B. MEASUREMENT AND RELATIONSHIP

B.1 Measurement Concepts

Linear Measurement Activities : Grade II *(Bortnik)*

The assumption is made that the children will have had some previous experience with graphing and that they will have a record book in which to keep track of their findings. They will work in five groups and rotate from one activity to another so that each student can try every activity.

PART ONE

PURPOSE - TO GIVE PRACTICE WITH COMPARISON AND TO SHOW THE CHILDREN A NEED FOR STANDARD MEASURE.

Card 1 Take a ruler from the jar. How many things can you find that are shorter than it? Be sure to keep a record of these things.

Card 2 Find out how many ribbons are longer than the yardstick. How many are shorter than the yardstick? Be sure to keep a record.

Card 3 Find out which strings are shorter than you. Which strings are taller than you? Be sure to keep a record of the strings that are shorter or taller than you.

Card 4 Take a cardboard strip. Use cardboard to measure the reading table. Be sure to keep a record of what you find out.

Card 5 Measure the teacher's desk in handspans. Be sure to record what you have found out.

PART TWO

PURPOSE - TO GIVE PRACTICE WITH PRACTICAL MEASURE.

Card 6 Guess how wide our classroom is. Measure how wide it is. Be sure to record your guess and how wide you found the room to be.

Card 7 Measure some of the things you use in reading class. Be sure to keep a record of the things you have measured. Remember to record what you have found out about them.

Card 8 Ask a friend to help you, then measure (1) around your ankle (2) around your waist (3) around your wrist (4) around your knee. Be sure to keep a record of these measurements.

Card 9 Find out how tall you are. Mark how tall you are on the class graph. Find two ways of saying how tall you are. Print these in your record book.

Card 10 Guess how long the hall is. Measure it. Be sure to record your guess and how long you measure the hall to be.

PART THREE

PURPOSE - TO PROVIDE ACTIVITIES TO DISCOVER WAYS TO ESTIMATE, USING HANDSPAN AND SHOE LENGTHS (FOR THOSE WHO FINISH EARLY)

Card 11 Cut some paper strips - one inch, two inches, three inches, four inches, five inches, six inches. Mix them up. In your record book arrange them from the shortest piece to the longest. Glue them in.

Card 12 Find a classmate who is taller than you. How much taller is this classmate? Be sure to record what you find out.

Card 13 Find a classmate who is shorter than you. How much shorter is this classmate? Be sure to record what you find out.

Card 14 Measure your handspan. Use your handspan to help you to guess how high the reading table is. Compare your guess with the true measurement. Remember to keep a record.

Card 15 Measure your shoe length. Use your shoe length to help you guess how wide the hall is. Compare your guess with the true measurement. Remember to keep a record.

Getting to Know our Friends in Grade III *(Keeler)*

Since the children do not live in the area adjacent to the school in which I teach, one of our first projects is "Getting to Know our Friends in Grade Three." Working together in groups to make charts and drawings adds a personal touch that is lacking in the everyday routine of the arithmetic program.

ACTIVITIES

I. Find out where we live. Collect data.

a) How many miles from school?

b) Which direction?

c) In how many different ways do we get to school?

II. Correlate with Social Studies.

a) We learn about the Park Country so drawing a fairly large floor map (to scale if possible) is one of our tasks. City and district maps are helpful but sometimes confusing because there are so many details.

b) Find out how many buses bring the children to our classroom.

Trace the main bus routes, both city and country, and other modes of travel (bike, car, walk).

c) How many children travel by country bus, city bus, car, bike, foot?

d) In how many different ways can you show the distances travelled (blocks, paper strips, pipe cleaners, hollow straws)?

e) Would you use the same unit of measurement (for example, the block) for everyone? If not, why? What would you use?

III. Today the Indian children go to school just like we do, but in the olden times there were no schools like ours. Indian children "learned by doing." Let's pretend we are Indians and try to measure things without a ruler.

a) In how many ways did the Indians measure (hands, feet, arrows, spears, etc.)?

b) See how many things you can think of that Indians had to measure with to make canoes, teepees, bows, arrows, etc.

c) Play "Find the Rock."

1. Chief hides the rock (about four spear lengths from the teepee).

2. Children measure the four lengths but have trouble finding the rocks. Why?

3. One child decides to measure in arrows instead of spears. Will the rocks be easier to find? Why?

4. Would moccasins be even easier, more accurate?

IV. Correlate with Health (for the more advanced pupils).

a) Working with clocks
- how long does it take each of us to get to school?

b) Who has to ride the bus the longest? Why?
- distance in miles from school,
- direction bus is travelling when child picked up.

c) Safety rules
- pedestrians, bikes
- dangers in heavy traffic
- giving yourself sufficient time to get to school on time.

d) Hours of sleep, bed time
- Why is Chris tired? (On bus at 7:30 a.m. and 60 minutes on the bus is enough to tire anyone.)

MATERIALS Construction paper, chart paper, bristolboard, crayons, felt pens, scissors, pipe cleaners, drinking straws, plasticine, rulers, clock model, maps of city, district, book *Indians Knew* , by T.S. Pine and J. Levine, McGraw-Hill, New York, N.Y., 1957. Children bring toy Indians, etc (if they have them at home), data from home regarding where they live, bus route, etc., little sticks to make teepees and for measuring.

Measurement for Grade III *(Risvold)*

[*As a guide for planning, I have referred to the STA 3 text with the idea of replacing the teaching of concepts introduced in the text with the workshop approach. I have attempted to structure the questions so the children will go beyond these concepts. I have also kept in mind the aspects outlined in* Freedom To Learn *which are to be covered when working on measurement: comparison, conservation, reiteration, standard units, precisions and accuracy, metric system.*]

A preliminary whole class discussion would take about two days and would involve the following:

First Day - To establish the concepts of comparison, conservation, and reiteration, I would have the children work in groups of two or three. Each group would be given one of the following questions with 10 to 15 minutes in which to work out the answers. The questions are:

1. How many spans is the length and width of your desk?
2. How many reaches is the length of the blackboard?
3. How many reaches is the width of the room?
4. How many bodies is the length of the room?
5. How many thumbs long are these new pencils, paint brushes?
6. How many of your own feet is the length of the hall?
7. How many cubits is the length of the teacher's desk?
8. How many cubits is the length of the cupboard?
9. How many spans is the length of the bulletin board?
10. How many thumbs is the length and width of your math book?

Each group would have a few minutes to report its results to the rest of the class. In the discussion I would hope that the children come up with the idea that these are not good measuring devices because they are not consistent or accurate. After this idea has come up, we would discuss various standard units of measurement which are used every day.

