folded into two parts of the same size and shape; and each of the parts is called a half of the whole sheet of paper. Say, "A half of the piece of paper is one of two parts that are the same size and shape.

Give each of the children a rectangular piece of paper. The pieces of paper should be of different sizes. Get each child to fold his paper into two other parts

which are the same size and shape. Ask what each part is called. You will observe that the children may fold the papers in different ways as shown below:



Show the different ways the children fold their papers. Say, as you hold up the papers, "Musoke folded his paper this way; Okello folded his this way." Ask, "Did each of them fold his paper into halves?" Talk about the question. If all of the ways of folding the papers shown in the above drawings were not made by the children, you should make such folds. Question the children and get them to say that the papers are folded into two equal parts and that each part is a half.

Provide each child with discs made of paper and pieces of string. Let them fold the paper and then the string into halves. Ask questions like the following to help the children understand one half:

How did Ama show half the string?

How did Naki show half the disc?

Into how many parts did Podo fold his string? What do you know about these parts?

How can Akello show that the two parts of her paper are equal?

How can Onyongo show that the two parts of his string are equal?

Pick up a piece of string from one of the children's desks and fold it into two parts not the same length. Say, "See Jambo's string. I have folded it into two parts. Are the parts the same length?" Let the children talk about this question until they decide, "The parts are not the same length. One will not fit exactly on the other." Ask, "Is one of the parts half of the string?" Let children talk about this until they decide, "No, because it is not one of two parts that are the same length." This may be repeated with other pieces of paper and string.

Activity 2: Using the idea of one half.

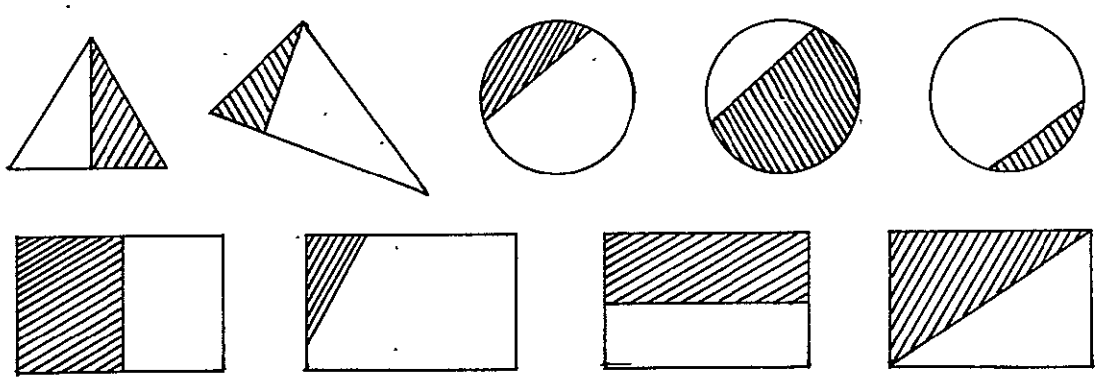
Make objects of several shapes out of coloured paper or cloth for a flannel board. Cut them into halves. Try to have two objects the same size but different in colour. Discs, squares, and triangles will do. Try to cut the rectangular cardboards in several ways.

Put a disc on the flannel board. Ask the pupils, "How can you show half of this?" (Fold into two equal parts.) "May we cut it into two equal parts?" "Does it make any difference where I cut it?" (Yes, it must be cut so that the parts are equal.) Place two discs on the flannel board, one cut into two equal parts and the other cut into two unequal parts. Ask, "Are each of these discs cut into two equal parts?" Talk about this question.

Remove everything from the flannel board except the disc which is cut into two equal parts. Remove one of the halves and hold it in your hand. Ask, "What part of the disc is on the flannel board?" "What part do I have in my hand?" "How can you show these are halves of the disc?" (By placing one on the other to see if they match.)

Repeat with triangular and rectangular shapes.

Make sketches like the following on the blackboard:



Ask, "Is half of the first picture shaded? Why?" Talk of each of the other figures in a similar way.

Activity 3: Learning the symbol " $\frac{1}{2}$ ".

Put out a 5" by 7" card with the symbol " $\frac{1}{2}$ " written on it, a rectangular piece of paper, a disc of paper, a banana or other piece of fruit, a piece of chalk, a stick, a string, and other available objects which can easily be cut or broken into halves.

Get a child to cut a string into two parts. Talk of whether these parts are equal. If the parts are not equal, the children should say the parts are not halves. Take another string and ask where it should be cut to make two equal parts. When this is decided, try to cut it at the point selected. Hold up one piece and ask what part it is of the string. (One half) Say as you write the numeral " $\frac{1}{2}$ " on the blackboard, "This is the way we write $\frac{1}{2}$."

Hold up the numeral card on which $\frac{1}{2}$ is written and ask, "What does this say?" (One half) Say, "I will stand this card, which says $\frac{1}{2}$, on the table. You put some halves of objects by it." Show the children some objects and let them cut or break them into halves. As a child places half of the object by the symbol $\frac{1}{2}$, he says, for example, "This is half of a banana." Let other children examine the two pieces of each object and decide whether the child is placing half of the object by the symbol $\frac{1}{2}$.

Let the children write several rows of the numeral " $\frac{1}{2}$ " in their exercise books.

Activity 4: Extending the idea of one half. Pupil Page 74

Study the pictures in the pupils' book and get in mind what you want the children to learn from the pictures. Note that different shapes are used so that the idea of half is not thought of in relation to one shape only. The first pictures are like those used on the flannel board.

Let the children open their books to page 74 and look at the pictures. Say, "Look at the first picture. What part of it is shaded? What part of it is unshaded? Are the two parts equal?" Let the children say that the parts are not equal and the parts are not called halves. Repeat these questions with the circle and the other rectangle, which are separated into halves.

Look at the pieces of chalk below the rectangles and the circle and ask, "Are the pieces of chalk broken into equal parts?" (One is) "Which one?" (The one on the left.) Ask, "Is the other broken into halves?" (No, it is broken into unequal parts.) Question the children carefully to get those responses. Ask similar questions about cutting the strings and the oranges.

Get the children to look at the pictures of water glasses. Ask, "Is the first glass full of water? How full is it?" Guide the children to decide that the glass is half full. Ask, "What about the next glass, is it full?" (No) "Is it half full?" (No) Talk of these questions with the children and lead them to say that the second glass is neither full nor half full; to make it half full a little more water is needed. Talk about the picture of the third glass. The children should say: "It is not full. It is not half full. It is more than half full. To make the third glass half full some of the water must be poured out."

Get the children to look at the last two pictures of the games of tug of war and see saw. Begin with the tug of war and ask, "Is the number of children on the left side equal to the number of children on the right?" (Yes) Ask, "If they are equal, what do you call each of the groups?" (Half, because there are 2 equal groups.) Talk about this and guide the children to say that one half the number of children is on the left and that one half the number of children is on the right. Your emphasis should be on the word "half".

Ask similar questions about the see-saw. You should observe that these two groups are not equal and therefore they are not halves.

UNIT 11

SUBTRACTION

Objectives:

1. To understand the meaning of subtraction as finding the missing addend in an addition sentence.
2. To learn the basic subtraction facts with sums of 9 or less.
3. To understand the meaning and use of subtraction sentences.
4. To understand the renaming of a number as the sum or difference of two numbers, with the sum limited to 9 or less.
5. To use subtraction in solving problems.

Background Information for Teachers:

Also see Part 2, "Arithmetic", in your Teachers' Handbook.

When we add two numbers, called addends, we get a number called their sum. For example,

$$\underset{\text{addends}}{4 + 5} = \underset{\text{sum}}{9}$$

This true sentence tells us that "4 + 5" is another name for "9".

The true sentence $4 + 5 = 9$ may be thought of in these two ways:

(1) If a set of 4 members is put together with a set of 5 other members, the union of the sets has 9 members.

(2) A set of 9 members can be separated into two subsets. If there are 4 members in one subset, then there are 5 members in the other subset. If there are 5 members in one subset, then there are 4 members in the other subset.

The first of these ways of thinking about "4 + 5 = 9" gives an exercise in <u>finding a sum</u>. In this exercise, we find a number which makes this sentence true:

$$4 + 5 = \square$$

The children have learned all addition facts with sums to 9 by now. They have solved problems using these facts.

The second of these ways of thinking about "4 + 5 = 9" gives an exercise in <u>finding a missing addend</u>. In this kind of exercise, we find numbers which make these sentences true:

$$4 + \square = 9, \qquad \square + 5 = 9$$

The addition facts can be used to solve exercises of the second type. In order to talk about this second kind of exercise, we use the word <u>subtraction</u>, and we write the symbol " − " for it. With this symbol we write the sentence

$$5 + \square = 9 \text{ in the form } 9 - 5 = \square$$
$$\text{and } \square + 5 = 9 \text{ in the form } 9 - 5 = \square$$

In other words, if one addend of 9 is 5, the missing addend is written "9 − 5". We read this "nine minus five". Then, "9 − 5" is another name for 4.

$$\underset{\text{sum}}{9} - \underset{\text{addend}}{5} = \underset{\text{missing addend}}{4}$$

In this unit the addition facts with sums of 9 or less are revised with subtraction in mind. The addition facts written as subtraction sentences are called subtraction facts.

Those with sums of 9 or less are listed below:

0 - 0 = 0	4 - 0 = 4	6 - 0 = 6	8 - 0 = 8	9 - 0 = 9
	4 - 1 = 3	6 - 1 = 5	8 - 1 = 7	9 - 1 = 8
	4 - 2 = 2	6 - 2 = 4	8 - 2 = 6	9 - 2 = 7
1 - 0 = 1	4 - 3 = 1	6 - 3 = 3	8 - 3 = 5	9 - 3 = 6
1 - 1 = 0	4 - 4 = 0	6 - 4 = 2	8 - 4 = 4	9 - 4 = 5
		6 - 5 = 1	8 - 5 = 3	9 - 5 = 4
		6 - 6 = 0	8 - 6 = 2	9 - 6 = 3
2 - 0 = 2			8 - 7 = 1	9 - 7 = 2
2 - 1 = 1		7 - 0 = 7	8 - 8 = 0	9 - 8 = 1
2 - 2 = 0		7 - 1 = 6		9 - 9 = 0
	5 - 0 = 5	7 - 2 = 5		
	5 - 1 = 4	7 - 3 = 4		
3 - 0 = 3	5 - 2 = 3	7 - 4 = 3		
3 - 1 = 2	5 - 3 = 2	7 - 5 = 2		
3 - 2 = 1	5 - 4 = 1	7 - 6 = 1		
3 - 3 = 0	5 - 5 = 0	7 - 7 = 0		

A subtraction sentence can be interpreted in terms of sets of counters. For example, $4 + \square = 9$ leads to the question, "How many members are in a set that can be put together with a set of 4 members to make a set of 9 members? The sentence, $\square = 9 - 4$ leads to the question, "If a set of 9 members is separated into a subset of 4 members and another subset, how many members are there in the other subset?" This may also be stated, "If a set of 4 members is separated from, or taken away from, a set of 9 members, how many are left?"

Stage 1: Separating Sets

Vocabulary: separating, box, sentence, add. (The terms vertical, addend, and missing addend will not be used with the children.)

Materials: objects for making sets; 1" × 1" numeral (0 - 9) cards for children; cardboard pieces (about 6" by 9") with half of each shaded; pupil pages 75 - 77.

Teaching Procedure:

Activity 1: Telling about the separation of a set into two subsets. Pupil Page 75

Let the children make a set of 6 objects, such as beans, on their desks. Let them separate their sets of 6 beans into two subsets so that one subset is a set of 4 beans. Ask, "How many beans are in the other subset?" (2) Say, "Now put all 6 beans in one set again." Let the children separate the set into two subsets, one having one bean. Ask, "How many beans are in the other subset?" (5) Continue this procedure, separating the set of six beans into two subsets, one having zero, one, two, three, four, five, or six beans. In each case, ask how many beans are in the other subset. Ask questions like this during the activity: "If a set of six beans is separated into two subsets and one subset has 4 beans in it, how many beans are in the other subset?"

Let the children then make a set of another number of objects, for example, 8, and separate it into two subsets. In each case, ask the children to describe the action in a way similar to this: "If a set of 8 beans is separated into two subsets and one of them is a set of 5 beans, the other is a set of 3 beans." Continue with other sets until the children understand the activity and can describe it.

Let the children begin with a set of 6 sticks and separate it into sets of 2 sticks and 4 sticks. Then put the sets of 2 sticks and 4 sticks together, to get one set of 6 sticks. Talk with the children of the relationship of the action of "putting two sets together" and "separating a set into two subsets". They may say the actions undo each other.

Show the children page 75 and let them find it in their books. Ask them to find the set of elephants. Ask, "How many elephants are there in the set?" (4) Tell them to cover all the dark elephants with counters (beans, seeds or bottle-tops). Ask, "How many elephants are not covered?" (3) "If we have a set of four elephants, and one elephant is covered, how many elephants are left?" (3)

Follow the same procedure for the sets of trees, fish, drums, and so on, each time letting children describe the separation of a set into two subsets.

After all the sets have been discussed, let the sets be used again, if needed, this time covering the light objects in the sets and describing the separation of the sets into two subsets.

Activity 2: Finding a subset to put with a given set to make a set of a known number. Pupil Page 76

Ask a child to make a set of five objects, for example, 5 sticks. Say, "You have a set of 5 sticks. If you want a set of 8 sticks, how many more sticks do you need?" Tell the children to count out enough sticks to make a set of 8 sticks.

Repeat the activity, beginning with a set of 6 sticks and making a set of 8 sticks. Repeat the activity beginning with 1 stick, 2 sticks, 3 sticks, and so on. Each time ask the children to find the set they need to make a set of 8 sticks. Let them tell what they have done each time. For example, they say, "I put a set of 6 sticks with a set of 2 sticks to make a set of 8 sticks."

Repeat with other sets. For example, get the children to tell what set put with a set of 4 bottletops makes a set of 7 bottletops, and so on.

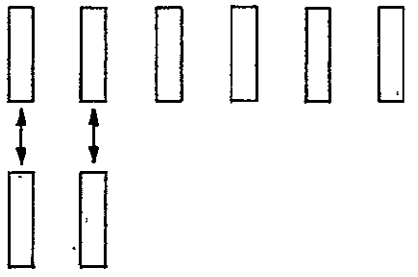
Ask the children to find page 76 in their books. Get them to find the set of beans on the page. Ask, "How many beans do you see?" (4) "What numeral do you see beside the set of beans?" (8) Talk with the children of how we can find how many more beans are needed to make a set of 8 beans. Let them place a counter on each of the four pictures of beans and then put out as many more beans as are needed to make a set of eight beans.

Follow the same plan with the sets of trees, coconuts, bicycles, and so on.

Activity 3: Comparing two sets. Pupil Page 77

The children should have at least 9 counters and their numeral (0 - 9) cards on their desks. Get a child to make a set of 9 or fewer sticks which you cannot see. You make a set of 9 or fewer sticks which he cannot see. You show your set and let him show his set. Get him to look at the two sets and tell whether his set has more or fewer members. Let him also say how many more or how many fewer. For example, he will say, "I have 3 more sticks than you have."

If he chooses a set of 6 sticks and you choose a set of 2 sticks, let him match the two sets as shown below.



Let the class talk about who has more sticks and how many more. The child will say, "I have 4 more sticks than you." You say, "I have 4 fewer sticks than you."

Let several pairs of children make sets, compare them, and say, "I have _____ fewer sticks than Ama," or "I have _____ more sticks than Ama." (The children should put a number on these sentences from the sets they make.) Include two sets which have the same number of members, and also two sets one of which is empty.

Pairs of children can now compare sets in this way at their desks. Move around the class, watching and listening, and giving help as needed.

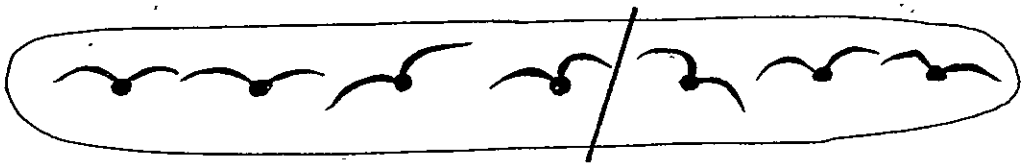
Show the children page 77 and let them find it in their books. Ask them to find the sets of books and pencils. Ask them which set has more members, the set of books or the set of pencils. (The pencils) Tell them to try to match the sets. (Some children will need to place objects on the members for matching.) When they have matched all the books with all the pencils, they will find that there are two pencils which have not been matched. Ask them to place their "2 card" in the box to the left of the sets of books and pencils.

Compare in the same way the sets of chairs and tables, cups and saucers, and so on. For example, after children have tried to match chairs and tables, ask, "Are there more chairs or tables?" (Chairs) "How many more?" (3) "Place the correct numeral card in the box to the left." Check to see that children have placed the "3 card" in the box. Ask, "If we have six tables and nine chairs, how many more chairs are there than tables?" (3)

Activity 4: Separating a set into two subsets.

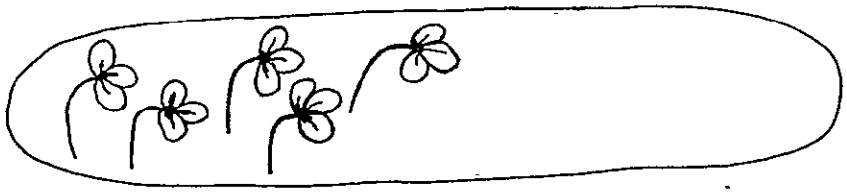
Draw a set such as this on the blackboard:

Say, "What are the members of this set?" (Birds) "How many birds are there in the set?" (Seven) "Suppose I separate the set like this:"



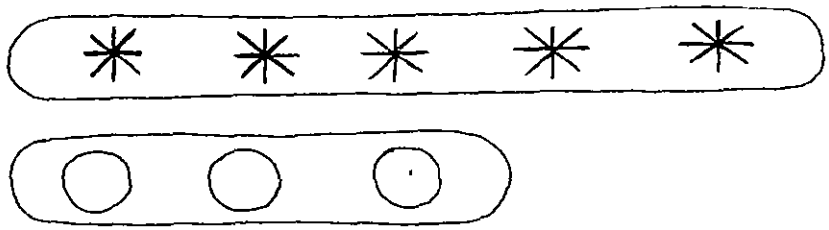
"How many birds are in the subset on the left?" (4) How many are in the subset on the right?" (3) When a set of 7 members is separated into two subsets, and one subset has 4 members, how many members will the other subset have?" (3) If a set of 7 is separated into two subsets and one subset has 3 members, how many members will the other subset have?" (4) Repeat with other sets.

Draw a set of five flowers, leaving room for more flowers in the drawings.

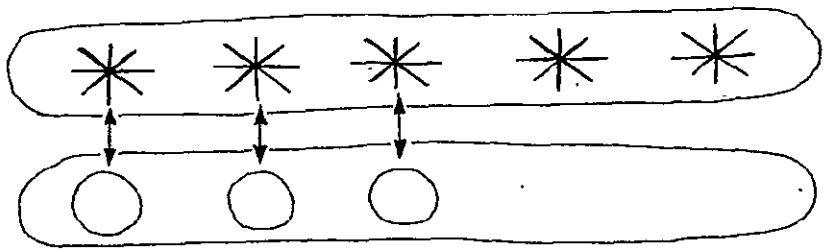


Ask these questions: "What are the members of this set?" (Flowers) "How many members are in this set?" (5) "How many more flowers are needed to make a set of eight flowers?" (3) Draw, or let one of the children draw, the three flowers needed to make a set of eight flowers. Follow this plan with other sets.

Draw two sets similar to the ones below.



Let the children tell what sets they see. (A set of 5 stars and a set of 3 discs.) Ask these questions: "How many stars?" (5) "How many discs?" (3) "Are there more stars or more discs?" Get the children to talk about this question. Let a child come to the board and match the members as follows:



The children should decide that there are more stars than discs. There are 2 more stars than discs. Repeat this activity with several other pairs of sets, for example, seven boys and five girls. Be sure to include some examples in which the two sets have the same number of members and in which one of the sets is empty.

Stage 2: Sentences with Missing Addends

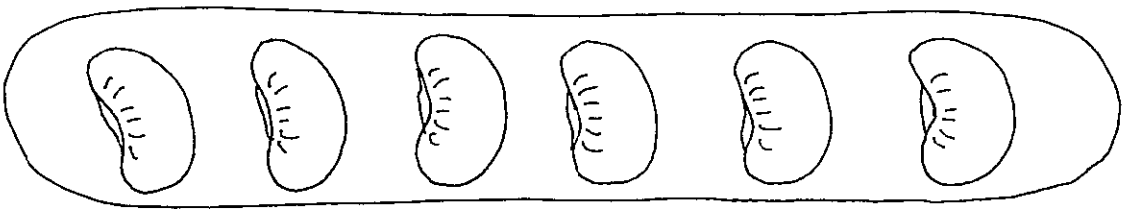
Vocabulary: subtract, minus, minus sign.

Materials: objects for making sets; pupil pages 78-85.

Teaching Procedure:

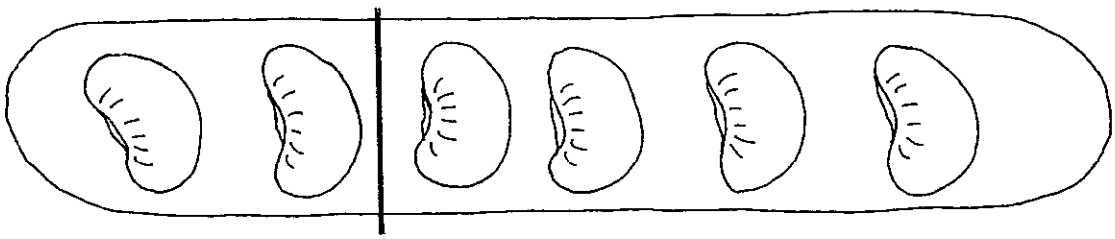
Activity 1: Writing a sentence about separating sets.

Let the children make a set of 6 seeds on their desks. You sketch a set of 6 seeds on the blackboard.



Ask, "If we separate our sets into a subset of 2 seeds and another subset, how many seeds will be in the other subset?" The children will know how to do this from their previous experience. Let them separate their set into the two subsets on their desks and you show the separated set on the blackboard as shown in the sketch below.

Ask the following questions, discuss the answers, and write the answers as shown in the sketch below: "How many seeds did we have in our set?" (6) "How many seeds are in the subset we made from the set?"



$6 = 2 + \square$

Let the children summarize the activity by saying, "We separated a set of 6 seeds into a subset of 2 seeds and another subset." Help them to make the number sentence, "6 equals 2 plus the number in the box." They should write the sentence on their papers under the sets which they make.

Let them talk of why they chose a number to put in the box. Let many children tell how they know. Some will know the number without counting, some will count the seeds in the second set they made, and others may know because they know "6 = 2 + 4" is true. The last way of finding the missing addend is the aim of this unit. Let the children write the number in the box to make the sentence true.

Repeat this plan with other examples. Let children separate sets on their desk, write sentences, and find the numbers that make the sentences true.

Change the way the sentences are written; for example, write the sum first sometimes, sometimes last. Also change the place where the box is written. For example,

$8 = 8 + \square$, $7 = \square + 6$, $\square + 2 = 7$, and $3 + \square = 9$.

Activity 2: Using sets to find a missing addend.

Write a number sentence like the following on the blackboard: $8 = 6 + \square$. Talk with the children of how sets are used to picture the sentence. Let them write the sentence on their papers and make sets with counters. Go around the class. Watch the children form a set of 8 counters, separate a subset of 6 from the set of 8, and find the number that goes in the box is 2. Let them write it there. Give them help and encouragement where needed. Let the pupils think about this question and answer it: "How can I find the number that makes the sentence true?"

The method used here is to separate a set of 8 into a subset of 6 and another subset, and then to look at the other subset to find what number makes the sentence true. If some children know the number should be 2 because $8 = 6 + 2$, do not let them continue to make and separate sets. They have reached the goal we wish them to achieve.

Write a few other sentences on the board. Let the children copy the sentence on their papers, make and separate a set for the sentence, find the number that makes the sentence true, and write it in the box.

Activity 3: Using the word "subtract" to describe a sentence like $4 + \square = 7$.

Write the sentence $4 + \square = 7$ on the blackboard and let the children write it on their papers. Ask them to make a set of counters and use the set to show how to find the number that makes the sentence true.

When they have finished, point to the sentence $4 + \square = 7$ and say, "In this sentence you know the numbers 7 and 4. You find the number to put in the box. To find the number for the box you subtract." Let them say this word after you several times.

Ask many questions which children need to use the word "subtract" to answer.

Activity 4: Writing a sentence like $4 + \square = 7$ as a subtraction sentence.

Write the sentence $4 + \square = 7$ on the blackboard and say, "We have another way to write this sentence. We can write:

$$4 + \square = 7 \quad \text{as} \quad \square = 7 - 4."$$

Tell the children that this is read "The number in the box equals seven minus four." The sign " - " is called a minus sign and means we subtract 4 from 7. Let the children read the sentence, tell you what the sign is called (minus sign), and what it tells us to do. (Subtract 4 from 7) Talk about the number which makes the sentence true and how it is found.

Write other sentences like $8 - \square = 2$ on the board. Let the children talk about the numbers which are subtracted. Rewrite the sentence in the form $\square = 8 - 2$, and read the new sentence.

Activity 5: Subtracting two numbers -- subtraction sentences written in all forms. Pupil Page 78

Write several sentences like the following on the blackboard. (Note that the sentences come in pairs, one to the right of the other.)

$\square + 1 = 7$	$7 - 1 = \square$
$6 = 2 + \square$	$\square = 6 - 2$
$9 = \square + 4$	$\square = 9 - 4$
$2 + \square = 3$	$3 - 2 = \square$

Let the children talk about each pair of sentences and tell what numbers they are to subtract. Let them say that each sentence on the right of the board is another way of writing the sentence on the left.

Let them tell how they can find the number that makes the sentence true, using sets or using what they know about adding two numbers. Let the class work together finding the numbers making a few sentences true.

Get the children to find page 78 in their books. Ask them to look at the first sentence and read it. (7 minus 3 equals the number in the box) Ask, "There are two numbers in the sentence. What are they?" (7 and 3) Talk with the children of what the sentence asks them to do with 7 and 3. (Subtract) Ask, "How can you use the set of giraffes to find the number for the box?"

Get the children to name the number which makes $7 - 3 = \square$ true and the number which makes $7 - 4 = \square$ true. The children should tell why the set of giraffes may be separated into the same two subsets to find the number in the box in each sentence. They may say, "If 3 and 4 equals 7, then 7 objects can be separated into subsets of 3 and 4 or into subsets of 4 and 3."

The children should put numeral cards on the boxes in the exercises to make the sentences true.

Let the children find the numbers which make other sentences true. Talk with the class, with groups, or with individuals, about those sentences with which they have difficulty.

Activity 6: Subtracting two numbers. Pupil Pages 79-80

Revise the subtraction of two numbers by talking about the first sentence on page 79. Let the children read the sentence, tell what two numbers are given, say what the sentence tells them to do to the two numbers, and find the number making the sentence true. Let each child find the number in his own way and place the numeral card on the box to make the sentence true.

Let the children tell the different ways in which they found the number for the box. First, ask a child who used counters to show how he found the number; then ask others. Some will say, "I know if 1 counter is separated from 4 counters, there are 3 other counters." Some will say, "I know that 1 and 3 equals 4." Others may say, "I know 4 minus 1 is 3." All these ways are good but as they are given above, each is a more mature way of subtracting than the one before it. A child must use a method he understands, but you should help him to learn a better way. The counters should always be available, however, for checking. Sometimes ask the children to picture their answers with counters.

Let the children find the numbers which make the other sentence true on pages 79 and 80. Some children may need to take the cards off the pages and place them on again. The children may also copy the sentences in their exercise books, writing in the numbers which make the sentences true.

Stage 3: Subtracting Numbers

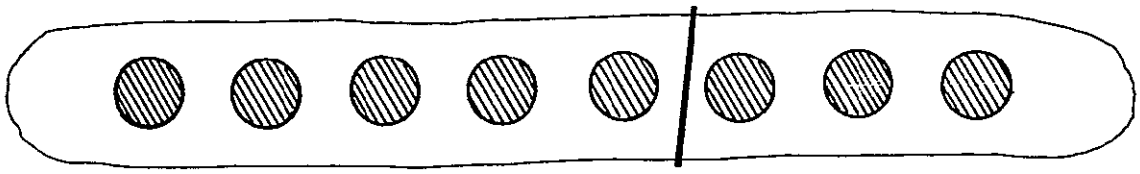
Vocabulary: rename.

Materials: objects to make sets; pupil pages 81-86.

Teaching Procedure:

Activity 1: Looking again at groups of addition facts.

Draw 5 discs and 3 discs on the blackboard, as shown below.



Say, "I have a problem for you. I want you to tell me 4 sentences which are pictured by these sets. You will have to think about the sets." If the sentences

are not given quickly, ask questions about the sets, such as: "How many sets are there?" "How many discs in each of the sets?" "Were any sets put together?" "Was any set separated into two different subsets?" These sentences should result:

$$5 + 3 = 8; \quad 3 + 5 = 8; \quad 8 - 3 = 5; \quad 8 - 5 = 3.$$

Let the class talk about the one fact which helps them to know the three other facts. If they know that 5 plus 3 equals 8, then they know three other facts.

Ask, "What other facts do you know if you know these addition facts?" (Some children may need counters to write the other facts, others will not.)

$$4 + 5 = 9; \quad 6 + 2 = 8; \quad 2 + 5 = 7.$$

The facts they will write are these:

Given fact	Other facts		
4 + 5 = 9	5 + 4 = 9	9 - 4 = 5	9 - 5 = 4
6 + 2 = 8	2 + 6 = 8	8 - 6 = 2	8 - 2 = 6
2 + 5 = 7	5 + 2 = 7	7 - 2 = 5	7 - 5 = 2

Write the following sentences on the blackboard and let the children write in their exercise books the three other true sentences they know from each of these sentences.

7 + 2 = 9	3 + 3 = 6	1 + 8 = 9
4 + 2 = 6	3 + 2 = 5	4 + 4 = 8
6 + 3 = 9	1 + 4 = 5	1 + 5 = 6

Activity 2: Looking again at groups of subtraction facts.

Place these sentences on the blackboard:

9 - 1 = ☐	9 - 0 = ☐
8 - 1 = ☐	8 - 0 = ☐
7 - 1 = ☐	7 - 0 = ☐

Ask the children to look at the first column of sentences. Ask them to think of the numbers that make the sentences true. Let them write other sentences that are like these. For example, 6 - 1 = ☐ , 5 - 1 = ☐ , and so on.

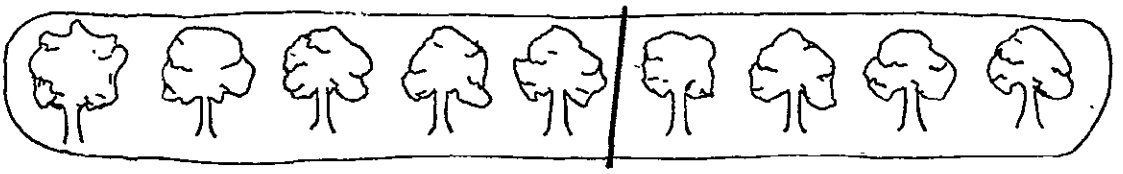
Ask what numbers make the second column of sentences true. Let the children write other sentences that are in the group. For example, 6 - 0 = ☐ 5 - 0 = ☐ , and so on.

Other groups of sentences which may be studied in the same way are:

9 - 9 = ☐	7 - 1 = ☐
8 - 8 = ☐	7 - 2 = ☐
7 - 7 = ☐	7 - 3 = ☐

Activity 3: Writing numerals in vertical form for subtraction.

Revise the activity of separating a set into two subsets. For example, separate a set of 9 trees into two subsets one of which has 4 trees.



Write an addition and a subtraction sentence which this pictures; for example:

9 = 4 + ☐ 9 - 4 = ☐

Point to the sentence 9 - 4 = ☐ and ask what the sentence says to do to 9 and 4. (Subtract) Ask, "What number makes the sentence true?" (5) Now say,

"This sentence is one way of showing that 9 and 4 are to be subtracted. Here is another way:

$$\begin{array}{r} 9 \\ -\ \underline{4} \\ \square \end{array}$$

What number goes in the box?" (5)

Write a few more examples of subtraction sentences. Help the children to write them in the vertical form. (Do not use the term vertical with the children. Ask the children to write the numbers to be subtracted in another way.)

$9 - 5 = \square$ $\quad$ $5 - 2 = \square$ $\quad$ $\square = 8 - 7$ $\quad$ $\square = 6 - 2$

$$\begin{array}{r} 9 \\ -\ \underline{5} \\ \square \end{array} \qquad \begin{array}{r} 5 \\ -\ \underline{2} \\ \square \end{array} \qquad \begin{array}{r} 8 \\ -\ \underline{7} \\ \square \end{array} \qquad \begin{array}{r} 6 \\ -\ \underline{2} \\ \square \end{array}$$

Talk about each example with the children. Ask them what number makes the sentence true.

<u>Activity 4</u>: Finding a missing addend when the numerals are in horizontal or vertical form. Pupil Pages 81-83

Ask the children to find page 81 in their books. Let them talk about the sets and the two ways of writing the numbers to subtract. They should now find the numeral cards which go on the boxes. The children may use counters if necessary to find the number which makes the sentence true and then place the numeral card on the box. However, they should be encouraged not to use the counters. Let a child use only the parts of pages 81-83 he needs. The children may also copy the true sentences in exercise books.

<u>Activity 5</u>: Renaming numbers.

Say, "You can add many pairs of numbers and you can subtract many pairs of numbers. Let us try these:"

Add:	5 and 2,	3 and 4,	1 and 6
Subtract:	9 and 2,	8 and 1,	7 and 0

Ask, "Did you notice the numbers you have just said? What were they?" (They were all 7's) "You know a lot about 7. Help me write some sentences about 7. I will write a few and you tell me some others."

7 = 5 + 2	7 = 1 + 6
7 = 3 + 4	7 = 8 - 1

Let the children make sentences until the list contains all the subtraction facts with missing addends of 7 and the addition facts with sums of 7, which the children know.

Say, "We have been renaming 7. Another name for 7 is 5 + 2. What are some other names for 7 in the list?"

Let the children rename 6, 9, and so on, in the same way.

Activity 6: Renaming numbers. Pupil Pages 84-86

Let the children rename the numbers on the pages as needed. Give help on page 86. Each of the sentences on this page have two numbers to be renamed. This page is a good one to use to find the pupils' understanding of addition and subtraction ideas. For example, in the first exercise "5 + 3" is renamed "8" and "8" is renamed "9 - $\boxed{1}$."

Activity 7: Using addition and subtraction.

Practice should now be given in using subtraction as well as addition to solve problems. This practice can be of the same kind as used for addition in Units 5 and 7. Here are some examples:

(1) I have 6 counters. My sister has 9 counters. How many more has my sister than I have?

(2) There are 7 buttons on Lucy's dress and 6 buttons on mine. How many more buttons has Lucy than I have?

(3) There are 8 girls playing outside and 5 girls reading in the classroom. How many more girls are there outside than inside?

(4) A teacher told 6 girls to clean the classroom. Only 4 came. How many stayed away?

(5) My mother planted two rows of cabbages. In one row she planted 9 cabbages and in the other only 7 cabbages. Which row had the most? By how many?

(6) There are 9 sticks in one bundle and 3 in another. How many more sticks in one bundle?

(7) There are 8 birds on a tree and 4 chickens on the ground. How many more birds are there than chickens?

(8) Margaret threads 7 beads. Her sister threads only 2 beads. How many more beads does Margaret thread than her sister?

(9) One tree has 9 mangoes ready to eat. A second tree has only 2 mangoes ready to eat. How many more are ready to eat on the first tree?

(10) We have 4 hens and 8 chickens. How many more chickens than hens do we have?

(11) We have 7 pots and 2 spoons. How many more pots than spoons do we have?

(12) Kofi and Kwesi went fishing. Kofi caught 5 fish and Kwesi caught 3. How many more fish did Kofi catch than Kwesi?

(13) Efua has 2 mangoes in her hand and 4 in her basket. How many more mangoes are in the basket than in her hand?

(14) Ama has 2 oranges. She wants 6 to make juice. How many more does she need?

(15) I had 7 balls in a basket and my friend took 4 of them. How many were left in the basket?

(16) Majuma was putting spoons on the table. There were places for eight spoons and she has put four spoons out already. How many more must she place?

(17) Araba had six paw-paws and Mary had eight. How many more did Mary have than Araba?

(18) There were 5 chairs in a room. Nine people came in. How many more chairs are needed?

(19) Kwame found 8 eggs, but 2 were broken. How many were not broken?

(20) Esi puts 7 cups on a table. Only one cup is large and the rest are small. How many are small?

(21) Aba picked 3 flowers to put in a jar. Her mother wants 9 flowers in the jar. How many more are needed?

Show the relation between addition and subtraction with these problems. Problems such as the following are to be used along with the problems just given: (Problems (a) and (12) go together, (b) and (13), and so on.) Let the children talk about problems (a) and (12) together and then about other pairs of the problems.

(a) Kofi and Kwesi went fishing. Kwesi caught 3 fish. Kofi caught 2 more than Kwesi. How many fish did Kofi catch?

(b) Efua had 2 mangoes in her hand. In her basket she had 2 more mangoes than she had in her hand. How many mangoes were in the basket?

(c) Ama had 2 oranges. She got 4 more in order to make juice. How many did she then have?

(d) I had 3 balls in a basket and a friend put in 4 more. How many were then in the basket.

(e) Majuma is putting spoons on the table. First she placed 4 spoons and then 4 more. How many did she place altogether?

Let the children make problems to go with problem 17 and others.

UNIT 12

COUNTING

Objectives:

1. To revise counting by 1's to 100 and beyond.
2. To revise counting by 10's to 10 tens and beyond.
3. To count by 2's to twenty and beyond.
4. To count by 5's to fifty and beyond.

Background Information for Teachers:

Also see Part 2, "Arithmetic", of your Teachers' Handbook.

The system of decimal numerals is discussed more fully in this section. The way the numerals are formed is shown by counting by ones, tens, twos, and fives. The whole numbers in natural order are listed below from 0 to 110. Actually, to save space some are omitted. The names omitted are the same as the names in the thirties with the proper change in the tens name. For example, 78 is a numeral for "seventy-eight", which is the same as "thirty-eight" with the tens name "seventy" replacing the name "thirty".

The list is extended easily by following the pattern.

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

Numeral	Number	Numeral	Number	Numeral	Number
30	thirty	40	forty	90	ninety
31	thirty-one	.	.	.	.
32	thirty-two	50	fifty	100	one hundred
33	thirty-three	.	.	101	one hundred and one
34	thirty-four	60	sixty	102	one hundred and two
35	thirty-five	.	.	.	.
36	thirty-six	70	seventy	110	one hundred and ten
37	thirty-seven	.	.	.	.
38	thirty-eight	80	eighty	.	.
39	thirty-nine	.	.	.	.

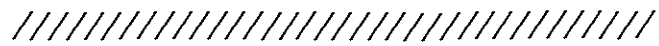
In Unit 8, children counted sets of ten objects tied into bundles. The bundles were counted "1 ten", "2 tens", "3 tens", and so on, to "9 tens" and "10 tens". Now we are ready to combine these words into the words "twenty", "thirty", "forty", and so on.

The same process can be used in counting by twos. Objects can be counted in pairs, "two", "2 twos", "3 twos", and so on. These then may be replaced with the words "two", "four", "six", and so on. The words for counting by twos are every other word in the list of numbers in natural order. In this unit, counting by twos is continued to 10 twos, or twenty.

Counting by fives is done in the same way. Objects such as sticks may be tied in sets of 5, or bottle tops may be grouped in 5's. These may be counted, "1 five", "2 fives", "3 fives", and so on.

The words for counting by five are "five", "ten", "fifteen", "twenty", and so on. These are every fifth word in the list of numbers in natural order.

The following is an example of counting objects by 5's. Think of counting the following set of marks:



Mistakes are often made in counting large sets by ones. Let us first separate the marks into sets of 5. Then think of each set in turn, thinking of the words for counting by 5's at the same time.

/////	/////	/////	/////	/////	/////
5	10	15	20	25	30

/////	/
35	36

The numerals are written under the sets of 5. There is one mark left over. The total number of marks is 35 and 1, or 36.

Counting by fives helps the pupils understand the way numbers are related. It gets them ready to learn the multiples of 5 and to divide by 5. Counting by fives is continued to 50 in this unit.

Stage 1: Counting by Ones, Tens, Twos and Fives

Vocabulary: twenty, thirty, forty, fifty, sixty, seventy, eighty, ninety, one hundred, fifteen, twenty-five, thirty-five, ... , to ninety-five.

Materials: several bundles of 10 sticks fastened with string or rubber bands that were used in Unit 8, a number tray with 3 compartments labelled HUNDREDS, TENS, ONES, three or four sets of beads and string for the beads; seeds, beans, and so on; discs or bottle tops; numeral cards for each child with 10, 20, 30,... 100; numeral cards for each child with 5, 15, 25, ... 45; one hundred number chart prepared for Unit 8; dice; pupil pages 70 (Volume I), 87-89.

Teaching Procedure:

Activity 1: The number words for multiples of ten (ten - ninety).

Show the class a set of 10 sticks. Ask, "How many in this set?" (Ten) "How do we write ten?" (10) Write "1 ten = 10 = ten", on the blackboard. Show the class 2 bundles of 10 sticks and ask, "How many now?" (2 tens) Put the 2 bundles in the TENS space in the number tray. Say, "We can say twenty

instead of 2 tens." Let the children repeat the word several times. Write the numeral for 2 tens and the word "2 tens" on the blackboard. It should look like this:

1 ten = 10 = ten

2 tens = 20

Do this again with 3 bundles for "thirty" and write "3 tens = 30" on the blackboard under the 2 tens statement. Repeat for all the numbers 40, 50, 60, 70, 80, 90. Let the class repeat the activity with their bundles of tens at their desks.

Activity 2: Counting by 10's and using the words "ten, ... ninety" and "one hundred".

Ask 10 children to get bundles of ten sticks from your table and stand in front of the class in a row. Let each child hold his bundle so that all can see. Ask a child (first child) to hold his bundle of sticks up and say, "I have ten sticks." Let him give his bundle of sticks to the second child. The second child says, "I have twenty sticks." Let the second child hand his bundles of sticks to the third child. The third child says, "I have thirty sticks." Go on in this way until the last child receives ten bundles. Say, "Ten tens has another name, the word for 10 tens is one hundred." Get the children to repeat "one hundred" several times. Let a child with 10 bundles of sticks go quickly to various members of the class asking, "How many?" Write "10 tens = 100" on the blackboard and let the children read, "ten tens equals one hundred".

Ask the 10 children with the bundles to count the bundles several times again as the bundles are passed, saying this time, "ten, twenty, thirty", and so on, to one hundred. Let other children count 10 bundles of ten sticks.

Get the children to look at the large hundred chart prepared for Unit 8, point to the numerals 10, 20, 30, ... 100, and read them, "ten, twenty, thirty, ... one hundred".

Ask the children to write the numerals for ten, twenty, ... one hundred on their papers and read the numerals.

Activity 3: Counting by 10's using the number words.

Prepare beads from bamboo, papyrus, paper, or seeds. Let children make several sets of one hundred beads by threading them on a string, in sets of ten. The sets of ten beads should be threaded in alternate colours or patterns. Let the children count the beads by tens (ten, twenty, ... one hundred).

Activity 4: Counting by 10's using number words Pupil Page 87

Let the children find page 87 in their books and look at the pattern of blocks on the left. Ask, "How many black and white blocks in each row? (10) What is the number at the end of row 4 (40); row 9 (90); and so on? Count the blocks in tens up to fifty; eighty; seventy; forty; and so on. Count backwards in tens from one hundred to sixty; from seventy to ten;" and so on.

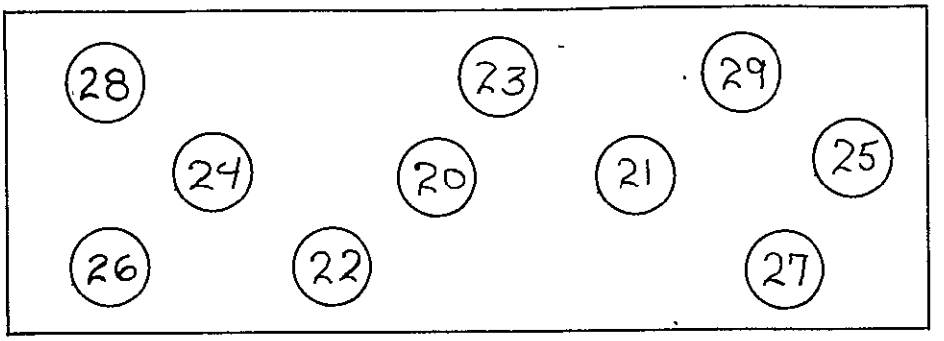
Let the children look at the picture of the steps on the right of page 87. Get the children to point to the 5th step, the 9th step, the 2nd step, and so on, and tell what number is on that step. (Fifty, ninety, twenty, and so on.) Point to the step which comes after 30, 60, 10, and so on, and ask what number is on that step. (Forty, seventy, twenty, and so on.) Point to the step which comes before 90, 20, 50, and so on, and ask what number is on that step. (Eighty, ten, forty, and so on.) Continue by giving similar directions; for example, what step comes between 40 and 20 and what step comes between 30 and 50.

Activity 5: Counting by 1's from 20-29 and using the words "twenty-one, ... , twenty-nine".

Give the children two bundles of ten sticks each. Put the two bundles in the number tray and ask the children to say the word "twenty". Write "20" on the blackboard and put a ring round it. Now ask a child to put one more stick in the ONES place of the number tray. Ask another child to write the numeral "21" on the blackboard. Ask what it means. The "2" of "21" tells us 2 tens. Ask what the "1" of "21" means. (1 one) Ask what other word we use for 2 tens. (Twenty) Now tell them we have another word for "2 tens and one" and the word is "twenty-one". Write the numeral "21" on the blackboard some distance away from "20"

and put a ring around it (see below). Repeat the activity, adding one stick each time to the number tray until all the numbers between 20 and 30 have been named and the numerals are spaced out on the blackboard.

Your blackboard will look something like this:



Let the children repeat the words in order as you point to them, twenty-one, twenty-two, and so on. Then have them turn and look at the back of the room. Rub off one numeral, 24. Get the children to look and think what number is missing. Ask a child to name the missing number. Ask another child if he is right. Let a child point to the numerals remaining, in order, to locate the one missing. Repeat by asking a child to choose a numeral to rub off. Let him ask, "Which numeral was rubbed off?" Vary the activity by letting children write on their papers the numerals rubbed off. (Remember to write them down yourself.) Continue until no numerals remain on the blackboard.

Dictate the words for numbers from 20 to 30 and let the children write the numerals in their exercise books.

<u>Activity 6</u>: The number words "eleven, twelve, ... nineteen". Pupil Page 70

Draw on the blackboard a set of 10 marks with a ring around them and one more mark, as shown below. Ask, "How many marks do you see?" (One ten and one) Write "1 ten and 1" on the blackboard.

1 ten and 1

Tell the class that we have another word for this number. Say, "eleven", several times. Let the children repeat "eleven" several times.

Ask the children to put out on their desks a bundle of 10 sticks and 1 more and ask several of them, "How many?" Write the numeral 11 on the blackboard. Ask a child to put 11 sticks in the number tray.

Repeat a similar activity for the word "twelve" with twelve marks on the blackboard, sticks on the pupils' desks, and in the number tray. Repeat for the other number words "thirteen", ... "nineteen".

Let the pupils look at the number chart in their books on page 70 (Volume I) or at the large chart made for use in class. Ask them to put their fingers on 1 and say "one", on 2 and say "two", ... on 11 and say "eleven", on 12 and say "twelve", ... "twenty". Also ask them to go on to "thirty".

Ask the children to go through a similar activity beginning at 20 and counting backwards to 1. Then at 30 and counting backwards.

The chart may also be used in the following ways among others:
Read all the numbers in the second row. (Point to the row.)
Read all the numbers in the third row. (Point to the row.)
Read all the numbers between 17 and 20.
Read all the numbers between 25 and 20.

Activity 7: Counting by 1's from 30-100.

Revise the counting of 30 objects by 1's by asking pairs of children to put their counters together and count out 30. They should put them in sets of ten as they count.

Let several children use the number tray and count out 30 sticks, tying them into bundles of tens, and putting them in the number tray until they say "thirty". Ask how many bundles of tens are in the TENS space. (3 tens) Say that another word for "3 tens" is "thirty".

Ask a child to put another stick on the ONES space. Let the class talk about what "3 tens and one" or "thirty and one" could be called. Perhaps they will say "thirty-one"; if not, get them to think of "twenty" and "twenty-one" Continue in a similar way until all the other number words have been introduced.

Let the children look again at the large number chart prepared for Unit 8 or pupil page 70 and direct them in activities like the following:

Read the numerals in the fourth row. (Point to the row.)

Read the numerals between 35 and 39.

Read the numerals between 95 and 90.

Read the numerals in the third column. (Point to the third column.)

Read the last five numerals on the chart.

Get the children to write numerals as you dictate them: 90; 45; 72; 35; 29; 13; and so on.

Activity 8: A counting game. Pupil Page 88

Pairs of children may use the path on this page to play a game. They will each need a bean of different colours and a pair of dice. (Children may prepare these from blocks of wood.)

The children take turns in throwing the dice. They begin with their beans on the 0-space of page 88. If the dice are thrown by the first child and the 2-spot and 1 spot are up, he may move his seed along 3 spaces from 0 to 1 to 2 to 3. He stops on the "3".

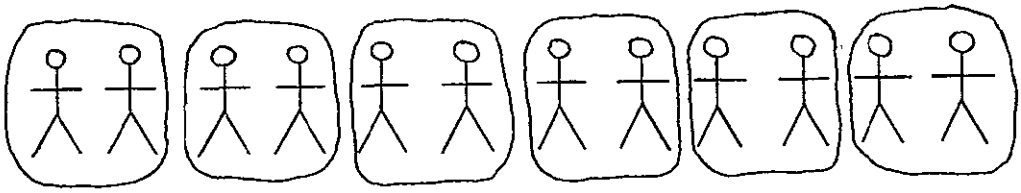
The second child throws the dice, finds the number of dots on the dice, and moves his bean from "0" that number of spaces. They continue in turn. The child who has a bean first on "30" wins.

As the children learn the game, this variation may be made in the game: if at the end of a count a bean is on any of the shaded squares, the player must move his bean back two squares.

The children may prepare their own paths in their exercise books so that they may be extended to 40, to 50, ... to 100.

Activity 9: Counting by 2's.

Draw several sets of 2 stick men or other small objects on the blackboard as shown below. Let the children put rings around pairs of the men.

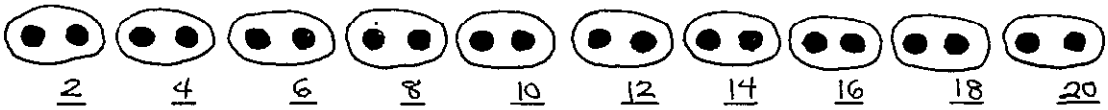


Cover all the stick men except one set; ask how many stick men. (2) Uncover another set; ask how many stick men. (4) Uncover the third set; ask how many. (6) Continue until all are uncovered. Repeat, letting the children tell how many they can see as you uncover sets of two. As they tell how many, they will be counting by twos.

Draw a series of twenty dots on the blackboard. Ask the children how many dots there are. (20) Let a child write the numerals he uses in counting below the dots, as shown below. Let children draw rings around pairs of the dots.

Say, "You counted the dots by 1's. I shall count them by 2's." Stand with your body covering many of the dots and your right hand and arm covering all of the dots except two. Count 2, 4, 6, and so on, as you uncover sets of 2 dots. Let the children count by 2's as you uncover sets of 2.

Ask, "Did we use all the numerals you wrote under the dots when we counted by 2's?" (No) Say, "Let's count again and let Yafi put a mark under the numerals we use." Let another child rub off the numbers not used. Get several different children to count the dots by 2's again. The blackboard will look like this:



Let pairs of children arrange bottle tops on their desks and count them by 2's. The sketch on the blackboard may be used for reference.

Activity 10: Counting by 2's. Pupil Page 89

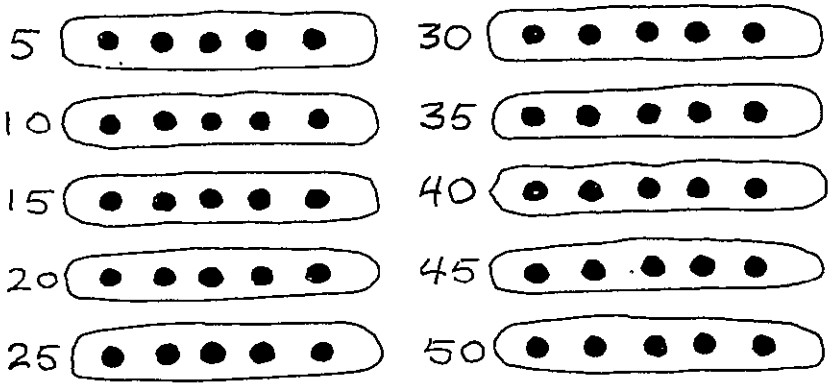
Give each child some one-inch numeral cards. Ask them to look at page 89 and find how many spaces there are on the page. (The children will probably count by 1's.) Let them find a numeral card for the total number of spaces and put it on the last space. Ask if they have the same number of spaces as is written on the page.

Let the children count by twos and put the numerals for the numbers used on the spaces as they count. You will find other uses for the page.

Activity 11: Counting by 5's to 50 and beyond.

Let the children show you the set of 5 fingers on their left hands and the set of 5 fingers on their right hands. Ask, "How many fingers do you have?" (10) Let 5 children come to the front of the room and ask each to show 2 sets of 5 fingers with their hands. Then ask them to put their hands behind their backs. Ask a child to hold out one hand. Ask, "How many fingers?" (5) Ask him to put out his other hand. Ask, "How many?" (10) Let all the children at the front of the room continue putting out one hand at a time as the other children count their fingers; 5, 10, 15, 20, 25, 30, 35, 40, 45, 50. Repeat the activity. Ask, "How many sets of 5 fingers have we counted?" (10)

Draw 10 sets of 5 on the blackboard:



Let the children count the sets. Then ask them to write the numerals used to count the sets at the side of each set. Get the children to count forwards and backwards by 5's. Ask the children to count by 5's up to 40, 45, 50, and so on. Let the children turn to look at the back of the room; then rub off one numeral, and ask a child to write in the missing numeral and read the numeral.

Let children draw sets of 5 objects on their papers and count the objects by fives.

Call attention to the large number chart prepared for Unit 8 or pupil page 70. Let a child point to the numerals on the chart and say the words used in counting by 5's.

Activity 12: Solving problems.

The children have learned to count; now they should count things. Make up problems about what the children do both inside and outside the classroom.