Second Day - The children work in the same groups and fill out a personal inventory sheet, including height, weight, span, foot length. When these data are collected, we make graphs using square inch paper, tiles, square foot tiles, or graph paper (depending upon the understanding of the pupils). [*Previous to this I plan a unit on graphing, using the one by Ed Irmis (see Page 4) as a guide, so the second day should serve mainly as a review.*]

For the actual workshop, the class would be divided into four groups. All would receive a copy of the questions. They would be briefly discussed and then chosen by the groups. I would require that the data be presented in five or six different ways, accompanied by a verbal description. Extra activities would be available in the permanent math station for those who completed their work early. The open-ended questions would be mainly concerned with aspects of standard units, prevision and, if the children decided to use it, the metric system.

Length

1. How would you find the value of one yard of pennies, nickels, dimes, quarters?

2. Collect five objects and ask ten friends to estimate the length of each. How could you make a graph or chart to show how close the estimates are?

3. How could you measure what your pace is? Use your pace to measure the length of the gymnasium. How close were you to the exact measurement? Show this on a graph.

4. What is the height and reach of your classmates? How can you find out if they are square? How can you show this?

The group would then continue into the areas of weight, capacity and time. (Open-ended questions for these topics are incorporated in the weight, capacity and time sections following.)

Development of Standard Units of Length: Grade III *(Gregg)*

Arbitrary Measurement

MATERIALS Blocks, books, string, boxes, etc.

Pick an object from the table. Measure your partner with this object. How are you the same? Different? Who is bigger? Find something smaller than both of you and guess the measurement of it. Measure it.

Using Body Measurements for Measuring

MATERIALS Charts showing and naming body measurements (digit, palm, span, cubit, fathom, foot, pace).

1. Measure an object in the room using at least three body measurements to measure it.

   a) Are your results the same as your partner's?
   b) Which body measurement gave you the best measurement?
   c) Which took you the longest to do?

2. Find the distance around the areas of the playground. Use a body measurement to measure. Guess before you measure.

   a) Whose play area is the largest? Smallest? Are there any the same?

3. Use a body measurement to measure three or more of cupboards, floors, doors, hallways, windows, boards, desks, papers, books.

   a) Compare your measurements with those of others who measured the same thing. Are your results different? How can you explain this difference?

Development of the Need for Standard Units

Using string, find the length of your body measurements. Have your partner help you. Place your body measurements on the chart beside your name. (Class discussion of the differences in each person's body measurements leads to the need for something standardized. Introduce each child to three measuring sticks: inch, foot, yard. Each child receives three measuring sticks, unmarked.)

Relation of Body Measurements to Standard Measurements

1. Compare your inch, foot and yard to your body measurements. Are there any the same?

2. Measure a small, medium and a big object in the room. Use a body measurement first. Guess the number of standard units. Check, using standard units. How good was your guess?

3. Measure your reach and height. Are you a square?

Relation Within Standard Units Using Standard Units

1. Mark your yard measure stick using the other two measure sticks. Mark your foot measure stick. Now answer these questions:

   a) How many feet and inches are in three yards?
   b) How many inches are in two feet?
   c) How many inches and yards are in three feet?

2. Find two things that are 1 inch, 12 inches, 24 inches, 36 inches. Which measure stick will you use?

3. Find the length of the boards, room, doors, hall, windows, desk. Guess, then measure. Which measure stick will you use for each measurement?

Units of Length: Grade IV *(Merta)*

OBJECTIVES (a) To direct students of Grade IV level in discovering and experiencing concepts pertaining to distance, length, width, perimeter, circumference, broken lines, and comparison of units of length. (b) To introduce appropriate units for measuring length (inch, foot, yard, mile, and others of student discovery).

MATERIALS Ruler, yardstick, tape measure, string, discs or cans, tacks, stick of non-standard length, squared paper.

Experiences with Distances or Lengths in the Classroom

1. Walking heel to toe, measure the length of your classroom. Get three friends to do the same thing. Make a table of your results. Do you all have the same answer? Why do the answers differ?

2. How many steps do you and your friends get when you measure the length of the classroom? Why do the answers differ?

3. How could we find the exact length of the room? Measure the length and compare your answers with your other measurements.

4. Suppose we wanted to measure the distance from here to Mexico. Would we use these methods of measuring? Why?

5. Can you give other units that we could use to measure lengths or distances?

6. What would be a good unit of measurement to find -
   a) the distance to the moon
   b) the distance to the office
   c) the length of a thumb tack
   d) the length of my finger
   e) the length of my pencil
   f) how far I am from my home.

Estimating and Experimenting with Height

1. How high do you think the door is?

2. Use three ideas that may help you to find the height of the door. Compare the results.

3. Could we use these methods to find the height of a flagpole? The Husky Tower? A tall building?

4. Take two rulers and bolt them together at one end. Using squared paper and other items along with these rulers, how could you find the height of a tree?

5. Have four groups find the height of the flagpole. Do you all have the same answer? Why? Estimate the height first.

Perimeter (Estimating and Measuring Distances Around Things)

1. In measuring the distance around the classroom, is it necessary to measure the length of all four sides?

2. Can you arrive at a method that will help you find the perimeter of a rectangle? What is the secret?

3. Try this secret to find the perimeter of your desk, the teacher's desk, the blackboard, the table. Does it work?

4. Draw six triangles on the squared paper. Can you see the secret you used before?

5. Are there some special triangles that have a secret method for finding their perimeters? What kinds are these?

Circles (Diameter/Circumference Relationships)

1. Use the discs and measure the diameter and the circumference of each and record your findings on a chart. Draw a graph that shows the relationship.

2. What is the secret or the formula that you could use to find any answer?

3. Can you predict what the circumference would be if the diameter is 6 inches? Four and a half miles? Eleven yards? Sixty feet?

4. Can you predict from the graph what the diameter would be if the circumference is 18 inches? Four blocks? Eight feet?

Perimeters of Other Four-Sided Figures

1. Draw a neat picture of a trapezoid, a parallelogram, a quadrilateral, a rhombus. What do you notice about the sides of these figures?

2. What is the secret about finding the perimeter of the parallelogram?

3. Is there any special way of finding the perimeter of a quadrilateral?

4. What is the secret for finding the perimeter of a rhombus?

5. Why does the trapezoid have no two sides the same length?

6. Draw a neat diagram for each of the figures and pass it to your friend. Have him find the perimeter of each of the figures. Do you agree with his answer?

7. Can you name some things in the school, at home, or up town that are in the form of a rhombus? A parallelogram? A trapezoid? A quadrilateral?

8. How do you think an engineer would find the perimeter for these figures?

Distances for Broken Lines

1. The road map says that it is 560 miles to Vancouver but the pilot says that it is only 480 miles. Who is right? Why?

2. Why can we not always go in a straight line when we travel?

3. Can you find some rule that would help us find the distance between two towns if there were obstructions in between? Tell the class about your method.