Make sure by questions that the children understand the problems and know what numbers they need to find. Ask questions which will help the children find the answer. Ask them to tell how they found the answer. Let the children act out the problem or draw pictures to help them. Below are some problems you may use:

(1) There are 4 rows of 2 buttons on a card. How many buttons altogether?
(2) I eat 2 sweets every day for 5 days. How many sweets do I eat?
(3) There are 5 needles in a packet. I buy 5 packets. How many needles have I?
(4) My mother has 4 bunches of bananas. There are 5 bananas on each bunch. How many bananas altogether?
(5) There are 3 children in our house. Each has a pair of shoes. How many shoes altogether?
(6) A button card has 6 rows of 5 buttons on each row. How many buttons are there?
(7) Ten baskets have 5 eggs in each. How many eggs are there?

(8) Our school has 5 cupboards. Each cupboard has 2 doors. How many doors are there?

(9) I see 6 chickens. How many legs have they?

(10) Seven rows of banana trees have 5 trees in each row. How many banana trees are there?

(11) There are 7 sets of 2 children standing in lines outside the classroom. How many children are there?

(12) I have 8 bundles of pencils with 5 pencils in each bundle. How many pencils have I?

(13) Three children have 5 books each. How many books do they have altogether?

(14) Each of eight children has a set of 2 beans on his desk. How many beans are there altogether?

(15) Nine rows of bottle tops have 5 in each row. How many are there altogether?

UNIT 13

GEOMETRY

Objective:

To develop the ideas of straightness, line segment, four-sided figure, rectangle and circle.

Background Information for Teachers:

Also see Part 2, page 67, "Geometry", in your Teachers' Handbook.

Your pupils began to learn the ideas of "straightness" and "roundness" from things around them. They learned from things that grow, such as trees, grass, reeds, flowers, fruits and seeds. They learned from man-made objects such as boxes, boards, sticks, houses, tins, balls, books, sheets of paper and pieces of cardboard. From these objects the children have some simple ideas of geometry such as straightness and roundness. We begin geometry by helping them to make these ideas clearer. We will follow these steps:

1. Find objects to show pupils straightness, roundness and so on.
2. Let pupils make objects which have straight edges, circular edges, four-sided faces and so on.
3. Let pupils trace the outlines of objects on the blackboards and on paper to show line segments, four-sided figures and so on.
4. Name the tracings or geometric figures "line segments", "four-sided figures", and so on.

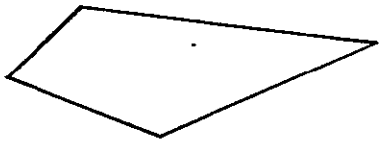
Each of the four figures, line segment, four-sided figure, rectangle and circle, is developed in turn in Stages 1-4 of this unit. For example, in Stage 2, to help the pupils learn about four-sided figures, we look at everyday objects. The four edges of a table top, of a piece of paper, of a book cover, and so on, are pointed out as showing "four-sided figures". The children are then asked to find other examples. Next they are given sticks and they make their own four-sided objects. After many are made in this and other ways, the children make

tracings of objects on the blackboard or on their papers. Finally, they name these tracings "four-sided figures".

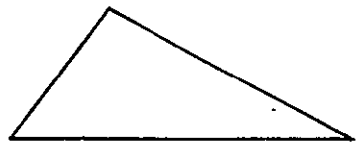
At the end of the four stages of this unit the pupils should have learned the following about figures:

This is a line segment.

These are not line segments.

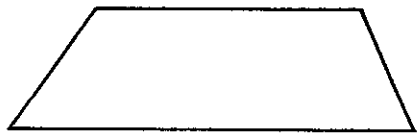


This is a four-sided figure.

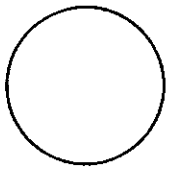


This figure is not four-sided.

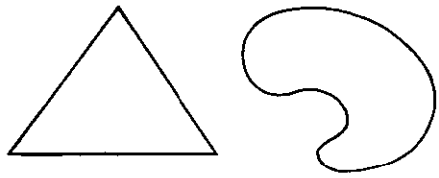
This figure is a rectangle.



This figure is not a rectangle.



This is a circle.



These are not circles.

Stage 1: Line Segments

Vocabulary: line segment, straight edge, figure, three-sided figure, four-sided figure, side.

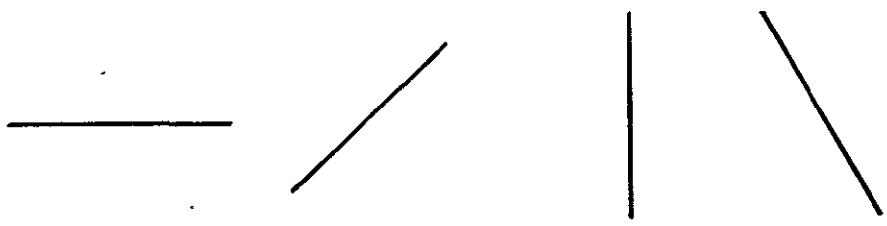
Materials: strings and other models of line segments such as straight sticks, pencils and chalk; pieces of cardboard and paper; sticks; nail boards and rubber bands; pupil pages 90-91.

Teaching Procedure:

Note: In this stage we first develop the idea of "straightness". Since the child's idea of straightness comes from what he sees and touches, we start with familiar objects that show straightness. We first point out straight objects like sticks and pencils, and the straight edges that are on tables, boxes, boards, books, and so on. Then the children themselves point out straight objects and straight edges. Next the teacher and the children make straight objects in the form of strings and threads made straight by stretching, and straight edges formed by folding paper.

The children then take the straight objects and edges they have found in the classroom, and those they have made, and trace them on the blackboard, slates, or paper. They learn to test the straightness of an edge and of a tracing by fitting on them a stretched string.

When the children have done these tracings they have made figures that look like these:



Activity 1: Straightness and line segments.

Show the children different types of objects with straight edges; each time run your finger along an edge and say, "This edge is straight." Get the children

to name familiar objects like pencils, match-sticks, counters, edges of table tops, books and maps. Let them run their fingers along the edges and say that the edges are straight. Encourage the children to name the objects and to point to the straight edges.

Hold a piece of string in front of the class. Pull it tightly at both ends. Ask the children whether it is straight. (Yes) Loosen the string and ask again whether it is straight. (No) Bring out the idea of straightness by contrasting various positions of a loose string to the position of a tightly stretched string. Hold the string in different positions to show children that straight edges are not always horizontal or vertical. They may be in any direction.

Fit stretched strings on the edges of table tops, picture charts, and doors, and also on straight marks on paper. Get the children to help you decide whether the edges and marks are straight.

Tell the children that the shape, which is suggested by stretched strings, thin straight rods, the edges of bookshelves, the edges of a door or the edges of a block, is what we call a line segment.

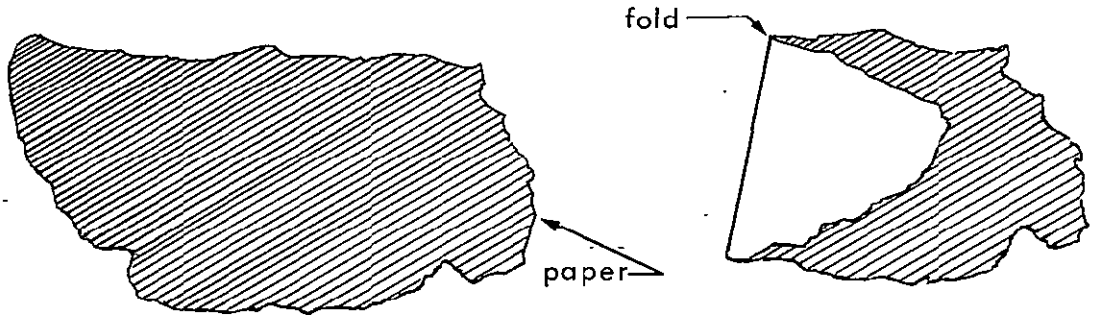
Show the class a thin rod, a stretched string, a tightly stretched thread, a pencil, and the straight edge of a piece of paper. Ask a child to pick out the thinnest of these objects (the thread and the straight edge of paper). Let the children decide the following: a tightly stretched thread is a better picture of a line segment than a stretched string; the edge of a folded piece of paper is a better picture of a line segment than a pencil or piece of chalk; the best picture of a line segment is a thread or the edge of a piece of paper.

Use the straight edge of a book to trace a line segment on the blackboard. Let children use different objects with straight edges to trace line segments on the blackboard. Test the line segments for straightness by fitting stretched strings on them. Put the pencil, rod, stick, rope, and so on, on the line segments to show the children that since these objects are thick the line segments are covered. Now put a stretched thread on the segment. Let the children see the difference. Emphasize the fact that line segments must be straight and thin.

Activity 2: Testing straightness

Pupil Page 90

Give each child a piece of paper and string. Let the pupils fold the paper once to form a straight edge. For example, take any piece of paper (with torn edges or not), and fold it. Pinch the fold flat like this:



Ask the class to point to the straight edge of the paper. Organize the children into small groups and let each group find objects with straight edges as pictures of line segments. When any group has found five such objects, let the pupils of the group point them out. Let them fit pieces of stretched strings and straight edges of papers on these objects to test them for straightness.

Let the pupils now turn to the page 90 of their books and point to a line segment. Ask why they think it is a line segment. If any child points to a curved line, do not say, "No, that is not a line segment." Let him use a stretched string or straight edge made from paper to find his mistake.

Ask the children to test each line and tell whether it is a line segment. Let them use stretched strings or the straight edges of their folded papers. Ask them to put a marker (bottle top) on each line segment. Let the children talk together about which lines are line segments.

Activity 3: Drawing line segments.

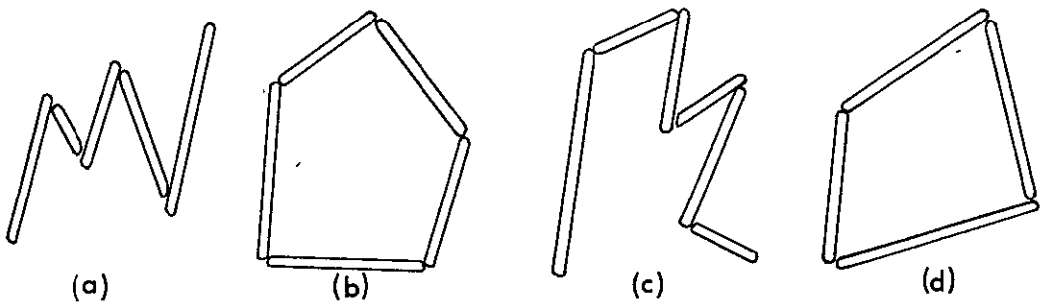
Let the children revise these by talking about them: (1) a string held tightly at both ends, the edge of a folded paper, or any object with a straight edge can be used to trace line segments; (2) a straight edge can be made from any piece of paper by folding the paper once and pinching it flat along the fold.

Use the edge of a folded paper to trace a line segment on the blackboard. Use a stretched string to test that the line segment is straight. Let several pupils come to the blackboard and use the straight edges of sticks, thick cardboard, and so on, to draw line segments. Ask other children what the children have drawn and let them answer, "Line segments"

Now let the children use objects with straight edges to draw line segments on their papers. Let them have plenty of practice in tracing the line segments. Go around the class helping the children trace straight segments and test their tracings with straight edges of folded paper.

Activity 4: Making geometric figures from line segments Pupil Page 91

Distribute about 8 sticks to each child. (Use the sticks collected for Units 8 and 12.) Ask the children to put the sticks end to end to form shapes. They may make patterns like those shown below:



Go around the class to see what each child has made. Tell those who have made closed figures, for example (b) and (d) above, to count the sticks they used to make the figure. Suggest that other children make closed figures. Emphasize that sticks must be fitted end to end.

Pick up three long sticks and hold them so they fit together end to end. Ask, "How many sticks did I use to make this figure?" (Three) Draw a closed three-sided figure on the blackboard using the three sticks to trace the three line segments. Ask the children how many line segments you used. (Three) Tell the class that the picture on the blackboard is a three-sided figure.

Ask all the children who have made three-sided figures on their desks to stand up. Let the others make three-sided figures. Ask, as you point to various figures, "Why do you think these are called three-sided figures?" (They are made from three line segments; they have three sides.)

Let one of the children come to the blackboard and trace a three-sided figure. Let him use sticks to trace the line segments. Get another child to hold the sticks in position while the first child traces the figure. Ask the others to trace three-sided figures on their papers using three of their sticks.

Let those children stand who made closed figures from four sticks. Tell the others to make a similar figure. Ask if anyone can give these figures a name. After talk about this, decide on "four-sided figure". Ask, "Why is that a good name?" (They are made from four line segments. Or, they have four sides.)

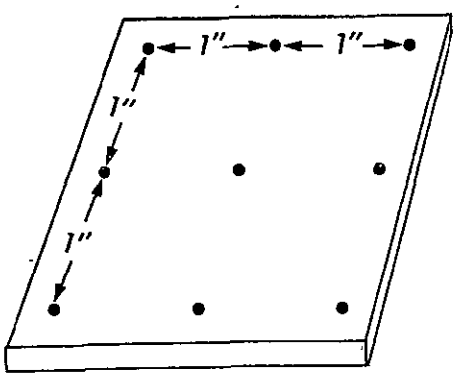
Let the children make other figures from sticks, one with three sides, four sides, five sides, and so on. Get them to trace them on paper and name them by the number of sides.

Ask the pupils to find page 91 in their books. Let them point out these things: line segments, three-sided figures and four-sided figures. Let them first put markers on three-sided figures, then on four-sided figures. Talk about each figure and say whether it is or is not a four-sided figure.

Activity 5 (optional): Using a nailboard to make line segments and figures.

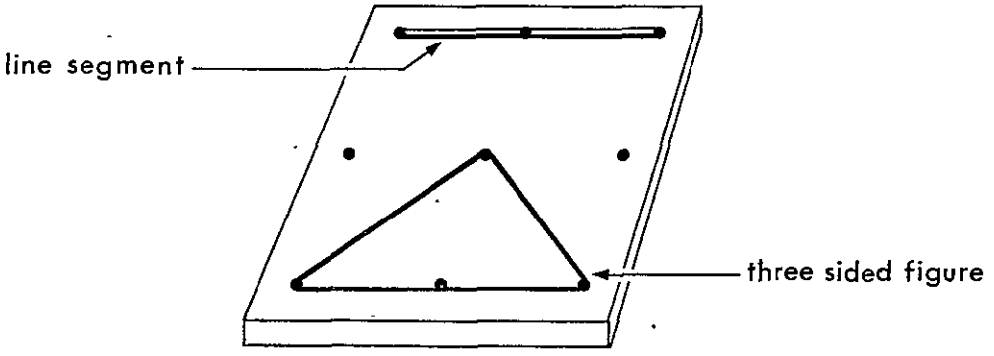
Note: A nailboard is a simple teaching aid. It can be used by the children to help them in their work with line segments, three-sided and four-sided figures, and later with other straight-sided figures. This teaching aid is made from a small piece of flat board about three inches square, nine small nails, and one or two rubber bands.

To make a nail board, draw a two-inch square on a piece of board. Separate the square into four one-inch squares. Dot the nine corners of the one-inch squares. The board will look like this:



At each of the nine dots drive a small nail, leaving one half inch of nail above the board.

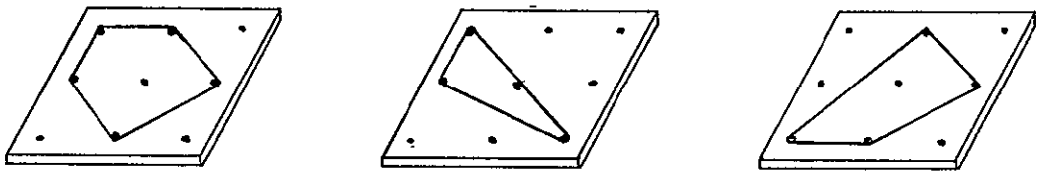
The board is ready to have one or more rubber bands stretched around the nails to show geometric figures. A nail board with rubber bands stretched to show a line segment and a three-sided figure is shown below.



Give each child, or each small group of children, a nail board and two rubber bands. Let the children fit the rubber bands around the nails on the boards until some show line segments. Go round the class to see what each child is doing. When a child makes a line segment show it to the class. Ask the others whether they can show a line segment on their nail boards. Let the next child who succeeds also hold up his board. Let this child move his finger along the rubber band to trace out the line segment. As each child makes a line segment let him repeat this activity. Go round the class to give help where it is needed.

Get the pupils to fold pieces of paper and hold the straight edges along the rubber bands, as they did earlier with the stretched strings. Also let them stretch pieces of string along the rubber bands which show line segments. Ask, "Are the edges of the folded papers, the stretched pieces of string, and the rubber bands on the boards alike in any way?" (Yes. They are all straight and are all pictures of line segments.)

Ask the children to fit rubber bands around nails to form many different three-sided figures, four-sided figures, five-sided figures, and so on. Let them hold up their nail boards for others to see when they succeed in making any of these figures. Let them work in groups and try to see how many different figures they can make. Some examples of figures they may make are these.



Stage 2: Four-sided figures.

Vocabulary: corner

Materials: wire models of four-sided figures, paper or cardboard cutouts of four-sided objects (see models in Activity 1); sticks, string, nail boards, rubber bands, scissors and clay; one envelope for each child.

Teaching Procedure:

Note: Teach about figures with four straight sides by asking children to look at objects. The four edges of a table top, or a piece of exercise paper, or a book cover or some pieces of cardboard, are pointed out as "four-sided figures". After children see many four-sided figures let them find objects in the classroom and outside which show four-sided figures. For example, they may be given four sticks and asked to "make a four-sided figure". Many more such figures are made

from string (See Activity 3). Then the pupils trace the edges of the four-sided objects they have found and made. These tracings are named "four-sided figures". At each stage the figures are tested to see if the sides are straight, and if there are four sides.

Activity 1: Tracing four-sided figures.

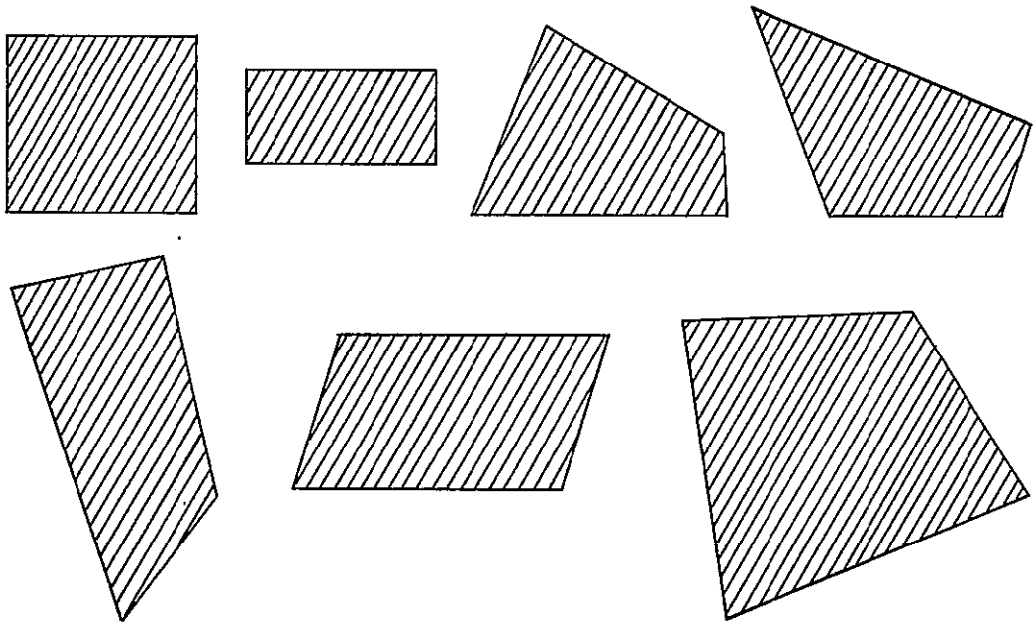
Give the pupils several cardboard cutouts which show four-sidedness. Tell them to count the number of edges as you run your finger along each edge. Let several of the children run their fingers along the edges of other cutouts as they count the number of edges. Ask the children to name some other four-sided objects in the classroom (books, slates, tabletops, sheets of paper, faces of boxes, picture frames, blackboards).

Again run your finger along two edges of a cardboard cutout. Say, "There are two edges. The edges meet here." (Point to corner.) This is called a corner." Repeat once again. Let pupils trace along two edges, point to where they meet, and say, "This is a corner."

Let the children look at the four-sided objects that they named in the classroom. Ask, "How many corners does the table top have? How many corners does the blackboard have?" and so on. Let them point to these corners. Discuss the number of corners each four-sided figure has. Let the pupil talk about four-sided objects in terms of the number of edges they have, and the number of corners they have.

Ask the children if they have made four-sided objects. (Yes. We made some with sticks.) Say, "You then traced them on the blackboard and paper and made four-sided figures. Let us do that now." Ask a child to choose a four-sided object and trace it on the blackboard. Then get the child to point first to the "four-sided object", and then to the "four-sided figure".

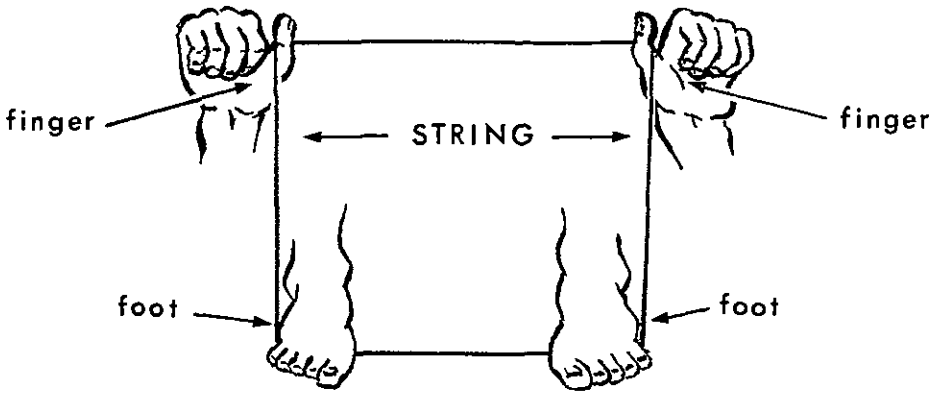
Let the children trace other four-sided figures from cardboard cutouts shaped like these:



Get several children to come to the blackboard and check that the sides of these figures are straight by fitting stretched strings on each side. Let the children once more prove by counting that each of these objects has four sides and four corners.

Activity 2: Making four-sided figures from string.

Make a loop by tying together the two ends of a fifteen foot piece of string. Step on the string with both feet apart. With a finger of each hand stretch the string to show a four-sided figure as shown below.



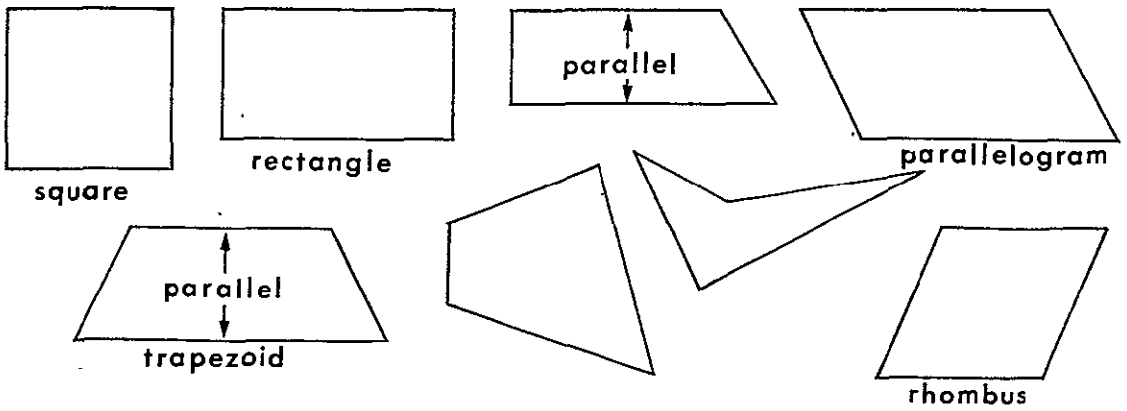
Let each pair of children make a string loop from a piece of string about 3 feet long. Tell each of the two children to use two fingers to stretch the string loop and thus form a four-sided figure. Let each pair repeat the activity until they have made many different four-sided figures.

Activity 3: Making four-sided objects from paper.

Give each child several pieces of scrap paper (newspaper will do) Let them fold the paper to show four-sided figures. Continue until several are made.

Let the children place their figures on paper and trace around the edges. Go around the class and give help as needed. Let the children test the line segments for straightness by stretching string along the line segments.

Choose the best figures traced out by each child and cut them out. Paste these cutouts on a large sheet of paper or cardboard to hang in the schoolroom. Try to get on this chart an example of each type of four-sided figure. A chart will have these figures on it.

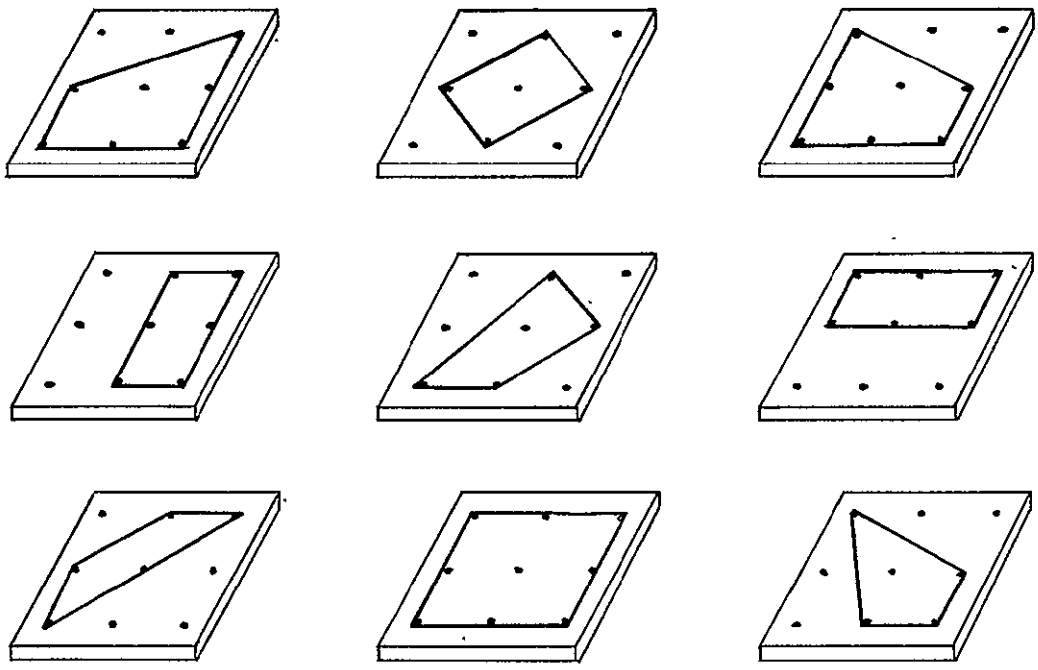


Activity 4 (optional): Showing four-sided figures on a nail board.

Separate the children into small groups and give each group a nail board, and each child a rubber band.

Make a four-sided figure with a rubber band on your own nail board. Show the class. Let them show four-sided figures on their nail boards. The children should take turns, each one trying to make a different figure from those already shown.

Encourage the children to make many different figures. Here are only a few that can be made:



Ask often as you examine the figures formed: "Does it have four sides? Does it have four corners? Does it show a four-sided figure?" When a child makes a figure which is not four-sided, ask the same questions and help him decide it is not a four-sided figure. Ask, "How many sides has this figure?"

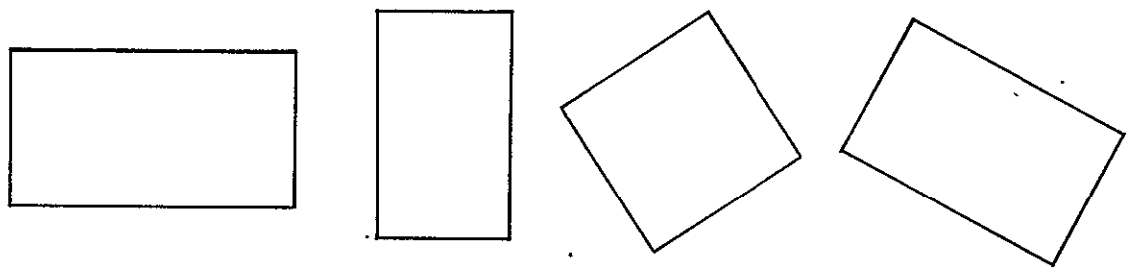
Stage 3: Rectangles.

Vocabulary: rectangle, square corner.

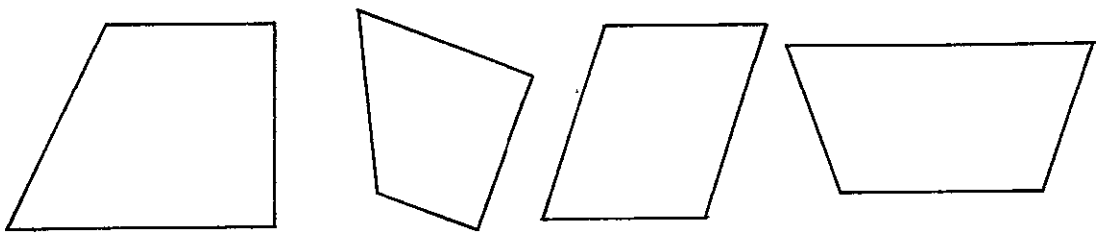
Material: objects in the classroom; cardboard cutouts in the shape of four-sided figures, some of which should be rectangles, some should have one or two right angles, and some should have no right angles (see models in Activity 2); newspapers; beans or other markers; pupil pages 92-93.

Teaching Procedure:

Note: Any four-sided figure has four corners. If all four corners are "square corners" like the corner of this book, the figure is called a rectangle. These four-sided figures are rectangles:



These four-sided figures are not rectangles:



Activity 1: Recognizing rectangles.

Show the class many objects which are four-sided. Some of them should be objects which show rectangles, and some should not show rectangles. Point out, for example, table tops, slates, chairs, books, and paper cutouts. Let the children describe each of these as four-sided. They should run their fingers along the edges, point out the corners and say, "This is a four-sided figure. It has four sides and four corners."

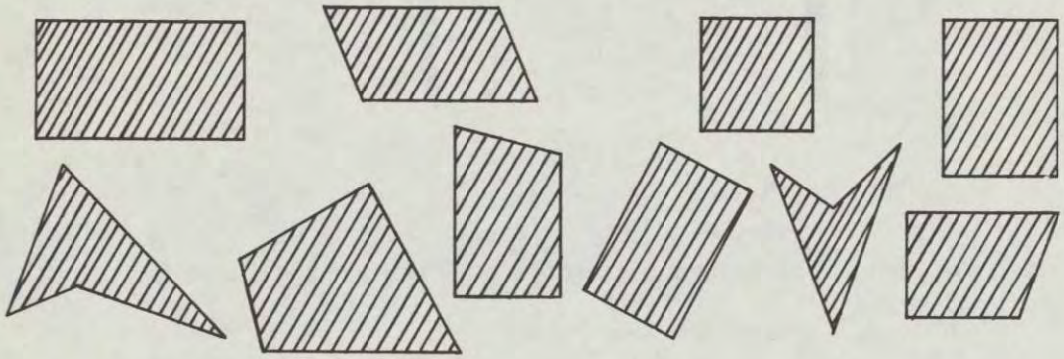
Pick up a four-sided object which is shaped like a rectangle. Show it and say, "This is a four-sided object. (Run your finger along the edges.) It shows a rectangle." Ask the children to repeat "rectangle". Hold up several other objects and tell the children the objects show rectangles.

Hold up a four-sided object which does not show a rectangle. Say, "This is a four-sided object. It does not show a rectangle."

Continue to classify objects in this way. You say each time, "This shows a rectangle," or, "This does not show a rectangle." Each time run your finger along the edges of the four-sided object and point to the corners. Let the children do and say the same thing with the objects.

Activity 2: Rectangles have square corners.

Place many four-sided cardboard cutouts on a table. Some should show rectangles. Some should not show rectangles. These are some shapes you might use:

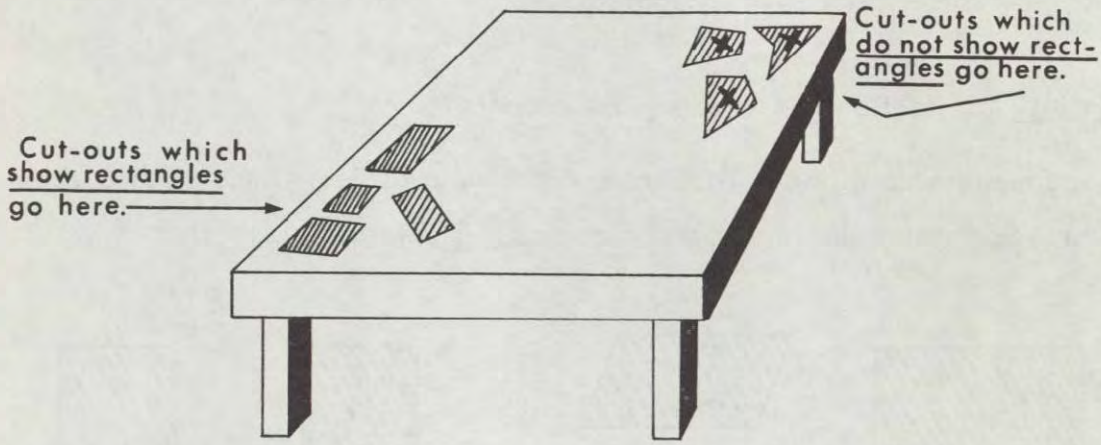


Now pick up a cutout which shows a rectangle. Say, "This shows a rectangle." Get the children to repeat, "This shows a rectangle" as you run your finger along the edges. Do this same thing with several other cutouts which show rectangles. Now pick up a cutout which shows a rectangle and ask, "Does this show a rectangle? Does it look like the others?" The children will possibly say "It shows a rectangle." If not, you tell them that it does.

Say, as you pick up all the cutouts which they have found to show rectangles: "We will put all the things that show rectangles here." Put them on one end of the table. Say, "We will use this space at the other end of the table for things that do not show rectangles."

Pick up the other cutouts one at a time. Help the children to decide which show rectangles, and which do not. Place each in the proper place on the table.

Let the children mark with an " × " all of the cutouts which do not show rectangles. As they mark them in turn they should be saying, "This does not show a rectangle."

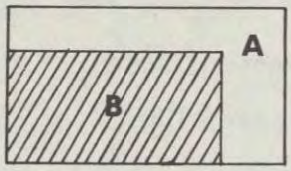


Pick up two cutouts that show different rectangles. Call one A, the other B, as shown below.

Place B neatly on top of A. Ask, "Do these fit exactly?" (Since the two cutouts show different rectangles, B will not cover A.) Let the children try to make them fit. They will say they do not fit.

Say, "These cutouts do not fit exactly. Maybe parts of them fit. What parts of four-sided cutouts do we know about?" (Sides and corners) "Try to make the

sides fit." Give the cutouts to children and let them try. They should slide cutout B so that it's bottom edge fits along edge of cutout A like this.



Ask, "Do the bottom edges fit exactly?" (Not for these cutouts.) Let the children show the other edges of these cutouts do not fit exactly.

Say, "The sides do not fit. What other parts should we try to fit?" (Corners) The children may have already shown that corners fit exactly. (See the drawing above.) Let them try to fit the corners. Ask questions until they say all pairs of corners fit exactly.

Give each pair of children a pair of cutouts that show rectangles. Ask the children to try to make the corners of the two cutouts to fit exactly. Ask, "Do the corners of your cutouts fit exactly?" (Yes) Let each pair of children exchange <u>one</u> of their cutouts with another pair of children. Let them again try to fit corners. Ask, "Do the corners of the two cutouts fit exactly?" (Yes) Continue as needed.

Let the children talk about whether the corners of all cutouts that show rectangles will fit. The children will agree.

You pick up any two cutouts which show rectangles and fit one corner of one to each of the four corners of the other. Turn the cutout over and show this again. Show the cutouts in many positions with corners fitting exactly. Say, "If I pick up any two cutouts that show rectangles the corners will fit exactly."

Pick up two cutouts, one of which shows a rectangle and one which does not. (The second one will be marked with an " × ".) Call a child to the front and let him try to fit the corners. Ask, "Do the corners of these cutouts fit?" He should find that some corners do not fit.

Give other children pairs of cutouts, one which shows a rectangle and one which does not. Ask them to try to make the corners fit. They will find the

corners of a cutout showing a rectangle do not all fit the corners of a cutout which does not show a rectangle.

Let the pupils talk about this question: "How can we decide if a four-sided object shows a rectangle?" After some discussion they should say, "It shows a rectangle if all the corners are alike."

Let them test some cutouts which show rectangles to decide if the corners are all alike. Hold in your hands a cutout which shows a rectangle and say as you run your fingers round the edges, "This shows a rectangle. Its corners are square corners."

Ask each child to hold up a cutout which shows a rectangle. Get him to point to each corner, and to say, "This is a square corner." Be sure he does this for all four corners.

Also ask each pupil to hold up a cutout which does not show a rectangle, to point to each corner and to say, "This corner is not a square corner" or "This corner is a square corner." Note that some of the corners may be square corners but not all of them.

Continue the activity as needed.

Activity 3: Testing for square corners with corners of books.

Pick up a book. Ask, "Does this book have square corners?" (Yes) Does it show a rectangle?" (Yes)

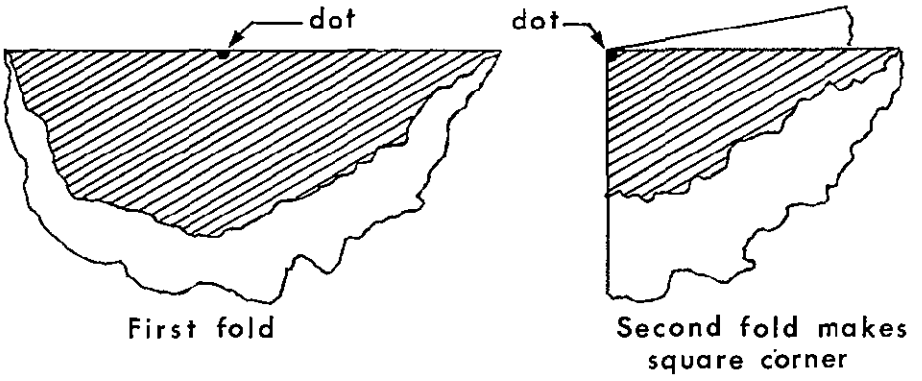
Say, "We can use a book to decide if a corner is square. Here is a four-sided object." Hold up a large cutout which is not a rectangular object. "How can we use the corner of the book to decide if its corners are square?" Let the children talk about this and say that they can see if the corners fit.

Let the children use a book to decide if corners of objects in the room and of cutouts are square corners.

Activity 4: Testing for square corners with folded paper.

Give each child a piece of paper. A piece of paper of any shape will do. It may be a piece of newspaper.

Ask the child to fold the paper once. (See below.) Let them make a dot about half way along the edge of the fold. They should now fold the paper again at the dot so that one part of the edge of the fold falls along the other part. (See below.)



Say, "Look at the corner you have made. It is a square corner. We will use it to decide if other corners are square."

Get the children to try to fit their square corner made of folded paper onto corners of objects in the room. Use tables, chairs, books, and other pieces of furniture as well as cutouts. Each time they should say or think, "The corners fit. This is a square corner." Or, "The corners do not fit. This is not a square corner."

Activity 5: Deciding whether a four-sided figure is a rectangle. Pupil Page 92-93

Put many four-sided cutouts on a table. Draw several four-sided figures on the blackboard.

Hold up a four-sided cutout which does not show a rectangle. Ask, "How can you decide if this shows a rectangle?" Let the children discuss this and say

that they must test each corner to find if it is square. If all the corners are square the cutout shows a rectangle.

Let the children test the cutouts and the figures on the blackboard to see if they are rectangles. Ask them to mark the ones which do not show, or are not rectangles, with an " × ". See that the same figure is checked by several children.

The children should check each corner and say, "This figure (or cutout) has four square corners; it is a rectangle," or "This figure does not have four square corners; it is not a rectangle."

Let the children find pages 92 and 93 in their books. Discuss what they see on the pages. (Four-sided figures.) Ask, "How many sides do the figures have?" (Four) "How many corners do the figures have?" Let the children run their fingers along the line segments which form one of the figures and point to the corners.

Ask, "Are the figures rectangles?" (Some are rectangles, some are not.) Let the children use their square corners to decide if a figure is a rectangle. Give them some beans or other markers. Ask them to test each figure on the pages and to put a bean or other marker on the figure if it is not a rectangle. Go around the class helping the children as each works. Ask questions to guide them, such as, "Are all the corners square?" "Did you test each corner?"

Stage 4: Circles

Vocabulary: round, circle.

Materials: coins, buttons, paper cutouts of round figures, bottle tops or lids, tins, string, drawing pins and cardboard; pupil pages 94-95.

Teaching Procedure:

Note: In the earlier stages of this unit children have learned that a line segment is straight. They have seen a line segment drawn with chalk on the

blackboard and they have drawn one themselves with pencil and straight edge. They have put sticks together to form four-sided figures and have traced around them. In all of these activities the children have been concerned with straightness.

In this stage we would like to help make clear to the children the notion of roundness. First, they will work with objects which are round. Later, they will trace the outlines of these and will draw circles with string compasses.

At the end of this stage a revision activity is presented to give the children more experiences in recognizing form and shape.

Activity 1: Noticing objects that are "round".

Children have seen many round objects -- the wheels of cars and bicycles, coins, buttons, tins, bottles and glass jars. In this activity they will look at them more closely.

See that each child is provided with a few round objects. The children themselves may be able to bring some objects from home. Try to give each a bottle top, a button and a paper disc. If other round objects are available, each child may have a set of four objects.

Let the children put their round objects neatly one on top of the other. Put the largest on the bottom and the smallest on the top. This gives them a chance to see how round objects are alike. Let the children exchange objects and form other stacks.

Ask a group of children to put all their objects into one stack. Ask, "Do you know of other objects that are like the bottle top and the button?" Let the children name others, for example, a clock face, and the bottom of a bottle.

The aim of this activity is to let the children see and feel round objects and to notice they are different from other objects.

Activity 2: Introducing circles. Pupil Page 94

Hold up a large round object (round basket) so that the children can see it. Run your finger around the edge. While doing this, say, "This is a round object." Get each child to run his finger around a button and say, "This is round."

Hold the large object against the blackboard and trace around it. Get the children to trace around their bottle tops on their papers. You repeat the activity with different round objects and let the pupils trace around other round objects they have. Say: "You have made a figure. Is it a four-sided figure? (No) Does it have any corners? (No) Is it round? (Yes)"

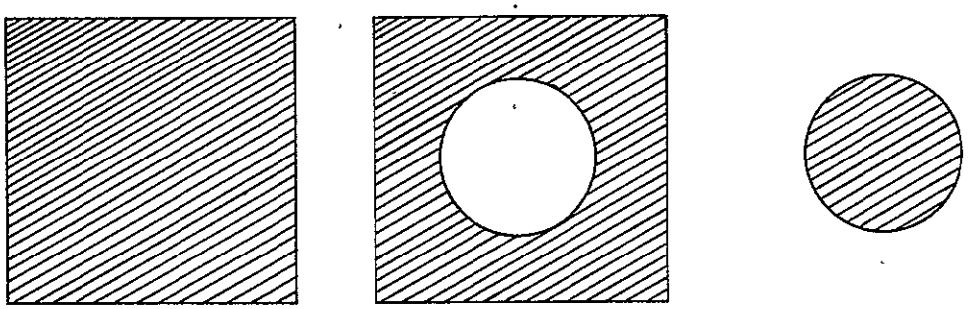
Say, unless a child does so, "This figure is a circle." Let the pupils continue to trace round figures with their fingers or on paper and say, "This is round. It is a circle."

Ask the children to find page 94 in their books. Let them decide as they trace along each figure with their fingers whether it is a circle or not a circle. As they do this, ask, "Is this like the circle we made?" "Is it round?" "Is it a circle?" Give the children several markers each. Let them put a marker on each figure or picture which shows a circle. The children should say for each figure, "This is a circle," or "This is not a circle."

Some children may need to put one of their round objects over the figures in their book to decide whether the figure is or is not a circle.

Activity 3: Tracing around objects which show a circle and naming the figures.

Cut a round figure out of a piece of large cardboard. Do this with a knife or other sharp instrument so a smooth cut is made. This will give you a disc and a piece of cardboard with a round hole in it.



If possible, make several of these cutouts so that the children will have a chance to use them. Demonstrate how the cutout fits nicely into the hole. Run your finger around the cutout and ask the children to name the outline. Trace this figure on the blackboard. Ask the children to name it. (Circle)

Do the same thing with the hole in the other piece of cardboard. Run your finger around the inside edge and ask the children to name the figure you are tracing. Trace the outline of the hole on the blackboard. Ask the children to name the figure.

Let the children do this at their desks with smaller cutouts. Let them outline the figure with their finger and say, "This is a circle."

Hold up an empty tin (open at one end only). Ask the children if the tin shows any round figures. Get them to notice that the bottom is circular, and so is the hole in the top. Run your finger around the edge of the top and bottom of the tin. As you do this, say, "This is a circle." Trace the outlines of the top and bottom of the tin on the blackboard. Get the children to call the figures circles.

Repeat this several times with other common objects that are round. Let the children handle these things, and trace the outlines with pencil and paper, and say for each, "This is a circle."

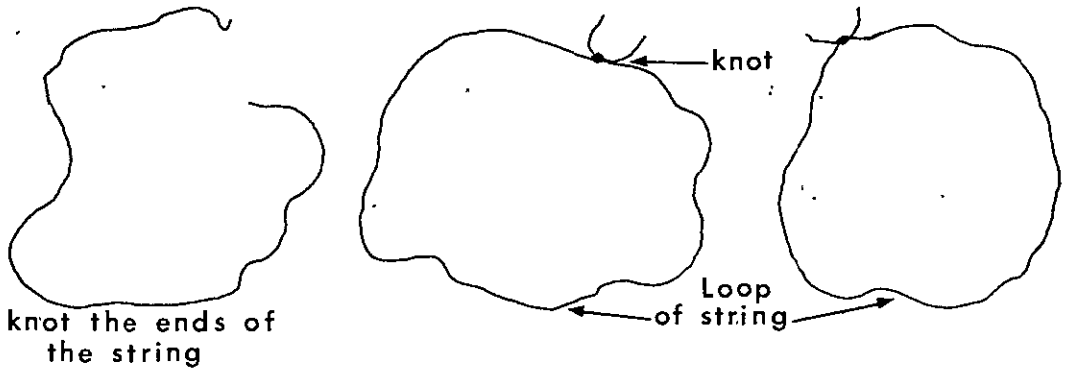
Activity 4: Making figures which are circles.

The children have looked at many round objects. They have traced the outline of these objects and they have named them circles. They should now make circles.

Ask, "How can we make a circle?" Let the children talk about this question. Draw a circle free-hand on the blackboard, but do a poor job of it. Ask, "Is this a circle?" If you have not made a circle, the children should say, "No."

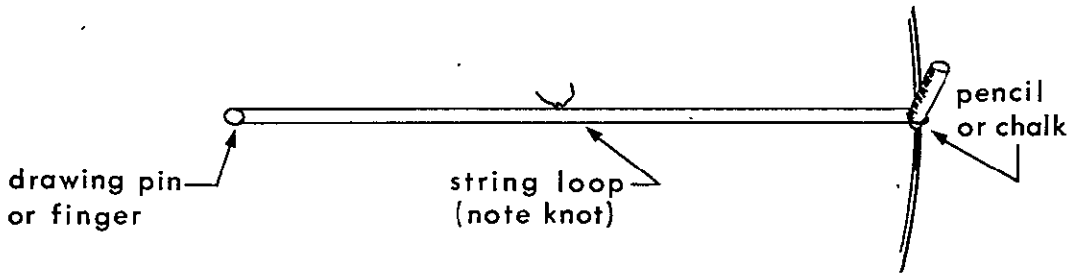
Hold up one of the large circular cutouts and trace its outline on the blackboard. Ask, "Is this a circle?" Say, "I can make a circle if I have an object which shows a circle." Discuss with them how they can make a circle if they do not have a circular object to start with.

Suggest they try to make a circle with a string. (See below.)

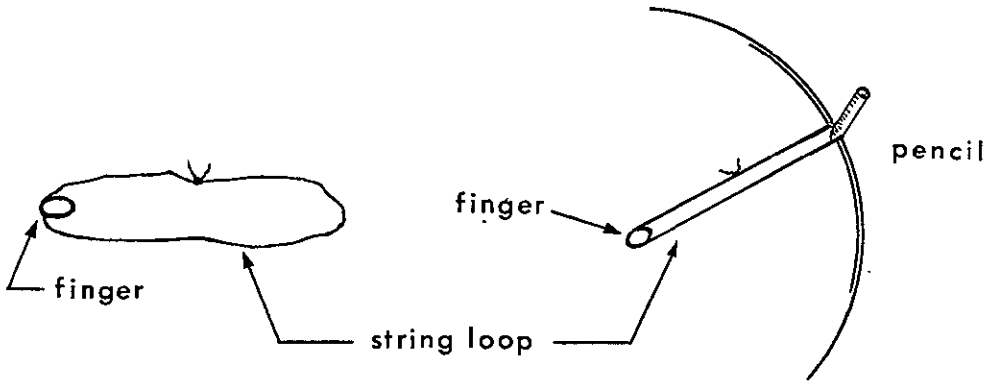


Ask, "Can you make a circle with this loop of string?" Let them try to shape it into a circle. Let them decide if they have made circles. They will decide that they are not good circles.

Say, "I can show you a better way to make a circle. I use a string loop." Take a large string loop as shown in the picture below. Put a finger of one hand in the loop. Hold a piece of chalk which is also in the loop in the other hand. Stretch the loop as shown. Place your finger on the blackboard. (A drawing pin may be used if the blackboard is made of wood.) Hold your finger firmly on the blackboard. Keep the string loop stretched tightly. Move the chalk and it will trace a circle on the blackboard.



Say, "You too can make circles this way using your loop, a pencil and a drawing pin." See the sketches below and help the children to draw circles. They can change the size of the loop to make larger and smaller circles.



Let the children make many circles on their papers.

Activity 5: Revision of figures. Pupil Pages 94-95

On page 94 there are nine figures. Three of these (1, 4, 7) are four-sided figures, one is a three-sided figure (6) and three are circles (2, 3, 9). The remaining two are new to the children. One is a five-sided figure (5) and the last one is not a circle and is not made up of line segments (8).

Ask the pupils questions about the figures on page 94 similar to these:

1. "Do you see any circles?" (2, 3, 9)
2. "How many circles do you see?"
3. "Do you see any four-sided figures?" (1, 4, 7)
4. "How many four-sided figures do you see?"
5. "Do you see any rectangles?"
6. "How many rectangles do you see?"
7. "What figures are made from line segments?" (1, 4, 5, 6, 7)
8. "Are there any figures with <u>less than</u> four sides?"
9. "Are there any figures with <u>more than</u> four sides?"
10. "Which figure has the <u>most</u> sides?"

The same kinds of questions can be asked about the figures shown on pupil page 95.

UNIT 14

FRACTIONS II

Objectives:

1. To extend the idea of one-half.
2. To introduce the idea of one-fourth.
3. To introduce the symbol $\frac{1}{4}$.
4. To use the idea of halves and fourths.

Background Information for Teachers:

See the "Background Information for Teachers" of Unit 11 and Part 2, "Arithmetic," in your Teachers' Handbook.

Vocabulary:

Four equal parts of a whole, fourths.

Materials:

Paper of various shapes (rectangular, triangular, square, and circular) and of various sizes for folding, strings, containers, flannel board and pieces, spot cards with 4 and 8 spots each; pupil page 96.

Teaching Procedure:

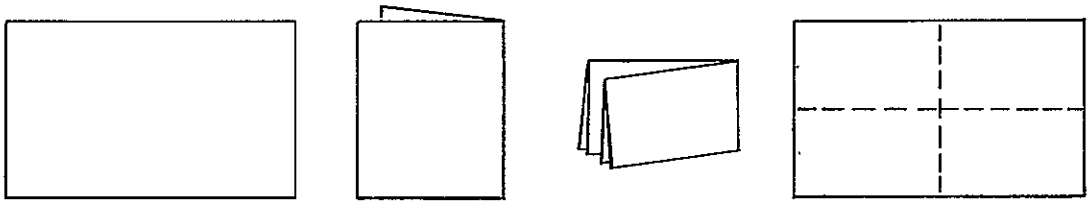
Activity 1: Developing the idea of fourths by folding paper.

Put out several sheets of paper of various shapes and sizes and pieces of string of different lengths.

Revise the idea of one-half as one of two equal parts of an object. Hold up a square paper. Fold it into two equal parts, and crease firmly. Ask the children,

"Into how many parts did I fold this paper?" (Two) "Are they equal?" (Yes) "What do we call each of these parts?" Let the children talk about this and say, "one half." Let a child show the two parts are equal. They can place one part on the other by folding. (The paper may be cut, if the children wish, after you are sure they have seen the two parts of the whole.)

Take the same folded paper and open it up to show the two halves. Refold it and then fold it a second time. Now it is folded into four equal parts. Crease firmly. Make the edges meet so that when the paper is unfolded, the creases will outline four equal parts as shown below.



Give each child a rectangular piece of paper. Take one yourself for demonstration. Say, as you fold the rectangle, "Hold up your papers and fold them into halves as I fold mine. Fold your papers again this way. Crease them firmly. Now open them up. Into how many parts was the paper folded?" (Four parts) Ask, "Are these four parts equal?" Let the children talk about this and say that the whole piece of paper is folded into four equal parts.

They may need to show the parts are equal by refolding the paper or by cutting the paper into four parts and placing the parts upon one another. Tell the children that each of these parts is called <u>one-fourth</u>. Let the children repeat the words "one-fourth" several times. Get them to say, "One of the four equal parts of my paper is one-fourth of my paper." Also get them to say that the four fourths together make the whole piece of paper.

Repeat the activity using paper of other sizes. Paper discs may also be used.

Pick up a string. As the children watch, put the ends together and fold the

string. Mark the point which separates the string into two parts with ink. Talk about each piece. The children should say, "This piece is one of two equal parts. It is one half of the string."

Refold the string into two equal pieces. Fold it again by putting the ends together. Mark with ink the points which separate the string into four pieces. Extend the string and ask, "What did we do to the string?" (We folded it into 4 equal parts.) Ask, "What are each of the pieces of the string called?" (Each part is one-fourth.) Emphasize that the four pieces together make the whole string.

Give the children practice in using the words, "whole," "part," and "fourths." Give each child a piece of string. Let him fold it into halves and then into fourths. Call a child to the front of the class. Ask him to bring his folded string with him. Ask him to hold up his string. Ask the class:

How many pieces of string has Musoke in his hand? (one)

Into how many parts is it folded? (four)

Are these parts equal? (yes)

What are the parts called? (fourths)

How can Musoke show the parts are equal?