4. Find the distance from the door to the top of the flagpole in feet, yards, steps, inches, sticks. Do you get the same answer each time? Why, or why not?

Making Graphs for Units of Length

Complete each of the following tables, then plot each on a graph. Make a large one for display.

Inches	Feet
12	1
	2
	3
	4
	5
	6
	.
	.

Feet	Yards
0	0
3	1
	2
	3
	4
	5
	6
	.

Yards	Miles
1760	1
	2
	3
	4
	5
	6
	.
	.

Feet	Miles
5280	1
	2
	3
	4
	5
	6
	7
	.

What is the secret for each relationship?

By using the graphs find the answers for the following.

38 inches =	feet
7 yards =	feet
80 feet =	inches
9 miles =	yards
40 yards =	feet
90 feet =	yards
900 yards =	miles

Make up some to test your friends.

Workshop in Measurement: Grade IV *(Koleyak, Misselbrook, Ritcey)*

OBJECTIVE To give the children experience in using various units of measurement. This is solely an introduction to buidiing readiness for more extensive experiences in measurement.

PART ONE

Open-ended questions

Try three different methods for each of the following.

1. What would you use to measure your wrist?
2. What would you use to measure your neck and your waist?
3. What do you guess is your wrist measurement?
4. What is it after you measure it?
5. What do you guess your neck measurement to be?
6. What is it really?
7. How many wrist measurements will you need for your neck measurement?
8. What do you guess your waist measurement to be?
9. What is the right measurement?
10. How many neck measurements will go around your waist?
11. Are your measurements the same as your partner's?
12. Where did you differ?

PART TWO (Accompanied by drawings of a giant and a dwarf)

Here is a team of acrobats who are giants and dwarfs. All the giants are the same height. All the dwarfs are the same height. All the heights are given in feet.

1. What is the height of the giant and the dwarf together?
2. What is the height of the giant less the height of the dwarf?
3. What is the height of the giant?
4. What is the height of the dwarf?
5. What is the height of a giant and two dwarfs together?
6. What is the height of a giant less the height of two dwarfs?

PART THREE

1. Have you a shadow?
2. Is it always the same length?
3. What is your height at 10:15 a.m., 11:15 a.m., 12:15 p.m., 1:15 p.m., 2:15 p.m.?
4. What is your shadow length at 10:15 a.m., 11:15 a.m., 12:15 p.m., 1:15 p.m., 2:15 p.m.?
5. How do you compare your shadow lengths to your height?
6. At what time would you expect your shadow to be the same length as your height?
7. At what time would you expect your shadows to be near the same length?
8. Do you and your shadow ever make a square?
9. Do you and your shadow ever make a triangle?

Group Work on Linear Measurement: Grades IV, V, VI *(Burton)*

Pacing

For 1 to 2 pupils

1. Is it useful to know how long your pace is? To find out, mark a chalk line in the yard and walk ten paces at your usual speed and comfortable stride.

2. When you have walked ten paces, mark the yard with chalk again.

3. Measure the distance between the starting chalk mark and the chalk mark where you finished.

4. What must you do to find the length of one of your paces? Discribe what you did and record the length of your pace.

5. Do the same thing for your running stride.

Trundle Wheel (Division 2)

For 2 to 3 pupils

1. Measure out 110 yards.
2. Walk the 110 yards you measured at your normal speed and find out how long it takes you to walk this distance. Use a stop watch.
3. Find out how many yards are in a mile. What fraction of a mile is 110 yards?
4. Can you find out an easy way to discover how long you would take to walk a mile at your normal speed?

Early Measures of Length (Division 2)

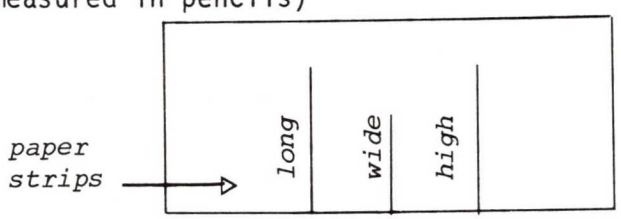
For 1 to 5 pupils

1. Use your pencil as a unit of measure and estimate how long your desk is in "pencils."
2. Measure how long your desk is in "pencils."
3. Estimate how wide your desk is in "pencils."
4. Measure how wide your desk is in "pencils."
5. Estimate how high your desk top is in "pencils."
6. Measure how high your desk top is in "pencils."

Linear Measurement

Name: _____

My Desk (measured in pencils)



Spans

For 3 to 5 pupils

1. Each member of the group guesses the height, in spans, of each of the other persons in the group. Write it down.

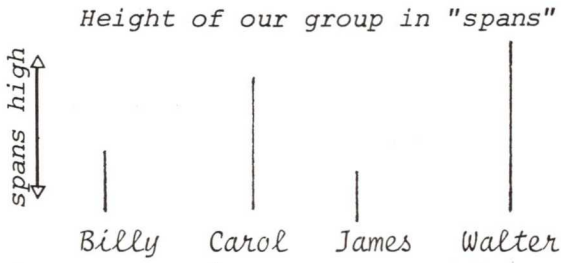
   - A span (hand span) is

2. Each person measures the others in the group and writes it down.

3. Did all in the group get the same answer for each person's height?

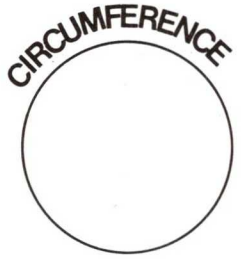
4. Why didn't they get the same answer?

5. Draw a bar graph to show the "spans high" of each member of the group.



Circumference I

1. Collect some round objects and measure all around them. This measurement is called the *circumference*



2. Can you find a way to do this?

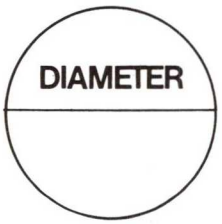
3. Draw the objects and write down each circumference to make a bar-type graph showing the circumferences.

4. Tell how you measured all around the objects you collected.

Circumference and Diameter II

For 1 to 5 pupils

1. Measure the distance across the middle of circles you want to draw (this is called the *diameter*).



2. Write down the diameter and the circumference of each circle in a table like the one below.

	Circumference (Distance around)			Diameter (Distance across)		
	Object	Estimate	Measurement	Difference	Estimate	Measurement	Difference
1							
2							
3							
4							
5							

3. Can you find a relationship between the circumference and the diameter of a circle? Make a chart like the one below and see if you can find the relationship.