Let the children talk about the last question. They will say he can show the parts are equal in two ways. He can cut the string where it was folded and place the pieces upon each other. Or he can fold the string again and show the parts fit exactly

Call more children forward and give them other strings or papers to fold into fourths and ask, "What is Ama doing?" (She is folding her string or paper into four equal parts.) Make clear that each of the four parts is one-fourth of the whole string and that the four parts make the whole string.

Ask the children to hold up their strings or paper and show the fourths. If a child does not have his string folded to show four equal parts, the other children should say, "These parts are not equal. The parts are not fourths." Get another child to help fold the string or paper to show fourths.

Pick up a paper folded into four equal parts and ask, "How many pieces of paper am I holding?" (One) Say, "It is a whole piece of paper." Outline one of the fourths with your finger and ask the children, "Is this one-half or one-fourth?" Outline one of the halves with your finger and ask, "Is this one-half or one-fourth?"

Fold a piece of paper into four parts which are not equal. Ask questions so the children say, "The paper is folded into 4 parts. The parts are not equal. The parts are not fourths." This will test whether the children understand what is meant by fourth.

Activity 2: Using the idea of half and fourth.

Put out a bucket of water and several water glasses.

Fill a glass with water and ask, "Is this glass full of water?" (Yes) Pour some water out of the glass until it is half full. Ask, "How full is the glass now?" (Half full) Fill another glass of the same size half full and ask the same question. Say, "I will pour the water from these two glasses together. How much water will there be? Let the children talk about this. Let them pour the water from the second glass into the first one to find out. The children will say, "The first glass is now full. Two half glasses make a whole glass of water."

Pour water into another glass until it is one-fourth full. Ask, "is the glass half full?" Let the children talk of this and say, "The glass is not half full. It is one fourth full."

Fill 3 more glasses of the same size one-fourth full. Say, I will pour the water from three of the glasses into the fourth glass. How much water will there be?" Let the children talk of this. Let them find out how much water there will be by pouring the water from three of the glasses into the fourth glass. The children will say, "The fourth glass is now full. Four fourths make a whole."

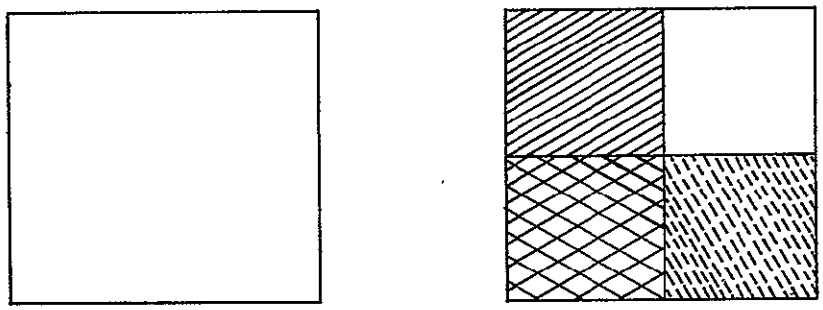
Activity 3: Using the idea of fourth.

Make rectangular objects of coloured paper or cloth for the flannel board. If you use paper, paste small bits of cloth to the back of the paper so the objects will

stay on the board.

Make pairs of objects of the same shape and size. Cut one of some of the pairs of objects into halves, some into fourths, and some into parts that are neither halves nor fourths.

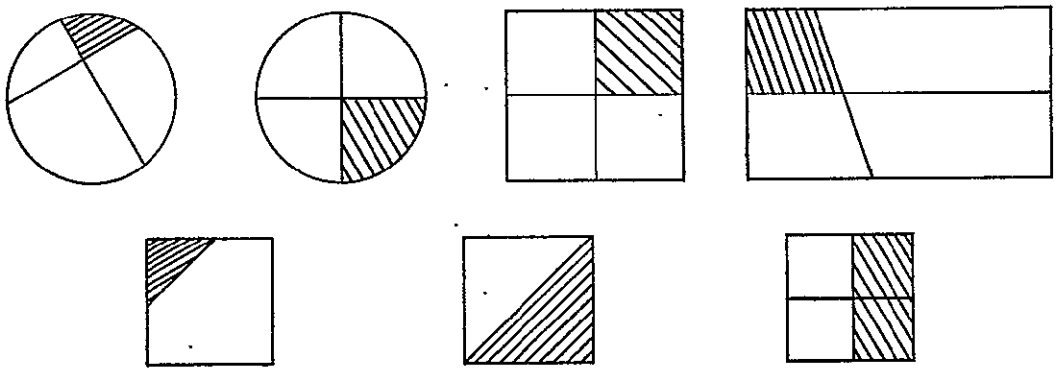
Hold up a square and put it on the flannel board. Put up another square of the same size but made up of four pieces. See below.



Ask, "Into how many parts is the second square separated?" (Into four parts)

Repeat this activity with other pairs of objects. Always ask, "Into how many parts is the second object separated? (2 or 4) Are these parts equal?" (Yes or No) "What are the parts called?" (Halves, fourths, or no special name)

Make sketches on the blackboard like those shown below.



Ask questions like the following about each of the figures:

Into how many parts is it separated?

Are the parts equal?

Are the parts halves? Fourths?

Let the children talk about how each figure is separated. If the figure is not separated into halves or fourths let the children separate it first into halves and then into fourths.

Activity 4: Introducing the symbol " $\frac{1}{4}$ "

Write $\frac{1}{4}$ on 3" by 5" card. Put out many kinds of objects. The objects may be string, oranges, bananas sticks and papers of various sizes and shapes on your table. Some of these objects should be separated into halves or fourths, some into parts which are neither halves nor fourths.

Take a string already marked into fourths and ask, "What is each of these parts called?" (Fourths) Let the children say "fourths" several times. Hold up the card and say, "This also says one-fourth." $\boxed{\frac{1}{4}}$ Stand the card on the table. Hold up the card that says $\frac{1}{2}$. Ask what it says. Stand it on the table. Again hold up the card which says $\frac{1}{4}$, ask the children what it says, and again stand it on the table.

Ask the children to look at the objects you put out. Let them talk of what they are and how they are separated. Ask them to choose the fourths of objects and put them near the $\frac{1}{4}$ card on the table. Ask them to choose the halves of objects and put them near the $\frac{1}{2}$ card. There should be some objects and parts of objects left.

Ask the children why they did not place the other objects by the cards. (They were not halves and fourths) Let the children talk about what parts the objects are. They may say, "Some are whole objects. Some parts are not halves and are not fourths."

Ask the children to write " $\frac{1}{4}$ " and " $\frac{1}{2}$ " on their papers.

Activity 5: Using the idea of fourth. Pupil Page 96

Study the pictures on pupil page 96, and have in mind what the children should learn from the pictures. Different shapes and objects are used so that the idea of one-fourth is not associated with one shape or one object only. Some of the pictures are like those used on the flannel board. Some have parts which are halves. Some have parts which are fourths. Some have parts which are neither halves nor fourths.

Tell the children to open their books to page 96 and tell what they see. Say, "Look at the first picture. What figure is this? (rectangle) Into how many parts is the rectangle separated?" (Four) "Are these parts equal?" (No) "Are the parts fourths?" (No, the parts are not equal) "How can you show that the four parts are not equal?" (They will not fit exactly if placed on each other) Repeat these questions with the circles and the other rectangles.

Get the children to look at the picture of the string and ask, "What is being done with the scissors? Into how many pieces is the string being cut?" (Four) "Are they equal?" (Yes) "What part is each piece of the string?" (Each part is a fourth.) Ask questions like these about the orange, the leaf, the stick and the rectangles with stars on them.

Ask the children to study the pictures of water glasses and tell about them. The children will say that the first glass is full and the last one is empty. Ask questions about the second and third glasses. "How full is the second glass?" (Half full) "What should we do to fill it?" (Take another glass of the same size and half fill it with water. Empty the water from one of the glasses into the other. Then it will be full.) "Why?" Let the children talk about this and say, "Two halves make a whole." Ask similar questions about the third glass.

UNIT 15

ADDITION AND SUBTRACTION

Objectives:

1. To revise the addition and subtraction facts with sums of 9 or less.
2. To introduce the addition of 2 or more numbers with sums of 18 or less.
3. To revise and extend the idea of missing addends and subtraction.
4. To develop skill with the addition facts.
5. To introduce the subtraction facts with sums of 18 or less.
6. To introduce the addition and subtraction of multiples of ten.
7. To introduce the addition and subtraction of numbers with 2-digit numerals with no renaming (carrying and borrowing) needed.
8. To expand the use of sentences to include inequalities.
9. To use addition and subtraction to solve problems.

Background Information for Teachers:

See also Part 2, "Arithmetic," in your Teachers' Handbook.

The aim of this unit is to help the pupil learn to add numbers whose sum is greater than ten. The system of decimal numerals makes this easy. The pupils do not need to memorize every result. They learn the addition facts with sums ten or less, and then use these facts and the decimal numerals to add other numbers.

The system of decimal numerals is based on ten. We use 10, multiples of 10, and many names for 10 to help us add. The names we use for 10 come from the addition facts with 10 as the sum. That is, 10 may be written as $0 + 10$, $1 + 9$, $2 + 8$, $3 + 7$, $4 + 6$, $5 + 5$, $6 + 4$, $7 + 3$, $8 + 2$, $9 + 1$, or $10 + 0$.

For example, we can use 10 to find the sum of 8 and 5. Think, ten can be named as $8 + 2$ and $5 = 2 + 3$. So, $8 + 5 = 8 + 2 + 3 = 10 + 3 = 13$. The 2 of the $2 + 3$ is added to the 8 to make 10.

Also, to add 8 and 5, we can think of 10 as $5 + 5$. Five is needed to add to 5

to make 10. Name 8 as 3 + 5. So, 8 + 5 = 3 + 5 + 5 = 3 + 10 = 13.

The addition facts whose sums are ten or more may be developed in this way. These facts are:

1 + 9 = 10	2 + 9 = 11	3 + 9 = 12	4 + 9 = 13	5 + 9 = 14
2 + 8 = 10	3 + 8 = 11	4 + 8 = 12	5 + 8 = 13	6 + 8 = 14
3 + 7 = 10	4 + 7 = 11	5 + 7 = 12	6 + 7 = 13	7 + 7 = 14
4 + 6 = 10	5 + 6 = 11	6 + 6 = 12	7 + 6 = 13	8 + 6 = 14
5 + 5 = 10	6 + 5 = 11	7 + 5 = 12	8 + 5 = 13	9 + 5 = 14
6 + 4 = 10	7 + 4 = 11	8 + 4 = 12	9 + 4 = 13	
7 + 3 = 10	8 + 3 = 11	9 + 3 = 12		
8 + 2 = 10	9 + 2 = 11			
9 + 1 = 10				

6 + 9 = 15	7 + 9 = 16	8 + 9 = 17	9 + 9 = 18
7 + 8 = 15	8 + 8 = 16	9 + 8 = 17	
8 + 7 = 15	9 + 7 = 16		
9 + 6 = 15			

Counters help children learn the addition facts in this way. For example, a set of 8 counters is placed beside a set of 9 counters. One counter is moved to the set of 9 from the set of 8 to make sets of 7 and 10 (8 + 9 = 7 + 1 + 9 = 7 + 10 = 17). Or, two counters are moved from the set of 9 to the set of 8 to make sets of 10 and 7 (8 + 9 = 8 + 2 + 7 = 10 + 7 = 17).

Ten is used in adding numbers greater than 10. For example, to add 23 + 45, think of adding 2 tens 3 ones and 4 tens 5 ones. The ones are added first 3 + 5 = 8. The 2 tens and 4 tens are then added, using the fact 2 + 4 = 6 (2 tens + 4 tens = 6 tens). The sum of 23 and 45 is 6 tens and 8 ones, written 68.

Ten is also used in subtraction. For example, 69 - 32 is thought of as 6 tens 9 ones minus 3 tens 2 ones. First subtract the ones, 9 - 2 = 7. Then the tens are

subtracted using the fact 6 - 3 = 3 (6 tens - 3 tens = 3 tens). So, 69 - 32 is tens 7 ones, written 37.

Stage 1: Addition with Sums of 18 or Less

Vocabulary: difference, true, not true, and the vocabulary of Units 5, 7, and 11.

Materials: bottle tops or other small objects for making sets; one-inch numeral (0-9) cards; pupil pages 97-104.

Teaching Procedure:

Activity 1: Revision of addition facts with sums of 9 or less.

Put out some objects on your table, such as bottle tops, pencils or pieces of chalk. Make a set with 4 objects; for example, 4 bottle caps. Make another set having 5 members; for example, 5 more bottle caps. Let a child describe the objects in the first set and tell the number of members. Let another child describe the objects in the other set and tell the number of members. Ask the children, "What do I get when I put the 2 sets together?" (A set with 4 bottle caps and 5 bottle caps) Ask, "How many objects will there be altogether?" (9)

With the children's help, write the sentence on the blackboard: 4 + 5 = 9. Ask several children to read the sentence.

Let a child make a set with 3 members. Call another child to make another set with 4 members. Let the children tell the numbers of objects in each set and describe them. Write this sentence on the blackboard. (3 + 4 = $\boxed{}$) Ask a child to put the two sets together and tell how many there are in the combined set. (7) Ask a child to tell what number makes the sentence on the blackboard true. (7) Let several children read the sentence aloud. (Three plus four equals seven)

Hold up a set of 4 pencils. Ask the children how many pencils are in the set. (4) Write 4 on the blackboard and let the children write 4 on their paper. Hold up 2 pencils. Ask how many in the set.(2) Write the numeral 2 on the blackboard and let the children write it on their papers by the 4.

Put the set of 4 pencils with the set of 2 pencils and say, "I am joining a set

of 4 and a set of 2. I made another set. What can you tell me about this set?" (It is a set of 6) Point to the 4 and the 2 on the blackboard and ask, "What do we do to 4 and 2 to get 6?" (We add) What sign goes between the 4 and 2? (The plus sign) Tell the children to write it on their papers between the 4 and 2. Get them to complete the sentence. Ask them to read the sentence (Four plus two equals six) Ask whether the sentence is true.

Give the children many exercises. These exercises should be ones which revise all the addition facts with sums 8, 9 or less.

Activity 2: Addition sentences. Pupil Pages 97-100

Give each child his one-inch square numeral cards and also some counters, for example, seeds, bottle tops, or sticks. Ask the children to find page 97. Let them look at the first sentence, and ask one child to read it. (Three plus zero equals the number in the box) Ask the children to think of the number which should go in the box to make the sentence true. Ask them to place a numeral card for that number on the box. Let a child read the sentence (Three plus zero equals three) Ask several children to read the sentence as they have it in their books.

Let the children look at the next sentence, read it to themselves, and place a numeral card in the box to make the sentence true. Let the children put numeral cards in the other boxes to make the sentences true. You go around the room and check the results.

Let the children find the sums on pages 98, 99, and 100. Let them remove the cards and write the sentences in their exercise books.

Activity 3: Revising the subtraction facts with sums of 9 or less.

Give at least 9 bottle caps, shells, or seeds to each of the children.

Hold up 7 pencils. Ask the children to tell you the number of pencils you are holding. (7) Separate from the set of 7 a set of 3 pencils. Say, "I am separating a set of 7 into a set of 3 and another set." Show the children the number of pencils

you have in your hand. Ask the children to tell what you did. Write on the blackboard the subtraction fact you have just shown. (7 - 3 = 4) Let the children read the subtraction sentence.

Let the children separate sets of their counters and write sentences. Get them to revise all the subtraction facts with sums of 9 or less.

Activity 4: Subtraction sentences. Pupil Pages 101-103

Give each child a set of one-inch numeral (0-9) cards. Ask them to find page 101 in their books.

Let the children look at the first sentence on the page. Ask one child to read it aloud. (Nine minus one equals the number in the box) Let the children find the number that should be in the box to make the sentence true and place that numeral card on the box. Let several children read the sentence. (Nine minus one equals 8) Let the children look at the next sentence. Ask another child to read it. (Eight minus 2 equals the number in the box) Ask the children to put the correct numeral card in the box to make the sentence true and let several children read the sentence. (Eight minus two equals six) Let the children continue placing numeral cards in the boxes to make the sentences true.

For pages 102 and 103 let the children write the sentences in their exercise books. They should write numerals in the boxes to make the sentences true.

Activity 5: Addition of two numbers with sums of 18 and less. Pupil Page 104

Get each child or each pair of children to put at least 18 counters on their desks. Ask the children to make a set of 10 objects and another of 3 objects. Let them put the two sets together and tell you how many members the new set has. Write the sentence this shows on the blackboard "(10 + 3 = $\boxed{13}$)." Let the children write it on their papers. In the same way, let each of the following sentences be written. 10 + 6 = $\boxed{16}$; 10 + 5 = $\boxed{15}$; 10 + 7 = $\boxed{17}$.

The children may now know a way to find the sum of two numbers without making sets of counters. Write the sentence $10 + 1 = \square$ on the board and ask them to tell the number that makes the sentence true. Some of the children will know at once that it is 11, others will need to make sets. Let them use the method they can. Do other examples in the same way, such as, $10 + 2 = \square$; $10 + 4 = \square$; $8 + 10 = \square$; $9 + 10 = \square$. Go on until the children can add 10 to any number 0 - 9. (Leave these sentences on the blackboard.)

Ask the children to make a set of 12 objects and another of 2 objects. Ask them to put the two sets together to make another set. Ask how many things are in the new set. Write the sentence $12 + 2 = \boxed{14}$ on the board. Now ask the children what number added to 10 will make 12. Point to the true sentences $10 + 2 = \boxed{12}$ which has just been written on the blackboard. Get the children to see that wherever we have 12 we can think of (10 + 2) because 12 and 10 + 2 are both names for the same number. Rewrite the sentence $12 + 2 = \square$ as $10 + 2 + 2 = \square$. Say that a set of 10 objects and a set of 2 and another set of 2 are all put together. Ask, "What will be the result if the two sets of 2's are put together first?" (We would have a set of 4) Now rewrite the sentence as $10 + 4 = \square$ below the last sentence. The writing on the blackboard looks like this:

$$12 + 2 = \square$$
$$10 + 2 + 2 = \square$$
$$10 + 4 = \square$$

Ask, what number goes in the box to make the sentence true.

Do a few more of these examples in the same way as above:
$11 + 1 = \square$; $12 + 1 = \square$; $13 + 1 = \square$; $11 + 2 = \square$; $12 + 2 = \square$; $13 + 2 = \square$; $11 + 3 = \square$; $12 + 3 = \square$; $13 + 3 = \square$. In each case, go through these steps:

$$13 + 4 = \square$$
$$10 + 3 + 4 = \square$$
$$10 + 7 = \square$$

The children should now turn to page 104 in their books and find the sums in the examples.

Stage 2: Revising Missing Addends

Vocabulary: no new words for children. (The words "horizontal" and "vertical" are not used in talking with the children)

Materials: objects for making sets; pupil pages 105-115

Teaching Procedure:

Activity 1: Finding missing addends.

Revise addition facts with sums of 9 and less in this way. Write this sentence on the blackboard: $3 + \square = 8$. Get the children to put a set of 8 counters on their desks and ask them to separate the set into two subsets. Let one subset have 3 members. Let the children tell how many members the other subset has. (5) Get them to show that the set of 3 counters and the set of 5 counters make a set of 8 counters. Ask them to look at the sentence and tell what number goes in the box to make the sentence true. ($3 + \boxed{5} = 8$)

Get the children to do this again. Let them say that to find the number in the box they make sets. They begin with a set of 8 objects and separate it into two subsets. One subset they know (3) and the other they find. Point to the plus sign in the sentence on the board. Ask, "What does this tell us to do?" (Add) Say, "We are adding 3 and the number in the box. When we find a number in a sentence like this there is another name for it. Do you remember what it is?" (Subtract)

We will now write this sentence as a subtraction sentence. The writing on the blackboard will look like this:

$3 + \square = 8$ $\qquad$ $8 - 3 = \square$

Get the children to show with objects how they find the number in the box for each of the sentences. They should say, "We do the same thing for each sentence. The sentences ask the same question."

Put the sentences below on the blackboard. Ask the children to write them on their papers. Let them write them first as addition sentences and then as subtraction sentences. Ask the children to find the number to put in the box to make each sentence true.

$2 + \square = 9$	$8 + \square = 8$	$\square + 1 = 9$	$\square + 4 = 5$
$3 + \square = 9$	$\square + 2 = 2$	$8 + \square = 9$	$9 = \square + 5$
$6 + \square = 7$	$7 + \square = 8$	$\square + 3 = 6$	$6 = 5 + \square$

Activity 2: Finding missing addends and sums of 18 and less. Pupil Page 105

Let the children revise quickly the addition facts which have one addend of 10. They are: $10 + 0 = \square$ $\quad 10 + 2 = \square$; $10 + 3 = \square$; and so on to $10 + 9 = \square$. Get the children to show some of the sentences with sets.

Write this sentence on the blackboard, $\square + 3 = 13$. Ask the children to put a set of 13 objects on their desks. Let them separate this set into two subsets so that one subset has 3 members. Ask how many members the other subset has. Then Write 10 in the box. Repeat the activity with another example, $4 + \square = 14$. By this time the children should know that to find the number making the sentence true, you you need to subtract the known addend from the sum. This means that the sentence $3 + \square = 13$ can be rewritten as a subtraction sentence, $13 - 3 = \square$ and $4 + \square = 14$ can be rewritten as $14 - 4 = \square$.

Get the children to find the number which goes in the box to make these sentences true:

$\square + 4 = 14$ $\square + 5 = 15$

Let them write the subtraction sentence for each. Get them to show each with objects if needed.

Write this sentence on the blackboard: $14 - 3 = \square$. Let the children help you rename 14 so that part of its name is 10. (10 + 4) Rewrite the sentence as show below. The writing on the blackboard will look like this:

$$14 - 3 = \square$$
$$10 + 4 - 3 = \square$$

Point to the 4, the 3, and the minus sign in the sentence. Ask what the sentence tells them to do. (Subtract) Ask them to subtract (4 - 3 = 1). Rewrite the sentence as the children tell you that 4 - 3 can be renamed 1. The work will now look like this.

$$14 - 3 = \square$$
$$10 + 4 - 3 = \square$$
$$10 + 1 = \square$$

The children may need to have this shown with sets.

Repeat using the sentence $\square + 5 = 16$. By asking questions, get the children to tell you that this sentence can be rewritten as $16 - 5 = \square$. Then ask, "How shall we express 16?" The answer should be, as 10 + 6. Now write the sentence as $10 + 6 - 5 = \square$. Ask the class what is left when 5 is subtracted from 6. The number making the sentence true should be 10 + 1.

Let the children now open their books to page 105 and find the number which makes the sentences true. Work the first few with the class.

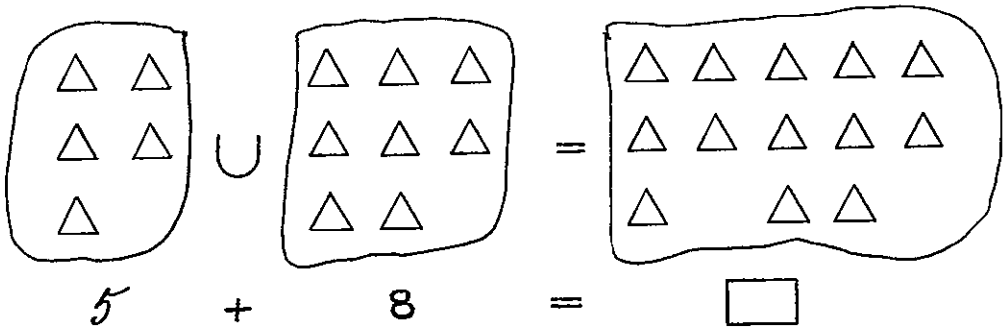
<u>Note:</u> Do not ask the children to write all the steps you wrote on the blackboard or the steps on the top of page 105. These are steps done in their minds. Let them write only the sentence completed.

Activity 3: Addition facts with sums of 18 or less.

Note: The children should now be quite familiar with the addition facts in which each addend and the sum are 9 or less. It is now time to extend these to include sums which are greater than 9 but 18 or less. The children may discover these basic facts by counting members of sets as before.

Let the children form a set of 5 objects and a set of 8 objects on their desks. Ask them to combine them and tell how many in the new set.

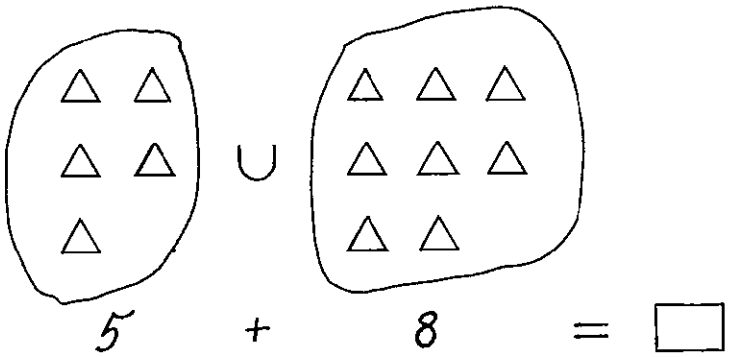
You draw a picture like the one below on the blackboard. Let the children help you write the sentence $5 + 8 = \square$ below the picture. Be sure the 5 is under the set of 5, the "+ " is under the "$\cup$", and so on.



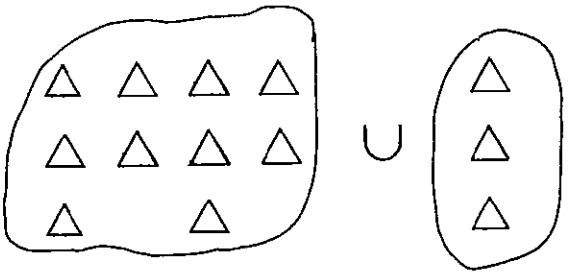
Ask how many things are in the set formed by putting the two sets together. (The children count and find that the answer is 13) Let the children write the sentence on their papers with 13 in the box. Ask, "Is the sentence $5 + 8 = 13$ a true sentence?"

Do the same activity with these sentences: $4 + 7 = \square$, $6 + 6 = \square$, $7 + 8 = \square$. Each time the children should make the two sets on their desks, put the sets together, count the objects in the new set, and write the true sentence on their papers.

Say, "I know a better way to find the sums. We do not count. We use tens." Point to the picture of the two sets on the blackboard. Let the children make a set of 5 and a set of 8 objects on their desks. See the picture on the next page.



Now ask the children how many members we must move from the set of 8 and put with the set of 5 to make a set of 10. (5) Let them make these new sets.

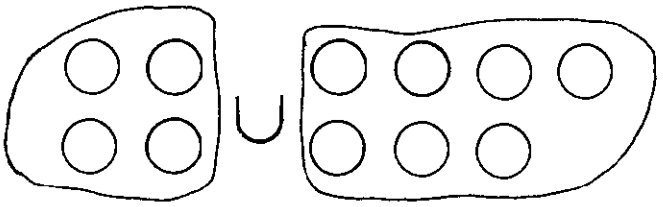


Ask, "How many members are left in the second set?" (3) Write this sentence:

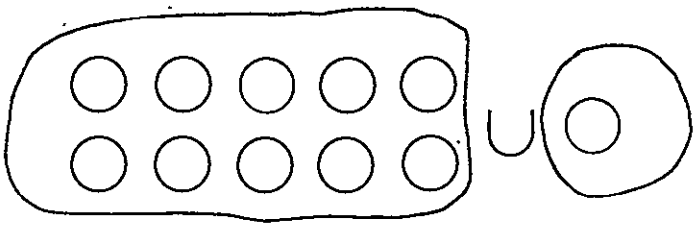
$$5 + 8 = 10 + \square$$

What number makes this sentence true? (3) Read the sentence. (Five plus eight equals ten plus three) Do you know another name for 10 plus three? (Thirteen) Write this: $5 + 8 = 10 + 3 = 13$.

Follow the same plan for the addition of other numbers, for example, $4 + 7$. Let the children make the two sets on their desks and you make a picture on the blackboard.



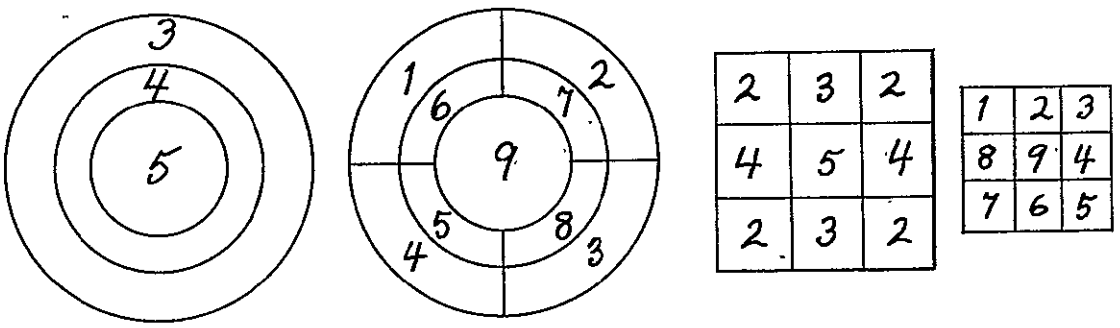
Say, "Move six objects from the second set and place them in the first set."



Get the children to say, "4 + 7 = 10 + 1" and "4 + 7 = 10 + 1 = 11." Let the children continue to write the addition facts with sums of 18 or less in this way. Some will soon not need counters. Some will soon know sums without thought. All of the children will need practice. The activities which follow will help to give them practice. You may need to plan more.

Activity 4: A game of addition.

Draw a pattern like one of these on the floor or on a large piece of paper cardboard.



Let a child toss two bags of beans or other suitable object on the pattern. Ask him to read the numbers in the spaces where the bags are. Let him add these numbers and write the addition sentence on his paper. Repeat with other children.

Make several other patterns and let children use them in groups as needed.

Activity 5: Addition and subtract facts using "ten". Pupil Page 106

Note: This is a review page of facts to be used in the work to follow. Ask the children to place the numeral cards on the boxes to make the sentences true. Some

children will need to show the sentences with sets of objects. Others will not.

When a child is finished, let him take the card off the page. Ask him to copy the true sentences in his exercise book.

Activity 6: Addition facts with sums of eleven. Pupil Page 107

Ask the children to find page 107 in their book. Tell them to find the set of bananas. Ask, "How many bananas are dark?" (9) "How many bananas are light?" (2) "How many bananas are there in all?" (11) "How did you find out?" Try to get these two answers: (1) by counting, (2) by adding. Ask a child to read the sentence. Ask, "What number makes the sentence true?" (11) Some children may need to make a set like the one shown and count the objects.

Do the same for the remaining examples on the page. Then list on the board the new facts they have found:

0 + 11 = 11	11 + 0 = 11	8 + 3 = 11	3 + 8 = 11
1 + 10 = 11	10 + 1 = 11	7 + 4 = 11	4 + 7 = 11
2 + 9 = 11	9 + 2 = 11	6 + 5 = 11	5 + 6 = 11

Activity 7: Finding sums of 11. Pupil Page 108

Ask the children to find page 108. Say, "We are going to add numbers by using 10. This is easier than counting."

Get the children to look at the first sentence. Ask, "What number makes this sentence true?" Some children will say, "11" at once. Other children can soon find "11" by counting. Get them all to think of making "10" from 9 and part of 2 named as 1 + 1. (9 + 2 = 9 + 1 + 1 = 10 + 1)

Let the children make the sentences all true by placing numeral cards on the boxes. Then get them to remove the cards and copy the true sentences in their exercise books.

Activity 8: Using addition facts with sums of 12-18. Pupil Pages 109-111

Note: This activity may be used as one lesson or used as two or three lessons. You plan as needed.

Get the children to use page 109 (addition sentences with sums of 12) as they used page 108 in Activity 7.

Get the children to use page 110 (addition sentences with sums 13 and 14) as they used page 108 in Activity 7.

Get the children to use page 111 (addition sentences with sums of 14 and 15) as they used page 108 in Activity 7.

Activity 9: Using addition facts. Pupil Page 112

Ask the children to find page 112 in their books. Let them look at the first row of numerals. Tell them to find the 9 above the row. Say, "What number added to 3 has a sum of 9?" (6) "Place the 6-card in the space to the right of 3." Let several children say the sentence, 3 + 6 = 9.

Let the children finish the page. Go around the class helping as needed.

Activity 10: Revising addition facts. Pupil Pages 113-115

Pages 113-115 are for the revision of all the new facts. (The facts are written in different forms.) Let the children copy the facts in their exercise books and write the sums.

Stage 3: Introducing Subtraction Facts

Vocabulary: no new words

Materials: objects to make sets; pupil pages 116-121

Teaching Procedure:

Activity 1: Subtraction facts with sums of 18 or less.

The addition facts with sums of 18 or less have just been learned. The relation of addition and subtraction can now be used.

Write the sentence $9 + 7 = \square$ on the blackboard. Ask the children to show this sentence with sets of objects on their desks. Ask them to tell how they show the sentence and how they find the number in the box.

Write the sentence $9 + \square = 16$ on the blackboard. Ask, "How can you show this sentence with sets of objects?" Let the children talk about this. Let them tell how the sets help them find the number in the box.

Repeat with these sentences and others:

$7 + 8 = \square$	$5 + 8 = \square$	$6 + 6 = \square$	$6 + 9 = \square$
$\square + 8 = 15$	$5 + \square = 13$	$\square + 6 = 12$	$6 + \square = 15$

Activity 2: Relating addition to subtraction. Pupil Page 116

Note: Pupil page 116 has nine pairs of addition and subtraction sentences which are related. One is written under the other.

Review the words "addend" and "sum" in the following way. Write these sentences on the blackboard.

$$6 + 5 = \square$$
$$6 + \square = 11$$

Ask the children to name the addends in the first sentence (6 and 5), and in the second sentence (6 and the number in the box). Ask them to name the sums in the sentences. (The number in the box and 11)

Say, "In each sentence we have two numbers given to us. What are they in the first sentence?" (The addends 6 and 5) "What are they in the second sentence?" (The addend 6 and the sum 11)

Say, "In each sentence we have a number missing. What is it in the first sentence? (The sum) What is it in the second sentence?" (An addend)

Ask, "How are these sentences alike?" (They are the same addition fact.) "How are these sentences different?" (The first one gives two addends and the sum is missing. The second one gives an addend and a sum and an addend is missing) "Can you find the number which goes in each box?" (Yes) "What helps you find the number?" (The addition fact $6 + 5 = 11$) Say, "You know one fact and you can use it in both sentences because the sentences are alike.

Repeat this activity as needed with a few of the pairs of sentences on page 116. Then get the children to make the other sentences true with numeral cards. They may also copy them in their exercise books.

Activity 3: Subtraction sentences with sums of 18 and less. Pupil Pages 117-118

Write the sentence $17 - 9 = \square$ on the blackboard. Say, "We will use what we know about addition to find the number which makes the sentence true. Ask the children to think of the sentence as an addition sentence ($9 + \square = 17$). Many children will know the addition fact $9 + 8 = 17$ and so will know at once that the number which makes the sentence true is 8.

Write the sentence $9 + \square = 17$ on the blackboard under the subtraction sentence. Get the children to make a set of 9 counters on their desks. Point to the sentence and to their desks and say, "To find the number added to 9 which equals 17, first find what added to 9 equals 10. Put more counters on your desk and make a set of 10. How many counters did you add?" (1) Go on asking these questions: "How many counters are on your desk now?" (10) "How many more counters do you need to have 17 on your desk?" (7) Ask, "How many counters were put with 9 counters to make 17 counters?" (8) As you are asking these questions write the answers in this form on the blackboard. Say, "You show with sets what I show with numbers."

$$17 - 9 = \square$$
$$9 + \square = 17$$
$$9 + \boxed{1 + ?} = 17$$
$$9 + \boxed{1 + 7} = 17$$
$$9 + \boxed{8} = 17$$

Repeat this activity with some other sentences. (Do not ask the children to write all of the steps you wrote on the blackboard. They need only to learn a method of subtracting and to use the addition facts to subtract.)

Let the children find page 117. Get them to tell the numbers which make the sentences true. Do not ask the children to copy these sentences. Let the children talk about these sentences. Some children may need to show the subtraction with a set of objects.

Ask the children to find page 118. Get them to write the first sentence as an addition sentence. Ask them to show the sentence with sets of objects and write the numeral in the box which makes the sentence true. Go around the room giving help as needed.

Let the children go on with a few more of the sentences.

Activity 4: Subtraction sentences. Pupil Pages 118-120

Revise Activity 3 and let the children make the sentences on page 118 true.

Let the pupils go on with pages 119 and 120 when they are ready. They are practice pages. The children should at all times use the addition facts they know to subtract. These pages should be a revision of addition.

You should provide more practice of this type as needed.

Activity 5: Revision of subtraction. Pupil Page 121

Pupil page 121 is planned for revision and practice of subtraction. Each number in the tables is to be subtracted from the number at the top of the table.

Let the children find page 121 in their books. Let them talk about the subtraction sentences in the first table. You write on the blackboard the table and the other things they say like this:

12	
4	8
6	6
9	3
7	5

$12 - 4 = 8$

$12 - 6 = 6$

$12 - 9 = 3$

$12 - 7 = 5$

Ask the children to copy the tables on their papers. Let them write the four subtraction sentences for the table and write the numerals in the boxes which make the sentences true.

Activity 6: Revision of subtraction.

Talk with the children about the tables they made in Activity 5. Draw this table on the blackboard. Let the children write the subtraction sentences and the numerals in the boxes as in Activity 5.

11	
9	2
8	
7	
6	
5	
4	
3	
2	
1	
0	

$11 - 9 = 2$

Ask the children to prepare other subtraction tables with 12, 13, . . . 18 at the top of the table.

Note: The children should by now know all the facts in these tables. The tables may be used both for addition and subtraction.

Stage 4: Adding and Subtracting Numbers with 2-Digit Numerals

Vocabulary: Bundles of tens

Materials: Bundles of thin sticks (10 to a bundle), single sticks, objects to make sets; pupil pages 122-132

Teaching Procedure:

Activity 1: Adding multiples of ten.

Give each group of four or five children 9 bundles of sticks (10 sticks in each bundle). Let the groups check to see that there are ten sticks in each bundle. When the children have counted the number of sticks in each bundle, ask, "How many bundles of 10 are there altogether?" (9)

Ask the children to count the sticks by tens. Let them count, 10, 20, 30, ...90. Ask the children some questions as a revision for counting by tens; for example, "What ten comes after 20?, What ten comes before 60?", and so on.

Show 3 bundles of sticks to the children and ask them how many tens there are. (3) Hold 4 bundles of sticks and show them to the children. Ask how many. (4 tens) Put the 3 bundles together with the 4 bundles and ask the children how many there are altogether. (7 tens) Write this sentence on the blackboard, 30 + 40 = 70. Let several of the children read the sentence. (3 tens plus 4 tens equals 7 tens) Also write the symbols in a vertical form on the blackboard:

$$\begin{array}{r} 30 \\ +\ 40 \\ \hline 70 \end{array}$$

Say as you write, "3 tens is the same as thirty (30). 4 tens is the same as forty (40). I will write the 4 under the 3. The 4 and the 3 tell how many tens you have." Ask, "What does the 7 tell you?" (How many tens we have altogether)

Show 2 bundles of sticks to the children and ask how many sticks there are. (20) Show 4 more bundles of sticks and ask how many sticks there are. (40) Hold the 2 bundles of sticks in one hand and the 4 bundles of sticks in another hand. Put them together and ask how many sticks there are altogether. (60) Let the

children use their bundles of sticks to find the answer. Write on the blackboard the sentence which the sticks show. (20 + 40 = 60) Let some of the children read the sentence. (Twenty plus forty equals sixty) Write the addition on the blackboard in vertical form:

$$\begin{array}{r} 20 \\ +\,40 \\ \hline 60 \end{array}$$

Let the children talk about why the 4 is under the 2 in the form above. (2 and 4 both tell how many tens.) Ask, "Why is the 6 under the 2 and 4?" (It tells how many tens.) Write exercises like the following on the blackboard and let the children find the sum. Let them first find the sums by using bundles. Then let them find the sums by thinking without the bundles of sticks.

20 + 30 = ☐ , 50 + 10 = ☐ , 60 + 20 = ☐ , 30 + 30 = ☐

$$\begin{array}{r} 20 \\ +30 \\ \hline \end{array} \quad \begin{array}{r} 50 \\ +10 \\ \hline \end{array} \quad \begin{array}{r} 30 \\ +30 \\ \hline \end{array} \quad \begin{array}{r} 50 \\ +10 \\ \hline \end{array} \quad \begin{array}{r} 60 \\ +20 \\ \hline \end{array} \quad \begin{array}{r} 70 \\ +10 \\ \hline \end{array} \quad \begin{array}{r} 40 \\ +40 \\ \hline \end{array}$$

Activity 2: Addition of multiples of ten. Pupil Pages 122-124

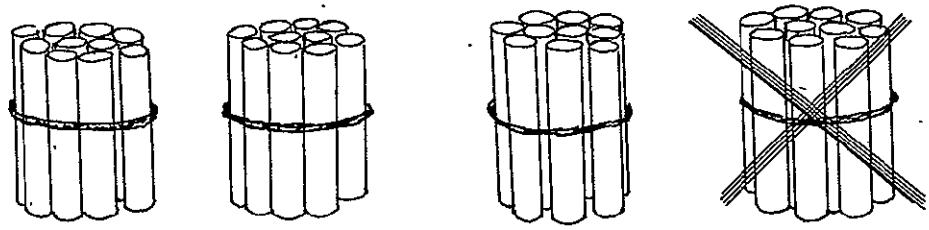
Let the children open their books at page 122. Give out 9 bundles of sticks to groups of five pupils. Let the children look at the first sentence. Ask a child to read it and tell the number that makes the sentence true. (10) Let the children write the true sentence in their exercise books. (10 + 0 = 10) Let them look at a few other sentences and talk about them in the same way. Let the children use their bundles of sticks if they need them. Ask the children to copy the other sentences from page 122 in their exercise books. Let them write the numeral which makes the sentences true.

Let the children go on to the sentences on pages 123 and 124 when they are ready. Give help as needed.

Activity 3: Subtracting multiples of ten.

Give out bundles of sticks to small groups of children. Hold up 4 bundles of

sticks and ask the children how many. (4 bundles) Ask the children, "How many sticks are there in one bundle?" (10) "How many sticks are there in 4 bundles?" (40) Write 40 on the blackboard. Let a child read the number on the board. (Forty or 4 tens) Still holding the 4 bundles, take 1 bundle away and ask, "How many have I taken away? (10) How many are left?" (30) Write the sentence $40 - 10 = 30$ on the blackboard. Draw a picture to show the sentence:



Let a child read what the picture tells. (4 tens minus 1 ten equals 3 tens) Let the children talk about what the picture says and what the sentence says.

Show 5 bundles of sticks to the children and let them tell how many. (5 tens or 50) Take 3 bundles away. Ask a child to tell what subtraction you have just shown. (5 tens minus 3 tens) Write the sentence $50 - 30 = 20$ on the blackboard. Ask the children whether they know another way of writing subtraction. Let a child write the subtraction on the blackboard in the vertical:

$$\begin{array}{r} 50 \\ -\,30 \\ \hline 20 \end{array}$$

Repeat this activity with other subtraction sentences. Show with bundles of sticks. Write the sentence. Draw a picture to show the sentence. Write the subtraction in vertical form. Use exercises like these:

$60 - 30 = \square$, $40 - 20 = \square$, $80 - 40 = \square$

Continue as needed.

Activity 4: Subtraction sentences. Pupil Pages 125-127

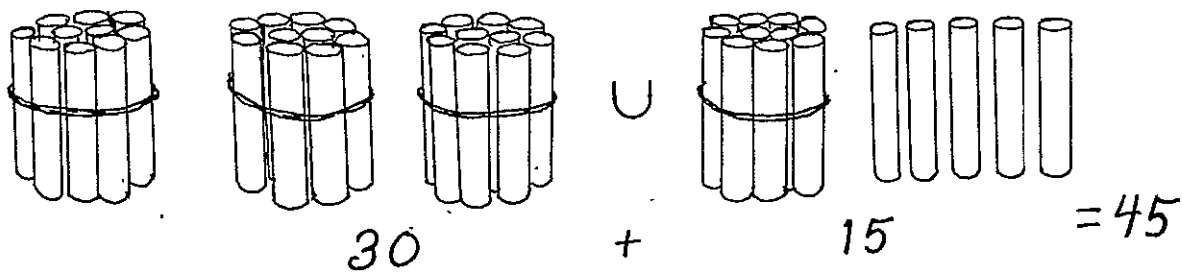
Let the children open their books to page 125. Ask them to read the first exercise on the page: ($20 - 10 = \square$) Let the children use their bundles of sticks to find the number which makes the sentence true. Talk about a few of the other sentences on the page. Let the children tell what number goes in the box.

In each case, ask whether the sentence is then true. Let the children write out the sentences in their exercise books. Let them find the numbers making the sentences true. Give help as needed. Let the children go on with the other sentences on pages 126 and 127.

Activity 5: Addition of multiples of ten and a few more, with no renaming.

Give groups of four or five children some bundles of sticks and some loose sticks. Hold up 3 bundles of sticks in one hand. Ask, "How many sticks do I have?" (30) Pick up a bundle of ten and 5 loose sticks in the other hand. Ask, "How many in this hand?" (15) Now as you put the sticks all in the same pile, ask, "How many do I have altogether?" (45) Ask the children to show this on their desks.

Draw a picture on the blackboard as shown below to show the joining of the sets. Let the children help you write the sentence below.



Show the addition in vertical form:

30	3 tens + 0 ones
+ 15	1 ten + 5 ones
45	4 tens + 5 ones

Get the children to put 2 bundles of sticks and 2 loose sticks on their desks. Ask how many sticks there are. (2 tens and 2 ones or 22) Let them show 2 more bundles and 3 loose sticks. Ask how many there are in this set. (2 tens and 3 ones or 23) Get them to put these two sets together and tell how many sticks there are altogether. Ask them to put all the bundles of ten together and all the single sticks

together. As they do this you write the following:

$$\begin{array}{lcl} \text{2 tens and 2 ones} & = & 20 + 2 \\ \text{2 tens and 3 ones} & = & \underline{20 + 3} \\ & & 40 + 5 = 45 \end{array}$$

Ask a child to hold up 1 bundle of ten sticks and 5 loose sticks. Ask how many sticks he is holding. (1 ten and 5 ones or 15) Let another child show 24 more. Ask the children to tell how many sticks the second child is holding. (2 tens and 4 ones or 24) Let another child put the two sets of sticks together. Ask, "Are all the bundles of tens together and all the single sticks together?" If not, let the child group them together. Ask, "How many sticks does he have altogether?" (1 ten and 5 ones plus 2 tens and 4 ones equals 3 tens and 9 ones) Write the sentence on the blackboard as the child puts the bundles and loose ones together:

$$\begin{aligned} 15 + 24 &= (10 + 5) + (20 + 4) \\ &= (10 + 20) + (5 + 4) \\ &= 30 + 9 \\ &= 39 \end{aligned}$$

Do not ask the children to write these sentences. They should make the two sets, put the two sets together, and write the final true sentence.

Let the children now work alone or in groups at their seats with the bundles of sticks and loose one to show these:

12 + 22; 21 + 24; 16 + 22; 30 + 43; 36 + 21; 13 + 35; 17 + 32.

Give help as needed.

When the children can use the horizontal form for the addition of numbers having 2-digit numerals, show them the vertical form. Always let them use bundles and loose sticks to show the addition.

You write the following addition exercise on the blackboard:

$$\begin{array}{r} 34 \\ \underline{+15} \end{array}$$

Let the children show the addition with sets of sticks. Ask, "What is the sum?" (4 tens and 9 or 49) Say, "I will write 9 under 4 and 5. I will write 4 tens under 3 tens and 1 ten."

Go over some other exercises in this same way; for example,

14	10	15	14	19	32
+24	+26	+22	+43	+40	+32

Let the children work some addition exercises like these on paper. Give help as needed. Be sure to let them show some with sticks.

Activity 6: Adding numbers with sums less than 100 with no renaming (carrying) needed. Pupil Pages 128-130

Give groups of four or five children some bundles of sticks and some loose sticks. Let them find page 128 in their books.

Ask the children to read the first exercise. (11 + 10 = ☐) Get them to show 11 sticks and 10 sticks on their desks. (The children in one group should work together.) Let them put the sets together, the bundles of tens together and the loose ones. Ask, "What is the sum of 11 and 10?" (2 tens and 1) Let them copy the exercise on their papers and write the sum. You say, "The sum is 21. We write the 1 of 21 under 1 and 0, 1 + 0 = 1. We write the 2 tens of 21 under the 1 ten and 1 ten, 1 ten plus 1 ten is 2 tens."

Let the children follow the same plan with the other exercises on page 128. When the children no longer need to show the addition with sets, ask them to stop using sticks.

Use the same plan for pages 129 and 130 as needed.

Activity 7: Subtracting numbers with sums less than 99 with no renaming (borrowing) needed.

Hold up 3 bundles of ten sticks and 5 loose sticks. Ask, "How many sticks do you see?" (35) Tell a child to come up and take 4 of your sticks. Let the

class tell how many you now have. (31) Ask a child to write a subtraction sentence about this. Ask another child to show the subtraction in another form.

$$35 - 4 = 31 \qquad \begin{array}{r} 35 \\ -\ 4 \\ \hline 31 \end{array}$$

Let a child show 46 sticks to the class. Ask him to place the sticks on your table. Tell another child to pick up 12 of the sticks. Ask, "How many sticks are now on the table?" Ask one child to write the subtraction sentence shown and another to show subtraction in another way.

$$46 - 12 = 34 \qquad \begin{array}{r} 46 \\ -12 \\ \hline 34 \end{array}$$

Point and say, "We write the 4 under the 6 and 2, $6 - 2 = 4$. We write the 3 tens under the 4 tens and 1 ten, 4 tens minus 1 ten equals 3 tens."

Give each group of three or four children some bundles of sticks and some loose ones. Ask them to show subtraction exercises with sticks and then to write the exercises on their papers. Some exercises they may solve are:

$$\begin{array}{r} 34 \\ -\ 21 \\ \hline \end{array} \qquad \begin{array}{r} 46 \\ -\ 14 \\ \hline \end{array} \qquad \begin{array}{r} 29 \\ -\ \ 8 \\ \hline \end{array} \qquad \begin{array}{r} 57 \\ -\ 23 \\ \hline \end{array} \qquad \begin{array}{r} 46 \\ -\ 22 \\ \hline \end{array} \qquad \begin{array}{r} 75 \\ -\ 23 \\ \hline \end{array}$$

Give help as needed.

Activity 8: Subtraction sentences. Pupil Pages 131-132

Give each group of four or five children some bundles of sticks and some loose ones. Ask the children to open their books to page 131. Ask a child to read the first sentence. Let each child find the number that makes the sentence true, using sets of sticks. Give the children in the groups enough time for each child to find the number. Let one child tell the class the numeral to be put in the box. Let him tell the class how he got the number. He may say, "37 is 3 tens and 7. Twelve is 1 ten and 2. $7 - 2 = 5$. Three tens - 1 ten = 2 tens." Ask him to write the subtraction in another form on the blackboard. Let the children talk about the exercise and how they showed it with sticks.

$$\begin{array}{r} 37 \\ -\ 12 \\ \hline 25 \end{array}$$

Say, "The 5 of 25 goes here because it tells how many ones. The 2 of 25 goes here because it tells how many tens."

Let the children work the other sentences on page 131. They should show the subtraction with sticks and then write a true sentence on their papers. Let the children stop using sticks when they can write true sentences without them. Go around the class and give help as needed.

Use page 132 in the same way.

Stage 5: Inequalities and Revision of True Sentences

Vocabulary: no new vocabulary.

Materials: objects for making sets; pupil pages 133-138

Teaching Procedure:

Write these sentences on the board:

$3 + 5 = 8$ $\quad$ $3 + 4 = 8$ $\quad$ $3 + 5 = 7$ $\quad$ $2 + 5 = 7$

Ask if all these sentences are true. Ask which are true and which are false. (The first and last are true; the other two are false.)

Get pupils to write other sentences. Tell them to write some true ones and some false ones. Tell them to write some addition and some subtraction sentences. Let other children read the sentences and tell which are true and which are false.

If no one writes a sentence using a box for a number, you write $3 + \square = 10$. Let the pupils read the sentence. Ask, "Is this sentence true or false?" Some children may say, "True"; some may say, "False." Both these answers are wrong. Some may say, "Neither" or "I can't tell" or "We don't know." These answers are good ones. Even better is the answer, "We can't tell until we put a number in the box."

Ask, "What do we do with a sentence such as $3 + \square = 10$?" (We put a number in the box) Ask several children to suggest numbers. Examples:

$$3 + \boxed{6} = 10$$
$$3 + \boxed{7} = 10$$
$$3 + \boxed{3} = 10$$
$$3 + \boxed{4} = 10$$

Ask which sentences are true and which are false. (The second one is true; the others are false) Talk about these questions: How many numbers could you put in the box? (Many) What number makes the sentence true? (7) Do any other numbers make the sentence true? (No)

Talk about other sentences in this same way, for example,

$15 + 11 = \square$, $9 + \square = 17$, $\square = 18 - 3$, $\square = 46 - 21$.

Activity 1: True and false sentences. Pupil Pages 133-135

Use pupil page 133 to give practice in telling whether sentences are true or false. Let children copy the sentences on their papers. Ask them to write T for true or F for false by the sentences.

Let the children find page 134 in their books. Ask, "Is the first sentence a true sentence or a false sentence?" Let them talk about this. They should say, "We can't tell until we put a numeral in the box." Name some numbers (5, 7, 1, and so on) and ask if they make the sentence true. They will agree that only 9 makes the sentence true.

Let the children copy the sentences on pages 134 and 135. Get them to write numerals in place of the boxes to make the sentences true.

Activity 2: Revision of "not equal" and "$\neq$". Pupil Pages 136-137

Write on the blackboard a few exercises such as

$5 + 8$ ___ 13 $\quad 8 + 7$ ___ 14 $\quad 11$ ___ 13

$7 + 5$ ___ 10 $\quad 1 + 1 + 2$ ___ 4 $\quad 12$ ___ $10 + 1 + 1$

Tell the children these are unfinished sentences. Tell them something is to be put in the sentences to make them true sentences. Ask, "What sign goes in the first sentence to make it true?" (=) Rub out the "___" and write in "=". Let the children talk about whether the sentence is true. Let them read the sentence. (5 + 8 = 13)

Ask, "What sign goes in the unfinished sentence 8 + 7 ___ 14 to make it true?" (≠ or >) Let the children talk about whether these signs make the sentence true. Rub out the "___" and write "≠". They will say the sentence is true. Tell them they will use ">" later. Let them read the sentence. (8 + 7 is not equal to 14)

Go on in the same way with the other sentences. In each sentence let the children decide whether "=" or "≠" goes in the sentence to make it a true sentence. Let them read the true sentences.

Let the children find pages 136 and 137 in their books. Get them to write these unfinished sentences as true sentences.

<u>Activity 3:</u> Revision and use of the symbols "<" and ">". Pupil Page 138

Write these unfinished sentences on the blackboard. Let the children make them true by writing in a "=" or a "≠".

5 + 2 ___ 9	8 ___ 6 + 2	17 + 2 ___ 15
3 + 4 ___ 1 + 1	12 ___ 11 + 2	13 + 12 ___ 27

Point to the sentence 5 + 2 ≠ 9. Say, as you point to "≠," "I know that 5 + 2 is less than 9. Can you tell me another sign I can put in the sentence." (<) If the children have forgotten this sign write it and the "greater than" sign (>) for them. Rub out the "≠" and write in "<." Let them read the sentence.