	Round object	Circumference (C)	Diameter (D)	(C+d)	(C-d)	C×d)	(C÷d)
1							
2							
3							
4							
5							

4. Which column shows the special relationship between circumference (C) and diameter (d)?

5. What is the relationship between circumference and diameter?

Perimeter

For 2 pupils

1. The *perimeter* is the *distance around* something.

2. On a piece of graph paper each person draw a square, a rectangle, a triangle, and one or two other figures. Change papers.

3. Estimate the perimeter of each of the figures and write it down by the drawing.

4. Measure the perimeters of the figures and write them down by the drawings.

5. What was the difference between your estimate and measurement?

6. Are you a good estimater? If not, have your partner draw more squares, rectangles and other figures for you.

For 1 pupil

1. Obtain a new pencil and find out how many pencils, placed end to end, would go all around the room.

2. Do you have to crawl all around the room measuring with your pencil? What is a quick way of doing this? (Record your answers as follows.)

   ____ pencils placed end to end would go all around the room.
   An easy way to find this answer is to _____

For 2 or 3 pupils

1. Estimate, then measure the perimeter (distance around) of places and things in the school, for example, the room, the yard, the chalk box, the S.R.A. box. Write down your estimates and measurements on a chart.

2. What was the difference between your estimate and the measurement? Are you good at guessing perimeters?

3. If you are measuring the perimeter of a square, do you have to measure all the sides? Show what sides you must measure on a diagram.

4. If you are measuring a rectangle, do you have to measure all the sides? Show, on a diagram, what sides you must measure.

How long would it take to walk a mile?

For 2 to 5 pupils

1. Measure 1/4 mile on the field or the running track. Do you have a 1/4 mile tape measure? If not, what other way can you measure 1/4 mile?

2. Write down how long it takes you to walk 1/4 mile. Use a stop watch.

3. What must you do to your answer to find out how long it would take you to walk one mile?

4. How many miles is it to your house from school? Tell how long it would take to walk from home to school.

5. How far do you live from Calgary? Okotoks? High River? Black Diamond? Cayley? Longview? Turner Valley? Millarville?

6. Figure out how long it would take you to walk to some of these places. Give the exact times and then round your times off to the nearest quarter hour. Use the table below to record your answers.

Length of time it would take me to walk to the following towns

Town	*Distance*	*Exact time to walk*	*Approximate time to walk*

Linear Measurement, Daily Use

For 1 pupil

Make up a book showing how people use measurements in their work. Use pictures and a short story to tell what people are doing. Some people in your town whom you might ask for information are people who make things, sell, test and build things.

Standards of Length (inches)

For 1 pupil

1. Collect some long objects and measure them in inches. Draw them and write down their sizes.

2. Collect containers (garbage can, plant pot, juice can) and measure how high they are inside. Is the height the same as the depth in every case? Can you measure in inches and parts of an inch?

For 2 or more pupils

1. Cut strips of construction paper into the following sizes: 1 inch, 2 inches, 3 inches, 4 inches, 5 inches, 6 inches, 7 inches, 8 inches, 9 inches, 10 inches, 11 inches, 12 inches. Mix them up.

2. Arrange them from the shortest piece to the longest piece on a table.

3. Ask a friend to pick out the 6-inch length. Did he pick up the right one? Ask him to pick out another length. How many did he get right out of five lengths you asked him to pick out?

4. Ask other friends to pick out lengths you call out.

5. To make it more difficult you can mix up all the lengths and then lay them out on the desk for your friends to pick the sizes you ask them to.

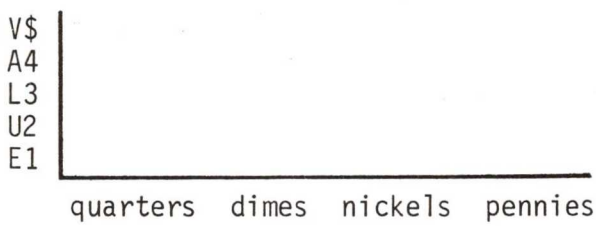
6. Ask your friend to call out lengths and see how many you get right out of five calls.

Money

For 1 to 5 pupils

1. Find the value of 1 yard of quarters, dimes, nickels, pennies.

2. Make a bar graph of your results.



Standards of Length (inches, feet, yards)

For 1 to 5 pupils

1. Each person in the group guess the length of the room and write it down. (Pick the most suitable units of length.)

2. Each person measure the length of the room. Did you have to use more than one unit of measure?

3. Were all your guesses the same?

4. Were all your measurements the same?

5. Each person work out if their guess was too long or too short.

6. How much too long or too short was your guess?

7. Pick a parner and measure the width of the room and write it down. (Pick the most suitable units of measure.)

8. Could you draw the room to scale on a piece of paper showing the length and width?

9. Use a scale where 1/4 inch stands for 1 foot.

	Things I Measured	*Guessed Length*	*Measured Length*	*Difference**
1				
2				
3				

**Put a check if you feel your guess was good.*

Estimating Distances

For 2 to 3 pupils

1. Draw 3 or 4 lines of different lengths in the yard with chalk.

2. Ask your partner to guess the lengths of the lines. (This is called *estimating* their lengths.)

3. Measure the lines to see how closely you estimated.

4. Have your partner draw lines. Try to estimate their lengths before you measure them.

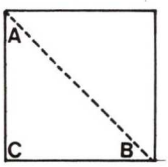
5. Do your estimates get better with practice?

Estimating Height

For 2 or 3 pupils

There are many ways of estimating height. One way is described below.

1. Make a 4-inch square in a thin card. Draw a line from one corner to the opposite corner. Cut along this line (A,B). Make the other corner "C." This triangle will help you to estimate the height of the school, telephone poles, etc.



2. To measure the height of the school, put point "B" at the end of your nose. Shut one eye and move back from the school until point "A" seems to be at the top of the building. Side AC must be upright.

3. Stand still and have your partner place a mark where you are standing. Measure the distance from the school to where your partner placed the mark. The height of the school is about the same as the distance from the school to your mark. To be more exact, add the height of your eye above the ground to the distance from the school.

Time Measurement *(Grigel)*

(Ages 6 to 9; M.A. 4 to 6)

OBJECTIVES (Primary General Learning Disabilities)

1. To promote in the children a general idea of time and how various times relate to various activities during the day.

2. To have the children recognize a need for standardized time measurements.

3. To teach the children to tell time--hours and half hours.

4. To have the children recognize the relative length of a minute, second, hour.

EXPLANATION In working with the cards, care must be taken to have at least one "reader" in each group to interpret the questions to the nonreaders. Groups of three or four would prove best at this level. The previous knowledge of the children is very limited. Only a few would have any concept of time and some will not know their numbers. I would have introduced some very simple pictographs and possible block graphs prior to this series of cards. On some of the cards, questions are asked that only a few of the children will be able to answer. These can act as "teachers" for the others of the group. The cards are quite structured in keeping with our theory of a structured (but not rigid) approach to the teaching of retarded children.