Let the children in turn come to the blackboard, rub out the "≠" in a sentence, and write either ">" or "<" to make the sentence true. Let the class decide if the sentence is true.

Get the children to complete the sentences on page 138. Ask them to think what sign goes in the sentences to make them true -- a "=", ">", or "<". Let them copy the true sentences in their exercise books.

Activity 4: Using addition and subtraction in solving problems.

The children should now be able to add and subtract numbers with sums of 99 or less. This activity in problem solving is planned so they may use addition and subtraction. You may wish to plan other activities.

You and the children may make up your own problems. Some problems you may use are:

(1) Outside the classroom window Efua counted 17 bicycles. In the afternoon, 8 bicycles were taken away. How many were left?

(2) A monkey climbed a tree and tossed down 6 coconuts. Then he climbed another tree and tossed down 7 more. How many did he toss down in all?

(3) The teacher passed out 44 sticks to Kwame and 32 sticks to Kofi. How many sticks did she pass out?

(4) A herdsman had 35 sheep and 67 goats. How many more goats did he have than sheep?

(5) Isatu had 9 eggs. If she wanted to use 12 eggs for cooking, how many more did she need?

Read each problem to the children. Let them talk about it. Let them write a mathematical sentence about it. Let them find the number that makes the sentence true. And, then get them to answer the question the problem asks.

You and the children can talk about the first problem like this:

How many bicycles did Efua count at first? (17)
Does Efua see more or fewer bicycles now? (Fewer)
Why? (Some bicycles were taken away)

How many? (8)

What are you asked about the bicycles? (How many bicycles were left?)

I want to write a sentence about the bicycles. Will it be an addition sentence or a subtraction sentence? (It will be a subtraction sentence)

Why? (A set of 17 bicycles was separated into two sets. One of the sets had 8 bicycles in it)

Will you write a subtraction sentence about the problem? ($17 - 8 = \square$)

What number makes the sentence true? (9)

What is the answer to the question asked by the problem? (There were 9 bicycles left)

Talk about problems 2 - 5 in the same way. Each time do these things: talk about the problem; write a mathematical sentence; find the number that makes the sentence true; answer the questions asked by the problem.

Children have trouble telling when to use an addition sentence and when to use a subtraction sentence. It helps them if the relation between addition and subtraction is clear. The following problems may be used to show the relation between addition and subtraction. Problem (1-a) below and (1) of the problems above go together, (2-b) and (2) go together, and so on.

(1-a) Outside the classroom window Efua saw 9 bicycles. In the afternoon, 8 more bicycles arrived. How many did Efua see now?

(2-b) A monkey tossed down 13 coconuts from two trees. If he tossed down 7 from one tree, how many did he toss down from the other?

(3-c) The teacher passed out 76 sticks to Kofi and Kwame. If Kofi got 44 sticks, how many did Kwame get?

(4-d) A herdsman had 35 sheep. He had 32 more goats than sheep. How many goats did he have?

(5-e) Isatu had 12 eggs. She used 9 for cooking. How many were left?

Solve problem (1-a) in the same way the other problems were solved. Then read problem (1) again. Ask, "Is this the same Efua in the two problems?" Let the children talk of how the two problems are alike and how they are different. They should say after much talk, "The girl and the bicycles are the same. In the first problem the set of 17 bicycles was separated into a set of 8 and another set. In the second problem the sets of 9 and 8 bicycles were put together. In the first problem we subtracted. (17 − 8 = ☐) In the second we added. (9 + 8 = ☐) One problem undoes the other."

Here are a few more pairs of related problems if they are needed:

(6) Johanna had a book with 85 pages. Miriam had a book with 63 pages. Whose book had more pages? How many more?

(6-f) Miriam's book had 63 pages. Johanna's book had 22 more pages than Miriam's. How many pages were in Johanna's book?

(7) There were 45 oranges in one basket and 34 in another. How many oranges were there in all?

(7-g) There were 79 oranges in two baskets. One basket had 34 oranges. How many oranges were in the other basket?

(8) One train has 52 cars. Another train has 47 cars. How many cars are there on both trains?

(8-h) Two trains have 99 cars in all. If one has 47 cars, how many does the other have?

(9) A boy is saving coins. He has saved 11 so far and he needs 19 in all. How many more must he save?

(9-i) A boy saved 11 coins in one week and 8 the next week. How many did he save in the two weeks?

(10) A girl had 32 bottle caps. She gave 12 to her friend. How many did she have left?

(10-j) A girl had 20 bottle caps and her friend had 12. How many did they have together?

UNIT 16

MONEY AND THE CLOCK

Objectives:

1. To identify coins by name and to know some things each coin will buy.
2. To read the clock by the hour and to know some things which happen at particular hours.

Background Information for Teachers:

Since there is no common set of coins used in the countries of Africa, the learning activities in this book are not specific. You may follow the suggestions made and plan others yourself. Learning activities for the development of time are limited to reading the clock to the hour and knowing the hour of the day specific things happen in the life of children. You should center all activities for both money and time around the things the pupils do from day to day.

Stage 1: Money

Vocabulary: names of coins in your country.

Materials: picture cutouts of familiar toys and simple inexpensive objects; old toys if available; small packets of sand, stones, or beans labelled "sweets" "biscuits", and so on; play coins made from paper; some real coins; pupil page 139.

Teaching Procedure:

Activity 1: Recognizing and using coins. Pupil Page 139

Show the children the coins used in your country. Name each coin. Mix the coins and let the children name them.

Show the children the coin of least value. Name it. Let the children repeat the name and then tell some things they can buy with the coin. Repeat with each coin.

Mix the coins. Let a child in turn choose a coin from all the coins, name it, and tell one thing it will buy.

Let the children tell what coin will buy each object on pupil page 139. Give each of the children in turn a coin. Let him tell what object on the page he can buy with the coin. Tell the children to select a coin which will buy an object which you name.

Activity 2: Shopping.

Put out some coins. Get objects or pictures of inexpensive objects that pupils might like to buy. You and the children make price tags for each object. Use prices which require only one coin.

Let one child be the shopkeeper, another a customer. Let the customer select an article, ask its price, and find a coin needed to buy the article. Use other children in turn as shopkeeper and customer.

Activity 3: Bus conductor.

Put out coins. Give the children the coins as they need them. Let the children decide on a few nearby villages to visit. Let them decide on a single coin fare to each.

Let the children in turn be the bus conductor. Let the other children in turn enter the bus, name the village they want to travel to, and name and pay their fare.

Note: You think of other activities to help children learn the names of coins and what the coins will buy.

Stage 2: Reading the Clock to the Hour

Vocabulary: Time, clock, minute, minute hand, hour, hour hand, o'clock

Materials: Clock, large demonstration cardboard clock, sticks, inch-square cards.

(You may wish to have each child make a clock face to set at given hours. This activity is left for you to plan.); pupil pages 140-142.

Teaching Procedure:

Activity 1: The time things happen.

Talk with your pupils about when they do things and when things happen. The talk should provide a chance for the children to use these words related to time: yesterday, today, tomorrow, morning, noon, night and day.

Let the children talk about things they do such as:

We sleep at night.
We eat at noon.
The sun shines during the day.
We come to school in the morning.

You can guide the talk by asking such questions as:

When do you see the moon?
When do you see the sun?
When do you eat?

Activity 2: Describing a clock.

Get the children to talk about time. A child may say the time in clock hours, for example, "I eat at 12 o'clock." You ask, "What tells us it is 12 o'clock?" (The clock)

If the above does not happen, ask, "What time of day is it?" And, "What do we look at to find the time of day?" These questions or others will call attention to the clock.

Point to a clock. Let the children talk about where they see clocks, who owns clocks, and what people use them for. Get the pupils to describe a clock face. (It has numerals on it. They are 1, 2, 3, . . .12. The numerals form a ring. The 12 is at the top. The 6 is at the bottom. There are two hands on a clock.)

Say, "The long hand is called the minute hand. See it move. It tells us when minutes pass." Let the children point to the minute hand and say "Minute hand."

Say, "The short hand is called the hour hand. It points to the hour of the day. Now it points to 9. It is 9 o'clock." Have children repeat as they point, "This is the hour hand. It points to the hour of the day."

Use a large demonstration clock or a real clock. Move the hour hand of the clock to point to different numerals and have the children say, "The hour hand points to 5. It is 5 o'clock," or, "The hour hand points to 11. It is 11 o'clock." Continue as needed.

Let some children give a time, say 5 o'clock, and ask other children to show that time on a clock.

Note: If you use a demonstration clock, keep the minute hand at 12. Try to keep the hour hand as close to a numeral as possible. Let children read either the demonstration clock or a real clock to the hour the hand is nearest.

Activity 3: Time you do things. Pupil Page 140

Set the demonstration clock at the hour the children get up in the morning. Say, "The clock says 7 o'clock. What do you do then?" Move the hour hand around the clock. Stop the hand on hours of the day that the children do things which are important to them. You ask questions and give clues. The talk may include these statements or similar ones:

It is 10 o'clock. We play at 10 o'clock.
It is 12 o'clock. We have lunch at 12 o'clock.
It is 4 o'clock. We go home at 4 o'clock.
It is 7 o'clock. We eat at 7 o'clock.
It is 8 o'clock. We go to sleep at 8 o'clock.

Let a pupil tell the time of day he does something and move the hour hand of the clock to that time. Continue with other children.

Ask the children to find page 140 in their books. Talk of what the child in the picture is doing. Let each child pretend he is the child in each of the pictures. Ask him what time the clock reads in each picture. Let him put a numeral card by each picture to show the time. For example, he may put an 8 card by the picture at the top which shows him going to school.

Activity 4: Completing and using a clock face. Pupil Page 141

Give each child twelve inch-square pieces of paper. Ask them to write the numerals for a clock face on the squares, a "1" on the first square, a "2" on another, and so on. (The children may have prepared the cards in other activities.)

Let the children open their books to page 141. Ask what they see on the page. Ask, "Is the clock finished?" Let them finish it with their numeral cards.

Give each of the pupils two short sticks of different lengths to use for hands. Tell them, "Put the hands in the proper place to show 11 o'clock." Go around to check that the shorter stick points to 11. Ask the children what happens at 11 o'clock. Let the children show other hours on the clock face. Always ask what happens at the time mentioned. Move around the class to help as needed.

Let the children fix the minute hand to point to "12". Then fix the hour hand to point to "8". Ask, what time does the clock say? "What do you do at that time? What time will it be an hour after 8 o'clock?" Ask the children to move the hour hand of the clock to read that time.

Ask, "What time was it an hour before 8 o'clock?" Let a pupil move the hour hand to read that time. Go on with this activity using different times of day.

Activity 5: Reading a clock. Pupil Page 142

Tell the children to look at the clock faces on page 142. Ask, "Which clock reads 5 o'clock? Which clock reads 7 o'clock?" Let the children use their numeral cards to show the time each clock face shows. Go around the class to check whether the clock is read correctly. Talk with the children of what they do at the times shown on the clocks.

UNIT 17

MEASUREMENT

Objectives:

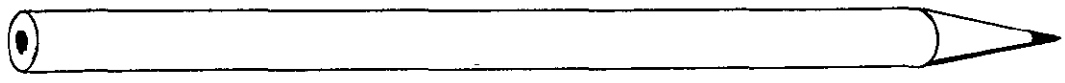
1. To introduce the idea of comparing distances in terms of longer than and shorter than.
2. To introduce the idea of comparing weights in terms of heavier than and lighter than.
3. To create the need for the standard units of length, inch and foot.
4. To develop the idea of unit of length.
5. To extend the idea of number to the measurement of length and distance.

Background Information for Teachers:

When we make measurements we are making comparisons. My village is farther from the school than your village is. I am nearer to the desk than he is. A giraffe is taller than a lion. Lorries are longer than bicycles. A boy is shorter than his father and takes shorter steps when he walks. These examples are all comparisons of distance. Sometimes the words width, depth, length and height are used. We measure the depth of a well, a jar or a lake. We use length when buying cloth or wood. We like to think of the width of a road or river. The word height is used to describe the tallness of trees or people. But all of these are measurements of the same thing, distance.

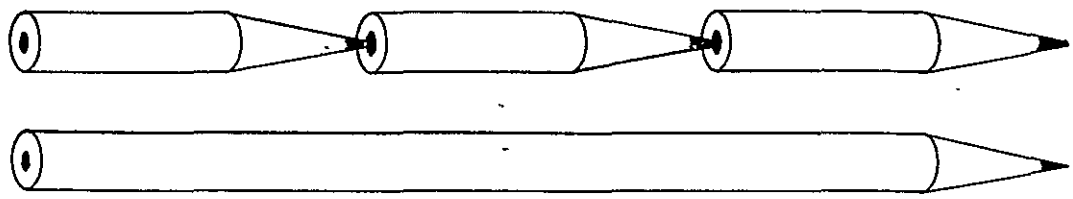
We recognize that two sticks are of different lengths. We say one stick is longer than the other. But we do not have a way to decide how much longer one stick is than the other.

The picture below shows one pencil. The number we think of when we look

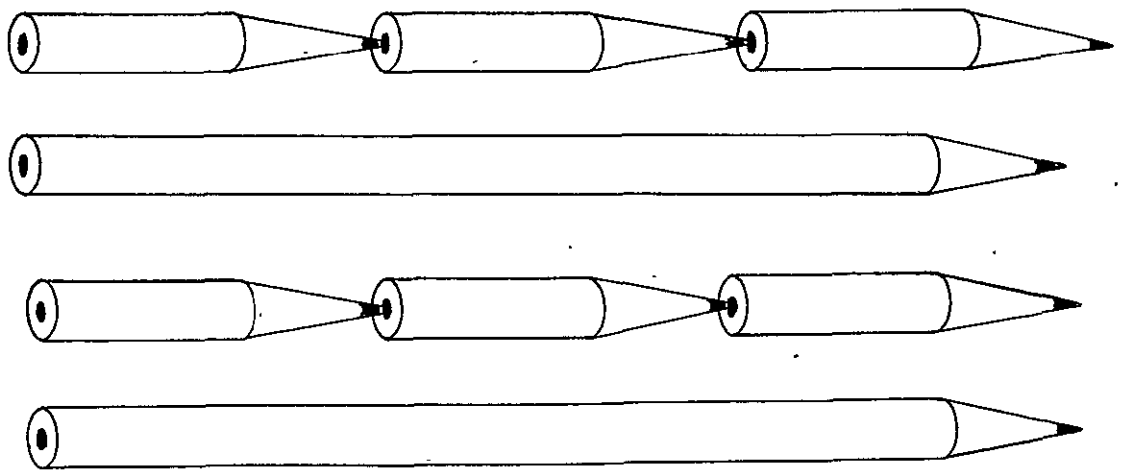


at the pencil is one. Yet a pencil has other properties besides oneness. One of these other properties is length. Each pencil has length; pencils are of different lengths.

If we have a very short pencil and a very long pencil, we can count the number of short pencils that make one long pencil. About three short pencils make the same length as one long pencil. The long pencil is about three times as long as the short pencil. Long objects and short objects can be compared by

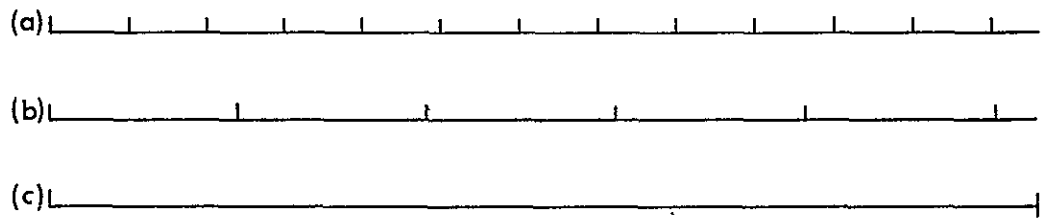


counting the number of short objects that fit one long object. It is not often that a whole number of short lengths make exactly one long length. The drawings below show two other examples of fitting short pencils to long pencils



The first of these drawings shows three short pencils are longer than one long pencil. In the second drawing three short pencils just fit one long pencil. In making measurements we often find small things do not fit exactly into large things. In the examples above, the short pencils are used as units of length.

In the measurement of length we use the idea of a number to count units of length. Anyone can invent a unit of length and use the idea of number in measurement. If the unit of length is small, more counting of units will be required. If the unit of length is large, less counting of units of length will be required. Both small and large units of length are useful in measuring distance. The drawings below show how the same distance can be measured with different units of length. The unit of length used in Line (a) is small and there are many



units (between 12 and 13). The unit of length in Line (b) is larger. There are more than 5 of these units of length in the entire length. In Line (c) we use our unit of length equal to the distance we wanted to measure. In this case we can say that the distance we measured is one unit in length. In each case the distance we measured was the same, but the number of units of length we used was different.

In counting these units of length the only time we got a whole number was in the last drawing. Here we made the unit of length just equal to the distance we are measuring. But if we use this same unit of length to measure other distances we would find that we would not always get a whole number of units.

It is not convenient for each of us to use our own unit of length for measuring things. No one would be sure just what distance another person was talking about. Long ago people decided that standard units of length had to be used to prevent misunderstandings. In the English-speaking world we have several standard units of length. The smallest common unit of length we call the inch. We count inches up to twelve and then use another unit which we call a foot. The yard is three feet or thirty-six inches. The longest common unit of length in the English system is the mile. (One mile equals 5280 feet.)

Another common measurement we often make is that of weight. If you lift a jug of water, pour the water out and then lift the empty jug, you may say that the jug of water is heavier than the empty jug. Someone else may say that the empty jug is lighter than the jug of water. Yet, both of you are making the same comparison. Both the terms "lighter than" and "heavier than" are used when we compare the weights of two different objects. If the objects are quite different in weight, it is easy to decide which one is heavier and which one is lighter. We can lift each object and our muscles tell us which is heavier. But if the objects we lift are not very different in weight, we have more difficulty deciding which is the heavier and which is lighter. When this happens we need weighing scales to decide for us.

Stage 1: Measurement of Length

Vocabulary: measure, measuring, measuring by steps, measuring by hand, measuring by arms, longer than, taller than, shorter than.

Materials: classroom furniture and other objects in the classroom, sticks, long pieces of string; no pupil pages.

Teaching Procedure:

Activity 1: Using longer than and shorter than to compare lengths.

Collect a number of sticks of different lengths. They should vary in length from about 3 inches to about 2 feet. Hold up a long stick and a pencil in one hand and say, "The stick is longer than the pencil." As you say this trace along the stick and the pencil with your other hand. Now hold up the pencil and a stick that is shorter than the pencil. Say, "The pencil is longer than the stick." (Trace along the objects as you say this.) Do this several more times using the same pencil with sticks of different lengths. Let the children tell which is longer: a pencil or a stick.

Hold up two different sticks (one much longer than the other). Say, "Which

stick is longer?" Call on children to tell which stick is longer. Do this until the children can use "longer than".

Put five sticks of different lengths on the front desk. Hold up one of the five sticks (one that is not the shortest or the longest). Ask a child, "Can you find a stick that is longer than this one?" Have him hold up the sticks and say which one is longer. Repeat the exercise until the children can pick out a longer stick.

Repeat this exercise with common objects in the classroom (desk tops, books, string). Have the children decide which of two objects is the longer.

Repeat the entire activity using the phrase shorter than.

Activity 2: Measuring by steps.

Say to the class, "I am going to walk from the blackboard to the back of the room. I want you to count my steps." Walk with your usual step, counting with the children as you go. Ask them how many steps you took, and say, "It is ___ of my steps from the blackboard to the back of the room." Ask, "Would I take the same number of your steps if I walked from the back of the room to the blackboard?" Show this by walking back to the blackboard and letting the children count the steps.

Ask some pupils to guess how many steps you must take to walk across the room. Walk across the room. Get the children to count the steps. (Stop half way across the room and ask if anyone wants to change his guess.) If you took 10 steps to cross the room, say, "It is 10 of my steps across the classroom." Compare this number with the guesses.

Tell the children that counting steps as you walk from one place to another is called "measuring by steps."

Have children in pairs measure the width or length of the classroom, the first child stepping and the second counting. Repeat with the second child stepping and the first counting. Write on the blackboard the number of steps they count and say, "From the blackboard to the back of the room is 18 of Koso's steps, 20 of Frieda's steps," and so on. Point out differences in the number of steps counted. Some children may need to "measure by steps" again.

Activity 3: Measuring by feet.

Ask, "Can you think of a different way of using legs and feet to do measuring?" If they cannot, say that one way is to walk with a shorter step, placing one foot right after the other. Show the children how this is done by measuring something in the classroom. For example, measure from one leg of your desk to another leg. Do this by putting the heel of your left foot in line with the desk leg, your foot pointing along the desk, then placing the heel of your right foot against the toe of your left foot. Shift your weight to your right foot and move the left foot until its heel is against the toe of your right foot. Continue putting one foot in front of the other, counting as you go, until you reach the other edge or leg of the desk.

Let the children help you tell about this. Say, "It is 6 of my _____ across the desk." If a good name is suggested, use it. They are likely to suggest "feet". If so, use the term and say, "It is 6 of my feet across the desk." Say, "This is another way of measuring, called "measuring by feet".

Repeat Activity 2, measuring by feet instead of measuring by steps.

Activity 4: Measuring by hands.

Ask, "If you wanted to measure across your desk and your legs and feet were tied, is there another part of you to measure with?" Try to lead them to say, "My hand." Show them handspanning. This is done by spreading out your right hand and putting on the desk your thumbtip and the tip of your middle finger. Your thumbtip should be at the edge of the desk. Hold the middle fingertip firmly on the desk and bring your thumbtip up to the middle fingertip, putting it firmly down on the desk. Then spread your four fingers out again, putting your middle fingertip down firmly on the desk in its new position. Do this from one end of the desk to the other, counting as you go. (This amounts to "skipping your hand across the desk") Say, "It is 7 of my hands across the desk." Tell them this is called "measuring by my hands", and is another way of measuring.

Repeat Activity 1, measuring other objects such as sticks, stretched string, and desks by hands instead of by steps.

Activity 5: Taller and shorter.

As a final measuring activity for this stage, select a tall child, Koso, and a short child, Kisa, and have them come to the front of the class. Tell the class as you place your hands on the tops of the heads of Koso and Kisa, that "Koso is taller than Kisa" and "Kisa is shorter than Koso." Repeat this with two other children. Get a third pair of children up front and ask the class to fill in the proper words as you say, "Frank is _____ than Morton," and "Morton is _____ than Frank." Try a fourth pair of children, this time asking, "Who is taller?" and getting the children to say, "Obed," and, when asked, "Who is shorter?" replying, "Frieda."

Separate the class into groups of three children each. In each group have each child in turn look at the other two and decide who is taller and who is shorter. In at least one group, point out to the class that when C looked at A and B he said, "B is taller than A," but that when A looked at B and C he said, "B is shorter than C." A child can be taller than another child but shorter than a third one.

Stage 2: Measuring with Sticks

Vocabulary: measuring stick; one stick long, two sticks long.

Materials: a bundle of sticks all the same length (8 to 16 inches); other bundles of shorter sticks all the same length (2 to 3 inches); no pupil pages.

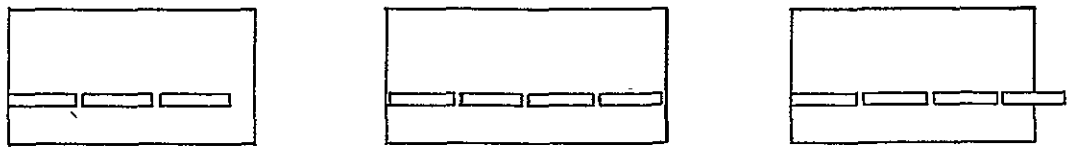
Teaching Procedure:

Activity 1: Measuring lengths in sticks.

Choose a stick from the bundle of longer measuring sticks. Hold it up and say, "This is a measuring stick." Let the children compare the sticks in the bundle and decide the sticks are the same length.

Hold up a stick and then place it on your desk near the front edge. Put it so one end is even with a side edge of the desk and the other end points straight

across to the opposite edge of the desk. Say, "One." Point out that one edge of the stick is even with the desk edge and that the stick points straight across. Choose another stick and place it on the desk end to end with the first stick. Make it point in the same direction. Say, "Two." Continue placing sticks and counting until no more sticks can go on the desk. The desk top will then look like one of these pictures.



Note: In the center picture the last stick, which is on the right, ends at the desk edge; in the right-hand picture the last stick juts beyond the desk edge; in the left-hand picture there is still room on the table but if another stick is put down it falls off because too much of it is beyond the edge.

Count with the children the number of sticks on the desk. Say, "I have measured the desk top with my measuring sticks. How many sticks long is the desk?" If there are four sticks on the table the children should say, "Four sticks long." If they don't, tell them, "The desk is four sticks long." Repeat the measuring if necessary.

Choose another object to measure, say a child's desk. Do exactly as you did when you measured your desk top; remember to ask the children how many sticks long the object is.

Separate the children into small groups. Give each group a bundle of the short measuring sticks and an object whose length or width they are to measure. Tell them to use the sticks to find how long the object is. Help them as needed. Remember that at this stage of measuring it is not important to be exact. Let the children in each group take turns putting down the sticks and then counting the sticks.

Activity 2: Measuring lengths with shorter sticks.

Choose an object too small to be measured with one of the measuring sticks you used in Activity 1. Use a book or your hand or your shoe sole. Try to measure it with one of the sticks. Show that it falls off.

Ask the class, "What should we do?" Some child may say, "Use shorter sticks." If it is not suggested, suggest it yourself. Put out a bundle of shorter sticks all the same length. You can call them short measuring sticks or some name which you or the children make up. Use them to measure the object you just tried to measure with the longer stick. If this takes three short sticks, say, "I have measured this (name of object). It is three short sticks long." Tell the children, "We will use these sticks to measure small things." Let them help you measure several objects.

Give a bundle of these short measuring sticks to small groups of children. Tell them to use the sticks to measure their mathematics books. Walk around the class and help the children. Give them other objects to measure. Get each child to say, "This book is _____ short sticks long."

Stage 3: Measuring Lengths in Feet.

Vocabulary: One foot, two feet, three feet; and so on; shorter than 1 foot, longer than 1 foot.

Materials: A specially coloured or marked stick that is one foot long; a bundle of unmarked sticks all one foot long; a bundle of unmarked sticks of different lengths, some shorter than one foot, some longer than one foot, including some several feet long; pieces of string about 15 feet long (one piece for every 3 children); scissors; no pupil pages.

Teaching Procedure:

Note: If some people using a language had one name and only one name for a door and other people using the same language had a different name for a door, the

people could not talk with each other about a door. It saves time and work to have at least one word known by all people for door and for one kind of any object. For the same reasons, it is wise to have just one main unit for measuring length and to have just one name for that unit. In the English-speaking world this unit has been chosen and is called the foot. In this stage the children begin to learn to use the foot.

Activity 1: Choosing sticks 1 foot long.

Tell the class, "Each of you can use his own steps and feet and hands to measure things, or he can make his own measuring stick. These will do for you. But if two of you choose different measuring sticks you get different numbers when you measure the length of things. We will not use Frambi's step to measure, or Helen's feet to measure, or Tom's stick to measure. We will all use a stick that everyone uses everywhere."

Hold up your specially marked or coloured stick and say, "This is our special stick. It is marked so we can tell it from our other sticks. It is called one foot. This measuring stick is like ones used in many parts of the world."

Put out some sticks, some one foot long, some shorter, some longer. Hold up the special stick you know is 1 foot long. Ask, "Do these two sticks have the same length?" (Yes) "How can we be sure?" (Fit the special stick to the other one to see if they fit exactly) Fit the two sticks together and show that they fit exactly. Ask, "How long is the unmarked stick?" (One foot long) Put a mark on this stick. Tell the children that the mark is a special one for sticks that are 1 foot long. Put the newly marked stick down at one end of the table and say, "Here is where we are going to put sticks that are 1 foot long."