Card 1: How many handclaps does it take for your friend to walk around the table? Let him clap his hands to time you. Using heartbeats see how many it takes for each person to walk around the table. What other ways can you think of to time things. Are these good ways to time things? Why?

Materials - no special materials for this card.

Card 2: Look at Clock 1 and put the numbers on the face. Can you put them on Clock 2 without looking at the big clock? What can you say about the numbers on the clock?

Materials - mimeographed sheets of two clock faces without the numbers on identified as Clock 1 and Clock 2.

Card 3: The two black shapes are hands. What is different about them? Find the minute hand, and hour hand. Put them on your big clock. Show on

your big clock a. when you get to bed, b. when you get up, c. recess, d. noon hour, e. home time, f. supper time.

Materials - clock faces approximately 12" diameter; 2 hands for each and fastener to put on hands.

Card 4: Find out when everyone goes to bed. Make a graph to show this. What time do most children go to bed? Why? Can you do the same thing with the time that each person gets up? Can you tell how many **hours of** sleep each child has? The teacher? Why is it different? (This is a "hard" chart. Only a few of the children will be be able to complete it.)

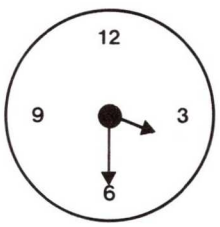
Materials - block graph paper.

Card 5: On the page of clocks show:
8:00 2:00
5:00 9:00
3:00 12:00

What do you see about the minute hand? Take your big clocks and show other times that the minute hand does the same thing. Tell what time you have.

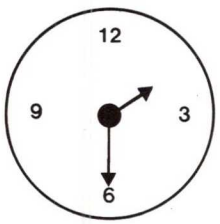
Materials - mimeograph sheet with six clock faces. Clock faces with hands from card 3.

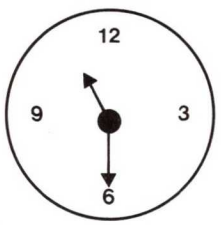
Card 6: On your big clock put the minute hand at 6. Now move the hour hand. Can you tell what time you show in each case? We write this:

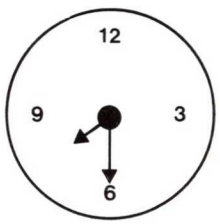


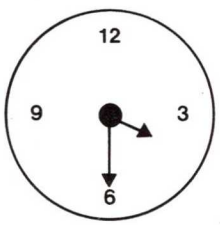
3:30

How would you write:









Show on your big clock:
6:30 9:30
5:30 10:30
1:30 12:30

Materials - clock faces from card 3 or small individual clock faces from a watch company.

Card 7: Can you hold your breath for 10 seconds? 10 minutes? 10 hours? Why? How can you find out who can hold their breath the longest? Why are there differences?

Materials - have a watch with a second hand available. Hopefully someone will think to ask for it!

Card 8: Can you find pictures of other ways people use to tell time? Ask your father or mother to help you. You can tell us about what you find out. Maybe you could make a model for the class. An attempt to involve parents!

Materials - vary with the class.

Time Unit: Grades II, III *(Penner)*

1. Can you tell how much time you spend playing in one day? One week? One month? How can you show this?

2. How much time do you sleep? Compare this with others. How can you show this?

3. Make a graph to show how many hours you spend on each activity during your day. What other way can you show your results?

4. In how many different ways can you measure time? Make a chart to show as many of these ways as you can.

5. How much time does it take to walk the length of the hall? hop? skip? move backwards? with eyes shut? downstairs? to school? with a heavy box? Guess your answers first. Compare with time taken by others. Show your results.

6. Using a TV guide, find the time between two specific programs. Find the time you would spend if you watched all the programs you like. Show this in some way.

7. Using a calendar, can you find out what a leap year is and why we have it? Report on what you find. Do all the months have the same number of days? Why or why not? How can you show this?

8. What do you do before breakfast? Between breakfast and school time? Before dinner time? After dinner time? After school? Before bedtime? Show this in some way.

9. What time do you get up? Who at your house gets up earlier? Later? Same time? Do the children in your class get up at the same time? How many get up earlier? Later? Show your results. Repeat this for bed times.

10. What things travel fast? Slowly? Find or draw pictures.

11. How long does it take you to travel across the playground? Your friend? Try this more than once. Show your results.

12. What things can you do for a longer time than your friend? Show this in any way you wish.

13. Make a sand timer with 2 bottles, sand, plasticine. Use it to measure the time taken to do various activities. Compare with other children. Record the results.

14. Make a water timer with a pan of water and tin can. Do similar activities to those with the sand timer.

15. String timer (pendulum). Make it using plasticine and string. Count swings. Time various activities by counting swings. Vary length of string. What happens? Record your results.

16. How many different clocks have you seen at home? At school? Outside? Show as many different kinds as you can.

17. Use the clock. Show a time on it. Write the time in as many different ways as you can. Repeat for at least six different times.

Time Questions: Grade III *(Risvold)*

1. Using a clock with a second hand, find out:

   a) How many times the second hand goes around in 1 minute, 5 minutes, 10 minutes. Is there a pattern?

   b) How many times the second hand will go around in 1 hour, 10 hours, 1 day.

   c) How many times the minute hand goes around in 1 hour, 2 hours, 5 hours, 1 day, . . .

   d) How many times the hour hand will go around the clock in 1 day, 2 days, . . .

   Make a table showing what you have learned.

2. a) Using a pendulum made from string and a weight, find out what happens as the length of the string is changed. How can you make a pendulum speed up? slow down?

b) How much time does it take for your pendulum to make 10, 20, 30 swings? Try different pendulums. Would a pendulum be good for measuring time?

3. How do you spend the number of hours in a week? Make a chart to show how 5 classmates spend the time in a week.

4. Could you use your pulse to measure time? How can you find out how many times your pulse beats in one minute? Does your pulse stay beating at the same speed? Why? Does everyone have the same pulse rate? Would pulses be good for measuring time?

Pendulum: Grades IV, V, VI *(Eremko)*

MATERIALS Stop watch (or watch), string, weights (balls, lead, etc.), tape measure, balance scale.

1. Measure how far a pendulum travels in each swing.

2. Does the swing of a pendulum vary with the length of a string?

3. Using different lengths, how many strokes in one minute? Half a minute?

4. Use different weights. Does a heavy "bob" swing faster or slower than a light "bob"?

5. Measure the size of the "bob." How does the size of the"bob" affect the swing of the pendulum?

6. Graph the relationship between the swing of a pendulum and time interval.

7. What every-day uses has a pendulum?

8. Using a stop watch can you estimate the length of a pendulum with 30 strokes per second? Sixty strokes per second?

9. How can a pendulum be used to measure time?

10. Using a pendulum, calculate how long it takes to walk 10 feet, 15 feet, 20 feet.

11. How long would it take to walk 50 feet, 100 yards, 400 yards, 1 mile?

12. Using a pendulum, discover how long it takes your classmate to run a dpecified distance.

13. Using a pendulum, determine how long it takes someone to complete a task. What is the fastest time? The slowest time?

14. How else can a pendulum be used to measure pace and time intervals?

15. If a pendulum made one swing every second, how many swings would it make in 30 seconds, 60 seconds, 10 hours, 24 hours?

Money Activities *(Inkster)*

1. Write out a list of sums, such as 25¢, $.33, $1.05, $.08, and so on. Using play money have the children illustrate how many ways they can show those amounts of money.

2. Cut out some pictures (baseball glove, chocolate bar, etc.) and make up questions concerning change. Have the children show in how many ways they can give you change for those items.

3. Write down some amounts of money. With coins, have the children illustrate how many ways they can show you this amount using the fewest coins, most coins.

4. Set up a "store" with various items priced. Ask in how many ways one can pay for them. Have your partner overpay you. Can you give him the correct change in more than one way?

5. Your partner gives you a certain amount of money and asks you questions such as, "If you had this much money what items could you buy?" "Would you get change?" "How much?"

Money Assignment Cards: Grade III *(Keddie)*

MATERIALS Real money (amount will depend upon the cards used), collection of toys for each group, foot ruler for each group, apparatus for weighing, masking tape for price tags. [A letter to the parents explaining your activity will usually provide much of the material.]

IMPLEMENTATION Vary the procedures to suit the topic, the children and yourself. Set up five or six activity centers all on the same assignment and five or six activity centers each on a different topic or different aspect of the same topic. Pairs of children can work together, either on an individual basis or with a friend. [This could be your week's work since the groups rotate each day.]

Activity alone is not enough. There must be discussion with an understanding teacher who can help pupils to verbalize their experiences and clarify their ideas. This can be done during the activity period when the teacher is free to circulate from group to group, talking with children individually.

The reporting session at the end of an activity period is also extremely important. It is then that children discuss their problems, listen to other groups describe how they worked together, and generally consolidate their learning, extend their vocabulary, improve their thinking skills, and develop their concepts of social cooperation.

ASSIGNMENT CARDS

You If you had as many pennies as your age, how much would you be worth? What would be the least number of coins you could use to find your worth? Compare your results with those of your partner.
Coins Use your box of coins to find out how few coins can be used to make each of these amounts: 19¢ 41¢ 75¢ 91¢ 97¢
Coins Can you arrange your coins in patterns to show relationships between the coins? Tell about your results.
Coins Count all the money in your box. Share the money. How much is your share? Sell the toys to each other using your share of the money. One person will be the clerk and the other person will be the customer. Change the price of the toys as often as you wish.
Money Arrange your coins in piles. How much money is in each pile? Now make up an addition sum to find out how much money there is in all the piles. Can you make up any subtraction sums to prove that your answer is correct? Do this as many times as you like.
By the Foot Estimate, then find the value of one foot of each kind of coin that we use. Compare your results.
$1 Estimate, then find the weight of $1 worth of each of the coins we have used. Can you manage with just a few of each kind of coin? Compare your results.

5. Have four groups find the height of the flagpole. Do you all have the same answer? Why? Estimate the height first.

Perimeter (Estimating and Measuring Distances Around Things)

1. In measuring the distance around the classroom, is it necessary to measure the length of all four sides?

2. Can you arrive at a method that will help you find the perimeter of a rectangle? What is the secret?

3. Try this secret to find the perimeter of your desk, the teacher's desk, the blackboard, the table. Does it work?

4. Draw six triangles on the squared paper. Can you see the secret you used before?

5. Are there some special triangles that have a secret method for finding their perimeters? What kinds are these?

Circles (Diameter/Circumference Relationships)

1. Use the discs and measure the diameter and the circumference of each and record your findings on a chart. Draw a graph that shows the relationship.

2. What is the secret or the formula that you could use to find any answer?

3. Can you predict what the circumference would be if the diameter is 6 inches? Four and a half miles? Eleven yards? Sixty feet?

4. Can you predict from the graph what the diameter would be if the circumference is 18 inches? Four blocks? Eight feet?

Perimeters of Other Four-Sided Figures

1. Draw a neat picture of a trapezoid, a parallelogram, a quadrilateral, a rhombus. What do you notice about the sides of these figures?

2. What is the secret about finding the perimeter of the parallelogram?

3. Is there any special way of finding the perimeter of a quadrilateral?

4. What is the secret for finding the perimeter of a rhombus?

5. Why does the trapezoid have no two sides the same length?

6. Draw a neat diagram for each of the figures and pass it to your friend. Have him find the perimeter of each of the figures. Do you agree with his answer?

7. Can you name some things in the school, at home, or up town that are in the form of a rhombus? A parallelogram? A trapezoid? A quadrilateral?

8. How do you think an engineer would find the perimeter for these figures?

Distances for Broken Lines

1. The road map says that it is 560 miles to Vancouver but the pilot says that it is only 480 miles. Who is right? Why?

2. Why can we not always go in a straight line when we travel?

3. Can you find some rule that would help us find the distance between two towns if there were obstructions in between? Tell the class about your method.

4. Find the distance from the door to the top of the flagpole in feet, yards, steps, inches, sticks. Do you get the same answer each time? Why, or why not?

Making Graphs for Units of Length

Complete each of the following tables, then plot each on a graph. Make a large one for display.

Inches	Feet
12	1
	2
	3
	4
	5
	6
	.
	.

Feet	Yards
0	0
3	1
	2
	3
	4
	5
	6
	.

Yards	Miles
1760	1
	2
	3
	4
	5
	6
	.
	.

Feet	Miles
5280	1
	2
	3
	4
	5
	6
	7
	.

What is the secret for each relationship?

By using the graphs find the answers for the following.

38 inches =	feet
7 yards =	feet
80 feet =	inches
9 miles =	yards
40 yards =	feet
90 feet =	yards
900 yards =	miles

Make up some to test your friends.

Workshop in Measurement: Grade IV *(Koleyak, Misselbrook, Ritcey)*

OBJECTIVE To give the children experience in using various units of measurement. This is solely an introduction to buidiing readiness for more extensive experiences in measurement.

PART ONE

Open-ended questions

Try three different methods for each of the following.