Still holding in one hand your special stick, pick up another unmarked stick, one that is shorter than 1 foot. Ask, "Do these two sticks have the same length?" (No) "Is this stick shorter or longer than our special stick?" (Shorter) "How can we be sure?" (Fit it to the special stick) Fit the unmarked stick to the special stick, and point out the left-over part of the special stick. Say, "The unmarked stick is not 1 foot long. It is shorter than 1 foot." Put this unmarked stick down

at the other end of the table and say, "Here is where we are going to put all the sticks that are not 1 foot long."

Repeat this several times, each time using a different unmarked stick. Use some sticks that are longer than 1 foot, some that are shorter than 1 foot, and some that are 1 foot long. Ask a child to come up and choose any stick from the pile in front of you. Ask him, "Is your stick 1 foot long?" When he answers, ask the class if he is correct. Let him check his answer by fitting his stick to the special stick. If his answer is wrong, talk of why it is wrong. If the child's stick is 1 foot long, get him to put the special mark on it and put it in the pile it should be in.

Let several other children choose a stick and repeat the activity. Remember to get the other children to watch and check all answers. Do this until all the sticks have been separated into two piles. One pile contains all the sticks that are one foot long, and each of these sticks has a special mark. Tell the children, "These are going to be our measuring sticks. They are all one foot long."

Activity 2: Comparing sticks with 1-foot sticks.

Separate the class into two groups, A and B. Give group A a special 1-foot stick and a pile of sticks that are not 1 foot long. Let each child in turn choose a stick from the pile, compare it with the special stick, and say, whether the stick he chose is shorter or longer than 1 foot. Get them to put the sticks that are shorter than 1 foot in one pile and the sticks that are longer than 1 foot in another.

Give each child in group B one of the sticks that is one foot long. Let each child measure his desk, and each of his books to see whether it is 1 foot long, shorter than 1 foot, or longer than 1 foot.

After this has been done, let group A do what group B did, and group B do what group A did.

Activity 3: Measuring with 1 foot.

Separate the children into small groups. Give each group a bundle of 1-foot sticks and some objects to measure (long sticks, desks, doors, windows, and so on). Ask each group to use their 1-foot sticks to measure their objects just as they measured objects in Activity 2 of Stage 2. Tell the children that instead of saying,"This window is 3 sticks long," we now say, "This window is 3 feet long." Let them say the lengths of their objects in feet.

Activity 4: Measuring a child's height in feet.

Separate the children into groups of three. Give each group a 15-foot piece of string and four 1-foot sticks. In each group let two of the children use the string to help the third child measure his height. Let the first child hold one end of the string on the floor behind the feet of the child being measured. The second child stretches the string upward to the top of the head of the child to be measured, then turns around and cuts the string at that place. The first and second child are holding a piece of string that is just as long as the child being measured. Ask the two children to stretch the piece of string on the floor and let the third child measure his own height. He will measure the length of the string with a 1-foot stick.

Get each group to measure the height of each of the other two children in the same way.

Stage 4: Measuring in Inches and Feet

Vocabulary: one inch, two inches, ..., twelve inches; one-inch stick; one-inch cardboard; paper ruler, 1-inch pieces.

Material: a specially marked or coloured stick one inch long; 1-foot sticks; many 1-inch square cardboards; one 2-inch stick; cardboards that are 2 inches long, 3 inches long, ..., 12 inches long; no pupil pages.

Teaching Procedure:

Activity 1: Introducing a 1-inch stick.

Hold up a 2-inch stick. Ask, "Is this 1 foot long?" (No) "Is it longer than 1 foot?" (No) "What length is it?" (Shorter than 1 foot) "How can you find out?" (Measure it with a 1 foot stick) Ask, "Is this stick shorter than 1 foot?" (Yes) Ask, "How much shorter?" Let the children talk about this and say, "Much shorter than 1 foot," or something else that says the special 1-foot stick has a lot of "left-over". Point out that this means the 1-foot sticks are too long to measure short things.

Ask the children to help you find a way to measure the short sticks, and other short things like your finger, or a pencil, or a chalk. Try to get them to suggest using a stick, shorter than 1 foot, to measure short things. After they or you have suggested this, ask if any of them have ever heard of such a stick. If they have, ask them its name; if they haven't, tell them it is called "1-inch stick". Hold up a special stick that is one inch long. Give it a special mark or colour. Say, "This is our special short measuring stick. We use it to measure small objects. It is 1 inch long." Tell the children that sticks like this are used over a large part of the world to measure short objects.

Activity 2: Learning about "1 inch long," and "longer than 1 inch".

Put out on your desk a pile of cardboards which include many 1-inch squares and some which are 2 inches long, 3 inches long, and up to 12 inches long.

Hold up in one hand the special 1-inch stick and, in the other hand, one of the 1 inch square cardboards. Ask, "Do the stick and the cardboard have the same length?" (Yes) Ask, "How can we show this?" (Fit one edge of the cardboard to the 1-inch stick) Show that they are the same length. Ask, "How long is the cardboard?" (One inch long) Put the cardboard down at one end of the table and say, "Here is where we are going to put cardboards that are 1 inch long."

Still holding in one hand the special 1-inch stick, pick up a cardboard that is longer than 1 inch. Ask, "Do the stick and the cardboard have the same length?"

(No) "Is the cardboard shorter than the sticks?" (No) "What else do you know about it?" (It is longer than the stick) "How can we show this?" (Fit the cardboard to the stick) Do this and point out the leftover part of the cardboard. Say, "The cardboard is not 1 inch long. It is longer than 1 inch." Put the cardboard on the other end of the table and say, "Here is where we are going to put all the cardboards that are longer than 1 inch."

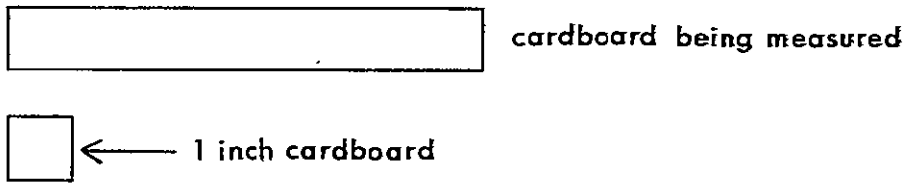
(The children may say that all the cardboards are 1 inch wide.)

Repeat this procedure several times, each time using a cardboard from the pile. Ask a child to choose a cardboard from the pile. Ask him if his cardboard is 1 inch long. Let the class tell whether his answer is correct. Let him fit his cardboard to the special 1-inch stick, to show whether it is 1 inch long or longer than 1 inch. Ask him to put his cardboard on the table in the proper place.

Repeat this with several children. Each time get the other children to watch and tell whether the answer is right. Do this until all the cardboards have been separated into two piles. Point to the pile of 1-inch long cardboards and say, "These are going to be our measuring cardboards. Each one is 1 inch long. We use them to measure short objects. We will call them 1-inch cardboards."

Activity 3: Using 1 inch cardboards to measure other cardboards.

Put out some cardboards that measure from 2 to 12 inches. Hold up a cardboard that is about 6 inches long. Ask, "Is this 1 inch long?" (No) "How long is it it?" (Longer than 1 inch) Let the class talk about how they can find how long the cardboard is. When they have said that they should measure it, ask "What can we use to measure it?" If 1-foot sticks are suggested, let the children try to use the sticks. They will see that the 1-foot sticks are too long. They will say, "Short things are needed to measure the cardboard." Guide the children to suggest using the 1-inch cardboards. Put the cardboard to be measured on the table. Pick up a 1-inch cardboard and ask, "How do I start measuring?" Put the 1-inch cardboard next to one end of the other cardboard, so that the ends of the two cardboards line up.



Pick up another 1-inch cardboard and ask them what to do with it. (Put it next to the other 1-inch cardboard.) Let a child do this. Ask, "What do we do next?" (Put another 1-inch cardboard next to the others.) Let a child do this. Let others put 1-inch cardboards down to fit exactly the cardboard to be measured. Let other children come up to look at the way the 1-inch cardboards are placed. Ask if there is room for any more 1-inch cardboards. When they say, "No," ask, "Is the measuring finished?" (No) "Why isn't it finished?" (We must count the 1-inch cardboards) Let several children come up and count the 1-inch cardboards. Ask, "How many inches long is this cardboard?" (Six)

Repeat the activity with another cardboard 9 inches long.

From the pile of cardboards that are longer than 1 inch give each child one. Separate the children into groups. Give each group some 1-inch cardboards. Let each child in turn use the 1-inch cardboards to measure the length of his cardboard. Ask each child to write on his cardboard the numeral which shows the length of his cardboard.

Activity 4: Finding the length, in inches, of a 1-foot stick.

Put out some 1-inch cardboards and some 1-foot sticks. Ask the children, "Could you use the 1-inch cardboards to measure other things than cardboards?" Ask them to name some things that they can measure. Lead them to suggest the 1-foot stick. Tell them you think it is a very good idea.

Separate the children into small groups. Give each child a 1-foot stick, and give each group a set of 13 or 14 1-inch cardboards. Let each child in each group use the 1-inch cardboards to measure the length of his 1-foot stick. Ask,

"How many inches long is the stick?" Help those who got a number other than twelve to measure the stick again. Point out that they all got twelve and that this means that a 1-foot stick is 12 inches long. Get them to say, "Twelve inches make 1 foot." Let the children repeat this.

Stage 5: Weight

Vocabulary: heavier than, lighter than.

Materials: paper bags or tins; stones or sand; no pupil pages.

Teaching Procedure:

In this stage the children are to lift objects. As they lift the objects they should use the terms "heavier than" and "lighter than" to compare the weights of the objects. In Primary II weighing scales will be used. But in this first experience with weight the children will use only lifting to make comparisons of weight.

A large object sometimes weighs less than a small object. Be certain that the children do not confuse heavier than with bigger than and smaller than with lighter than. To avoid this, the objects being weighed may be put into paper bags or tins so the children cannot see the objects.

After the children have the "feel" for heavier than and lighter than, stop putting the objects in tins or paper bags. You should, however, avoid using objects that differ greatly in size.

Activity 1: Comparing weights by lifting.

Choose two empty tins or paper bags of the same size. Fill one of them half-way with sand or small stones. Leave the other empty. Cover the open tops of the tins so that the children cannot see what is inside. (Wads of used paper will cover the tins.) Mark the tin containing the sand with an X and leave the other with no mark.

Lift the tins up for the children to see. Move your hands up and down so you

give the impression that you are comparing something about the tins. Get one of the children to lift the tins in the same way. Ask, "Are the tins different?" He may say they feel different. Let another child lift the tins. Ask, "Can you tell how they are different?" Let all of the children have a chance to lift the tins. After they have done this, let them talk about the feel of the tins. Lift the tins again yourself and say, "This tin is heavier than the other one. The tin with the X is heavier than the other tin." Let several children come up and lift the tins again. Get them to say, "The tin with the X is heavier than the other tin."

Change the stones from the marked tin to the unmarked tin. Ask, "Can you tell which tin is heavier than the other?" Get one of the children to decide after lifting which is heavier. Ask if he is correct. Ask, "How can you tell which of two objects is heavier?" (Lift and tell by the feel)

Repeat the activity using tins that contain different amounts of sand or stones. Always make certain that the tins are quite different in weight so the children know at once which is heavier.

Repeat this activity using the term lighter than to compare objects.

Activity 2: Lifting objects to decide which is heavier.

Ask the children to compare the weights of ordinary classroom objects by lifting. Choose objects of about the same size but which are quite different in weight. Get the children to lift the objects and use the terms "heavier than" and "lighter than" to compare the weights of the objects.

UNIT 18

NUMBER LINE

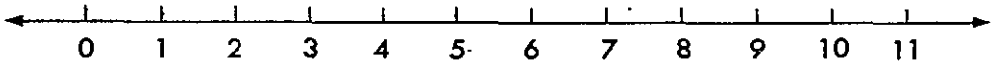
Objectives:

1. To introduce the number line.
2. To locate the whole numbers on the number line.
3. To develop the comparison of numbers by the terms "greater than" and "less than."
4. To illustrate operations with numbers by geometric ideas of direction on a line.

Background Information for Teachers:

Also see Part 2, "Arithmetic," in your Teachers' Handbook.

When numbers are matched with points on a line in the way numbers are matched with the marks on a ruler, the result is called a number line. Many number concepts and operations can be shown by the use of the number line. It is a useful teaching and learning aid. A picture of a part of a number line is shown below.



Note that the number line extends indefinitely in both directions. For the part shown above, a point on the left of the page is marked "0". The point marked "1" is some convenient distance to the right of the point "0". The other points are located so that the distance between 0 and 1 is the same as the distance between 1 and 2, 2 and 3, and so on. The distance is chosen so the points and numbers to be used

are on the part of the number line sketched.

We have compared two sets and found that one set may have more members than , as many members as , or fewer members than the other set. If the first set has more members than the second, the number of members of the first set is greater than the number of members of the second set, and the number of members in the second set is less than the number in the first set. The natural order of the numbers is based on a "one more than" pattern of ordering sets.

The natural order of numbers can be shown on number line. They form a regular sequence going from left to right as seen by the pupil. The direction of ordering the numbers from left to right is chosen here because this is the usual direction of ordering.

The order relations among numbers is shown by direction on a number line. Of two numbers, the one on the left is less than the one on the right. For example, 3 is to the left of 4 on the number line, and 3 is less than 4. The numeral 8 is to the right of 5, and 8 is greater than 5.

Addition and subtraction of whole numbers can be shown by steps or jumps along the number line. For example, adding 2 to a given number is shown by moving 2 steps to the right from the given number. To show $3 + 2 = 5$, imagine that you are taking a trip. The trip starts at 3 and you make 2 steps to the right. The trip ends at 5. Addition is shown by starting at a point given by one addend and taking a number of steps to the right given by the other addend.

Subtraction is shown by trips to the left. To illustrate $7 - 4 = 3$, a trip starts at the sum 7 and makes 4 steps to the left. The trip ends at the missing addend 3. Subtraction is shown by a trip which starts from the point given by the sum, and the number of steps made to the left is the number which is the given addend.

Later, when fractions, rational numbers, and other real numbers are studied, these numbers will find their places on the number line. Other operations, such as multiplication and division will also be shown on the number line.

Stage 1: The Number Line

Vocabulary: number line, forward backward, space, behind, in front of, greater than, less than, further.

Materials: objects to use as markers; pupil pages 143-144.

Teaching Procedure:

Activity 1: Using a road as a number line. Pupil Page 143

Ask the children to look at the picture on page 143 and tell what they see. (Road, sign posts, trees, a boy, a girl, a dog, houses, frog, and so on.) Talk about the fact that the road may go on and on in both directions.

Ask, "Do you see the frog? If he jumped along the road what would he see?" (Sign posts, trees, dog, and so on)

Let the children tell what they see on the sign posts. (Numerals) "Are the numerals on the posts in natural order?" (Yes) Ask, "At what sign post is the frog?" (Zero post) "Put a seed (or another counter) on the frog and imagine the seed is the frog. We will let the frog jump along the road. He never jumps off the road."

Give these directions: "Pick up the frog. Make him jump from the 0 post to the 1 post. Make him jump from the 1 post to the 2 post. Make him jump from the 2 post to the 3 post. When he jumps from one post to the next post, we say that he is jumping one space. Let the frog jump on, from the 3 post to the 4 post, from the 4 post to the 5 post, and so on, until he jumps off the page. How many jumps did he make to get off the page?" (29)

Ask the children to bring their frogs back to the zero post and let them jump the frogs to the 10 post. Ask, "How many jumps did it take the frog to get there?"

Say, "Now the frog is at the 10 post. He makes 2 jumps and is at the 12 post. He has jumped forward. Take him forward 3 more jumps. At what post will he be?

(15 post) Now let the frog jump back to zero. He is jumping backward."

Give directions for other trips jumping one space at a time, similar to these:

Jump the frog forward one space at a time from the dog to the boy. How many jumps does he take?

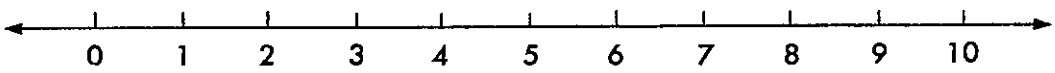
The frog wants to go with the boy to visit the girl.
How many jumps must he travel? Does he travel forward or backward?

How many jumps must the frog take backward from the girl's house to the dog?

Let pairs of children give directions to each other in moving the frog along the road forward and backward. Continue as needed.

Activity 2: Introducing the number line. Pupil Page 144

Draw a number line on the blackboard as shown below. The line you draw may have more numerals on it than this one. As you draw the line say, "I am drawing a line on the blackboard. I will place a 0 at this point, a 1 at this point, and so on." Tell the children that a line with numerals on it like this is called a number line.



Ask, "How is this number line like the road pictured on page 143 of your book?" Let the children talk about this. They should say, "It's like the road straightened out. They both have numerals along them. The numerals begin with 0. The numerals are in natural order. The line can go on and on in both directions just like the road." If these answers are not given, ask questions which will help the children say things like this to describe the number line.

Ask if the frog could jump on this number line as he jumped on the road. (Yes) Say, "Let us try to use the number line as a road for the frog." Use a piece of chalk to represent the frog and place a star, ☆, at the starting point. Place the initial of a child's name at the landing point.

Demonstrate the trip of a frog who starts at the 5 point and makes 6 jumps forward. Say, "I will put a star at the 5 point where the frog begins his trip. He makes 6 jumps forward, one, two, ... six. He is now at the 11-point. I will put my initial at the 11-point."

Ask a child to take the frog on a trip which begins at the 3-point. Let the child mark the starting point and count off the jumps of the frog as he makes 2 jumps backward. Get the child to put his initial at the end point of the trip. Ask at what point is the frog?" (1-point) Let the child describe the trip. (The frog started at the 3-point. He took 2 jumps backward. He landed at the 1-point.) Give directions like this to some other children.

Let the children find page 144 and with a seed to represent the frog, place the frog on the 6-point of the line. Ask the children to take the frog on a trip of 8 jumps forward. Go around the class giving help as needed. Let the children tell where the frog is at the end of the 8 jumps forward. (14-point) Ask a child to show the trip on the number line on the blackboard. Go on with other directions like these for the use of the number line in the pupil book.

After you have given the direction for some trips let the children in turn choose the starting point and give directions for the jumps. For example, a child may say, "My frog is at the 5-point. He jumps forward 7 jumps. My frog is now at the 12-point." Another child may say, "My frog is at the 8-point. He jumps backwards 8 jumps. He is now at 0-point."

As a child tells about the trip of his frog, other children should make the same trip with their frogs on the number line in their books. They should agree or disagree with the frog's stopping point. Go on with this activity as needed.

Note that a child may suggest jumps backward with the landing point to the left of the 0-point. Tell the children that their frogs are not allowed to make jumps like this. This is one of the rules. Tell them that at a later time the frogs will be allowed to jump to the left of 0 on a number line. If a frog is not allowed to make one trip, let the child select a different trip for his frog.

Note also that jumps forward may take the frog off the page. If this happens help the child imagine the line extended and find the stopping point of the frog as if the

frog could jump on.

Continue like this by letting a child tell about trips for other children to make. After each trip the children should agree on the landing point.

Ask a child to tell how he finds where his frog lands. If he counts off the jumps on the line to find where the frog lands, ask him if he can tell where the frog will land, without counting the jumps. He may answer, "Yes, I can. If my frog is at 5 and he jumps 7 spaces forward, he is at 12. 5 + 7 = 12." Let other children talk about this question and tell about other trips of the frogs.

Activity 3: Making two successive jumps on a number line. Pupil Page 144

Draw a number line on the blackboard like the number line on page 144. Ask the children to find their number line on page 144. Let each child put a counter which he calls a frog on the 0-point. Give directions for trips of the frogs as a revision.

Now say, "Today our frogs will make two trips, one after the other, on the number line. My frog is beginning his trips at the 0-point today. Put your frog on the 0-point and have your frog take the same trips my frog takes. My frog is jumping forward. He first jumps 6 spaces forward. He lands at the 6-point. (0 + 6 = 6) My frog now makes another trip of 8 spaces forward. He lands at the 14-point. (6 + 8 = 14)." Talk about the two successive trips and have the children agree on the landing point. Some children may need to count off the jumps for each trip. Give help as needed.

Say to the children, "What is your frog doing?" Ask Yafi to come to the blackboard and tell of two trips his frog makes. Let him go through the action as he tells of the trips his frog makes and where the frog lands.

Let the children make the same jumps on their number lines. Say, "Use your number line to find if Yafi is right." A child may say, "Yafi's frog starts at the 5-point and jumps 7 spaces forward and lands at the 12-point. He jumps 3 spaces more forward and lands at the 15-point. Yafi is right." Let the children, in turn, tell about jumps both forward and backward and find the landing point. Let other children make the same jumps on their number line. Examples are:

"My frog starts at the 8-point. He jumps 3 spaces forward. He lands at the 11-point. He makes a trip of 5 spaces backwards. He lands at the 6-point." "My frog is at the 15-point. He jumps 8 spaces backwards. He then jumps 6 spaces backwards. He then jumps 12 forward. He is at the 13-point."

"My frog is at the 4-point. He jumps 5 spaces backward. He goes behind the zero. By our rules this is not allowed, so he must make another jump.

"My frog is at the 17-point. He jumps 20 spaces forward. He goes off the page. The line goes on. He is at 37."

Let the children go on telling about two trips of their frogs and get other children to make the trips. Do this as often as needed.

Activity 4: Comparing two jumps on a number line. Pupil Page 144

Let the children find page 144. Say, "Today we have two frogs jumping. Ama has a frog and Efi has a frog. Get two seeds of different colours. Put one at the 0-point. This is Ama's frog. Put the other seed also at the 0-point. This is Efi's frog. Ama's frog makes a trip of 6 spaces forward and Efi's frog makes a trip of 7 spaces forward." Let the children make the two trips. Ask these questions: "Which frog is further along the line? (Efi's frog) How many spaces are they apart? (1) Why is Efi's frog further along the line?" (7 jumps is greater than 6 jumps)

Go on giving directions like these for two frogs. Ask the children to make the jumps on the number line in their books. Talk about where the frogs land, how many spaces apart they are, and why they are that far apart.

Let the children work in pairs on the same number line. Get one child to tell about a trip and make the jumps for his frog. Get another child to tell about a trip and make the jumps for his frog. Ask some of the children to show trips of their frogs on the number line at the blackboard. They should tell which frog is further along and how many spaces. Some trips may be these:

"Both frogs are at the 0-point. Ama's frog jumps forward 5 spaces and then 4 spaces more. Efi's frog jumps 8 spaces forward. Ama's frog is at 9 and Efi's frog is at 8. Ama's frog is 1 space further along."

"Both frogs are at the 6-point, Ama's frog jumps 7 spaces forward. Efi's frog jumps 5 spaces forward. Ama's frog is at 13. Efi's frog is at 11. Ama's frog is 2 spaces further along."

"Ama's frog is at the 5-point. He jumps 7 spaces forward. Efi's frog is at the 8-point. He jumps 8 spaces forward. Ama's frog is at 12. Efi's frog is at 16. Efi's frog is 4 spaces further along.

"Ama's frog is at the 17-point. He jumps 7 spaces backward. Efi's frog is at 15. He jumps 5 spaces backward. . . ."

"Ama's frog is at 0. He jumps 5 spaces forward. Efi's frog is at 16. He jumps 13 spaces backward. . . ."

"Ama's frog is at 3. He jumps 6 spaces forward and then 3 spaces forward. Efi's frog is at the 8-point. He jumps 7 spaces forward, and then 4 spaces backward. . . ."

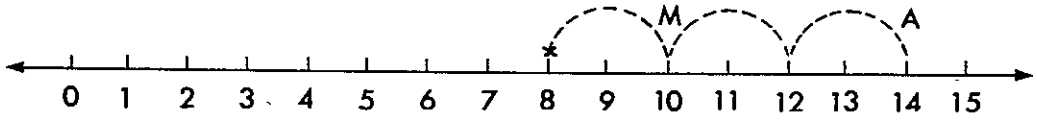
"Ama's frog is at 0. He jumps 10 spaces forward, then 7 spaces forward and then 8 spaces backward. Efi's frog is at 6. He jumps 9 spaces forward, then 4 spaces backward. . . ."

Activity 5: Multiple jumps on a number line. Pupil Page 144

Draw a number line on the blackboard with numerals to at least 20. Say, "Today we have four frogs on our number line. The first one is Mr. One Frog. He can jump one space at a time. Mr. Two Frog can jump two spaces at a time. How many spaces do you think Mr. Five Frog can jump? (5) What do you know about Mr. Ten Frog? (He can jump 10 spaces at a time.)"

Use a piece of chalk to represent Mr. Two Frog. Let him start at the 8-point. Let Mary make one jump forward for Mr. Two Frog. Sketch the jump, as shown on the number line below. Let Ama make two more jumps for Mr. Two Frog. Again sketch

the jumps. Go on in the same way until the children can make successive jumps of two spaces.



Give practice like this for jumps of Mr. Five Frog and Mr. Ten Frog. Choose starting points so the trips can be made on the blackboard picture of the number line. If some of the children can think of the line going on to the right, let them tell of trips for their frogs which go off the picture on the blackboard. You tell of trips like the following. Ask questions about stopping points, which frog is further from zero, and the number of spaces the frogs are apart.

> "Mr. One Frog is at the 0-point. He makes two jumps forward. Where is he? Mr. Two Frog is at the 0-point. He makes one jump forward. Where is he?"
>
> "Mr. Two Frog now makes four jumps forward. Where is he? Mr. Two Frog now makes three jumps forward. Where is he? He then makes five jumps backward. Where is he?"
>
> "Mr. Two Frog is at the 7-point. He makes three jumps forward. Where is he?"
>
> "Mr. Two Frog is at the 6-point. He makes four jumps forward. Where is he?"
>
> "Mr. Two Frog is a 0. He makes two jumps forward. Where is he? Mr. Five Frog is at 0. He makes two jumps forward. Where is he? How many spaces is Mr. Two Frog from Mr. Five Frog?"
>
> "Mr. Two Frog starts at the 0-point. He makes ten jumps forward. Where is he? Mr. Five Frog is also at the 0-point. He makes four jumps forward. Where is he? Are the two frogs at the same place? How many spaces is Mr. Two Frog from Mr. Five Frog?"

"Mr. Two Frog starts at the 0-point. He makes ten jumps forward. Where is he? Mr. Five Frog is also at the 0-point. He makes four jumps forward. Where is he? Are the two frogs at the same place? How many spaces is Mr. Two Frog from Mr. Five Frog?"

"Mr. Ten Frog is at 0. He makes 1 jump forward. Where is he? Mr. Five Frog is at 5. He makes two jumps forward. Where is he? How many spaces apart are the two frogs?"

"Mr. Ten Frog starts at 0. He makes two jumps forward. Where is he? Mr. Five Frog starts at 0. He makes four jumps forward. Where is he? How many spaces apart are the two frogs?"

"Mr. Two Frog starts at 0. He makes ten jumps forward. Where is he? Mr. Ten Frog starts at 20. He makes two jumps backward. Where is he? How many spaces apart are Mr. Two Frog and Mr. Ten Frog?"

"Mr. Two Frog is at 0. How many jumps must he make forward to get to the 10-point?"

"Mr. Two Frog is at the 12-point. How many jumps backward must he make to get to the 0-point?"

"Mr. Five Frog is at 10. How many jumps must he make to get to the 15-point?"

"Mr. Five Frog is at 15. How many jumps backwards must he make to get to 0?"

"Mr. Ten Frog is at the 20-point. How many jumps backwards must he make to get to 0-point?"

Other activities may be planned for the children as needed.