1. What would you use to measure your wrist?
2. What would you use to measure your neck and your waist?
3. What do you guess is your wrist measurement?
4. What is it after you measure it?
5. What do you guess your neck measurement to be?
6. What is it really?
7. How many wrist measurements will you need for your neck measurement?
8. What do you guess your waist measurement to be?
9. What is the right measurement?
10. How many neck measurements will go around your waist?
11. Are your measurements the same as your partner's?
12. Where did you differ?

PART TWO (Accompanied by drawings of a giant and a dwarf)

Here is a team of acrobats who are giants and dwarfs. All the giants are the same height. All the dwarfs are the same height. All the heights are given in feet.

1. What is the height of the giant and the dwarf together?
2. What is the height of the giant less the height of the dwarf?
3. What is the height of the giant?
4. What is the height of the dwarf?
5. What is the height of a giant and two dwarfs together?
6. What is the height of a giant less the height of two dwarfs?

PART THREE

1. Have you a shadow?
2. Is it always the same length?
3. What is your height at 10:15 a.m., 11:15 a.m., 12:15 p.m., 1:15 p.m., 2:15 p.m.?
4. What is your shadow length at 10:15 a.m., 11:15 a.m., 12:15 p.m., 1:15 p.m., 2:15 p.m.?
5. How do you compare your shadow lengths to your height?
6. At what time would you expect your shadow to be the same length as your height?
7. At what time would you expect your shadows to be near the same length?
8. Do you and your shadow ever make a square?
9. Do you and your shadow ever make a triangle?

Group Work on Linear Measurement: Grades IV, V, VI *(Burton)*

Pacing

For 1 to 2 pupils

1. Is it useful to know how long your pace is? To find out, mark a chalk line in the yard and walk ten paces at your usual speed and comfortable stride.
2. When you have walked ten paces, mark the yard with chalk again.
3. Measure the distance between the starting chalk mark and the chalk mark where you finished.
4. What must you do to find the length of one of your paces? Discribe what you did and record the length of your pace.
5. Do the same thing for your running stride.

Trundle Wheel (Division 2)

For 2 to 3 pupils

1. Measure out 110 yards.
2. Walk the 110 yards you measured at your normal speed and find out how long it takes you to walk this distance. Use a stop watch.
3. Find out how many yards are in a mile. What fraction of a mile is 110 yards?
4. Can you find out an easy way to discover how long you would take to walk a mile at your normal speed?

Early Measures of Length (Division 2)

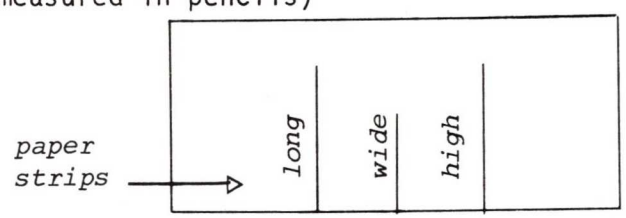
For 1 to 5 pupils

1. Use your pencil as a unit of measure and estimate how long your desk is in "pencils."
2. Measure how long your desk is in "pencils."
3. Estimate how wide your desk is in "pencils."
4. Measure how wide your desk is in "pencils."
5. Estimate how high your desk top is in "pencils."
6. Measure how high your desk top is in "pencils."

Linear Measurement

Name: _____

My Desk (measured in pencils)



Spans

For 3 to 5 pupils

1. Each member of the group guesses the height, in spans, of each of the other persons in the group. Write it down.

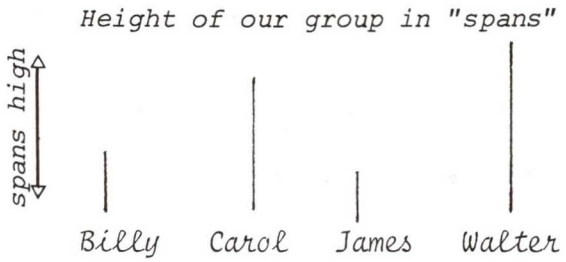
   - A span (hand span) is

2. Each person measures the others in the group and writes it down.

3. Did all in the group get the same answer for each person's height?

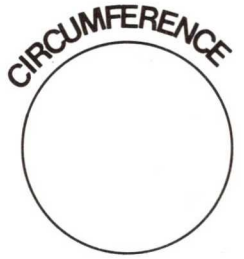
4. Why didn't they get the same answer?

5. Draw a bar graph to show the "spans high" of each member of the group.



Circumference I

1. Collect some round objects and measure all around them. This measurement is called the *circumference*



2. Can you find a way to do this?

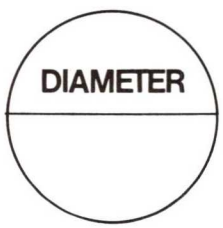
3. Draw the objects and write down each circumference to make a bar-type graph showing the circumferences.

4. Tell how you measured all around the objects you collected.

Circumference and Diameter II

For 1 to 5 pupils

1. Measure the distance across the middle of circles you want to draw (this is called the *diameter*).



2. Write down the diameter and the circumference of each circle in a table like the one below.

	Circumference (Distance around)				*Diameter (Distance across)*		
	Object	*Estimate*	*Measurement*	*Difference*	*Estimate*	*Measurement*	*Difference*
1							
2							
3							
4							
5							

3. Can you find a relationship between the circumference and the diameter of a circle? Make a chart like the one below and see if you can find the relationship.

	Round object	*Circumference (C)*	*Diameter (D)*	*(C+d)*	*(C-d)*	*C×d)*	*(C÷d)*
1							
2							
3							
4							
5							

4. Which column shows the special relationship between circumference (C) and diameter (d)?

5. What is the relationship between circumference and diameter?

Perimeter

For 2 pupils

1. The *perimeter* is the *distance around* something.

2. On a piece of graph paper each person draw a square, a rectangle, a triangle, and one or two other figures. Change papers.

3. Estimate the perimeter of each of the figures and write it down by the drawing.

4. Measure the perimeters of the figures and write them down by the drawings.

5. What was the difference between your estimate and measurement?

6. Are you a good estimater? If not, have your partner draw more squares, rectangles and other figures for you.

For 1 pupil

1. Obtain a new pencil and find out how many pencils, placed end to end, would go all around the room.

2. Do you have to crawl all around the room measuring with your pencil? What is a quick way of doing this? (Record your answers as follows.)

   ____ pencils placed end to end would go all around the room.
   An easy way to find this answer is to _____

For 2 or 3 pupils

1. Estimate, then measure the perimeter (distance around) of places and things in the school, for example, the room, the yard, the chalk box, the S.R.A. box. Write down your estimates and measurements on a chart.

2. What was the difference between your estimate and the measurement? Are you good at guessing perimeters?

3. If you are measuring the perimeter of a square, do you have to measure all the sides? Show what sides you must measure on a diagram.

4. If you are measuring a rectangle, do you have to measure all the sides? Show, on a diagram, what sides you must measure.

How long would it take to walk a mile?

For 2 to 5 pupils

1. Measure 1/4 mile on the field or the running track. Do you have a 1/4 mile tape measure? If not, what other way can you measure 1/4 mile?

2. Write down how long it takes you to walk 1/4 mile. Use a stop watch.

3. What must you do to your answer to find out how long it would take you to walk one mile?

4. How many miles is it to your house from school? Tell how long it would take to walk from home to school.

5. How far do you live from Calgary? Okotoks? High River? Black Diamond? Cayley? Longview? Turner Valley? Millarville?

6. Figure out how long it would take you to walk to some of these places. Give the exact times and then round your times off to the nearest quarter hour. Use the table below to record your answers.

Length of time it would take me to walk to the following towns

Town	*Distance*	*Exact time to walk*	*Approximate time to walk*

Linear Measurement, Daily Use

For 1 pupil

Make up a book showing how people use measurements in their work. Use pictures and a short story to tell what people are doing. Some people in your town whom you might ask for information are people who make things, sell, test and build things.

Standards of Length (inches)

For 1 pupil

1. Collect some long objects and measure them in inches. Draw them and write down their sizes.

2. Collect containers (garbage can, plant pot, juice can) and measure how high they are inside. Is the height the same as the depth in every case? Can you measure in inches and parts of an inch?

For 2 or more pupils

1. Cut strips of construction paper into the following sizes: 1 inch, 2 inches, 3 inches, 4 inches, 5 inches, 6 inches, 7 inches, 8 inches, 9 inches, 10 inches, 11 inches, 12 inches. Mix them up.

2. Arrange them from the shortest piece to the longest piece on a table.

3. Ask a friend to pick out the 6-inch length. Did he pick up the right one? Ask him to pick out another length. How many did he get right out of five lengths you asked him to pick out?

4. Ask other friends to pick out lengths you call out.

5. To make it more difficult you can mix up all the lengths and then lay them out on the desk for your friends to pick the sizes you ask them to.

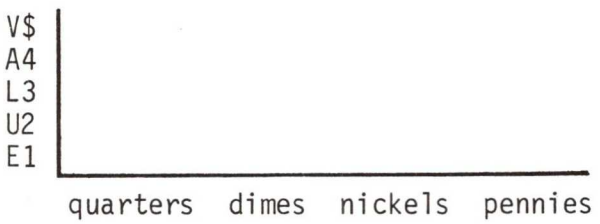
6. Ask your friend to call out lengths and see how many you get right out of five calls.

Money

For 1 to 5 pupils

1. Find the value of 1 yard of quarters, dimes, nickels, pennies.

2. Make a bar graph of your results.



Standards of Length (inches, feet, yards)

For 1 to 5 pupils

1. Each person in the group guess the length of the room and write it down. (Pick the most suitable units of length.)

2. Each person measure the length of the room. Did you have to use more than one unit of measure?

3. Were all your guesses the same?

4. Were all your measurements the same?

5. Each person work out if their guess was too long or too short.

6. How much too long or too short was your guess?

7. Pick a parner and measure the width of the room and write it down. (Pick the most suitable units of measure.)

8. Could you draw the room to scale on a piece of paper showing the length and width?

9. Use a scale where 1/4 inch stands for 1 foot.

	Things I Measured	*Guessed Length*	*Measured Length*	*Difference**
1				
2				
3				

**Put a check if you feel your guess was good.*

Estimating Distances

For 2 to 3 pupils

1. Draw 3 or 4 lines of different lengths in the yard with chalk.

2. Ask your partner to guess the lengths of the lines. (This is called *estimating* their lengths.)

3. Measure the lines to see how closely you estimated.

4. Have your partner draw lines. Try to estimate their lengths before you measure them.

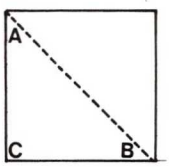
5. Do your estimates get better with practice?

Estimating Height

For 2 or 3 pupils

There are many ways of estimating height. One way is described below.

1. Make a 4-inch square in a thin card. Draw a line from one corner to the opposite corner. Cut along this line (A,B). Make the other corner "C." This triangle will help you to estimate the height of the school, telephone poles, etc.



2. To measure the height of the school, put point "B" at the end of your nose. Shut one eye and move back from the school until point "A" seems to be at the top of the building. Side AC must be upright.

3. Stand still and have your partner place a mark where you are standing. Measure the distance from the school to where your partner placed the mark. The height of the school is about the same as the distance from the school to your mark. To be more exact, add the height of your eye above the ground to the distance from the school.

Time Measurement *(Grigel)*

(Ages 6 to 9; M.A. 4 to 6)

OBJECTIVES (Primary General Learning Disabilities)

1. To promote in the children a general idea of time and how various times relate to various activities during the day.

2. To have the children recognize a need for standardized time measurements.

3. To teach the children to tell time--hours and half hours.

4. To have the children recognize the relative length of a minute, second, hour.

EXPLANATION In working with the cards, care must be taken to have at least one "reader" in each group to interpret the questions to the nonreaders. Groups of three or four would prove best at this level. The previous knowledge of the children is very limited. Only a few would have any concept of time and some will not know their numbers. I would have introduced some very simple pictographs and possible block graphs prior to this series of cards. On some of the cards, questions are asked that only a few of the children will be able to answer. These can act as "teachers" for the others of the group. The cards are quite structured in keeping with our theory of a structured (but not rigid) approach to the teaching of retarded children.

Card 1: How many handclaps does it take for your friend to walk around the table? Let him clap his hands to time you. Using heartbeats see how many it takes for each person to walk around the table. What other ways can you think of to time things. Are these good ways to time things? Why?

Materials - no special materials for this card.

Card 2: Look at Clock 1 and put the numbers on the face. Can you put them on Clock 2 without looking at the big clock? What can you say about the numbers on the clock?

Materials - mimeographed sheets of two clock faces without the numbers on identified as Clock 1 and Clock 2.

Card 3: The two black shapes are hands. What is different about them? Find the <u>minute hand</u>, and <u>hour hand</u>. Put them on your big clock. Show on

your big clock a. when you get to bed, b. when you get up, c. recess, d. noon hour, e. home time, f. supper time.

Materials - clock faces approximately 12" diameter; 2 hands for each and fastener to put on hands.

Card 4: Find out when everyone goes to bed. Make a graph to show this. What time do most children go to bed? Why? Can you do the same thing with the time that each person gets up? Can you tell how many **hours of** sleep each child has? The teacher? Why is it different? (This is a "hard" chart. Only a few of the children will be be able to complete it.)

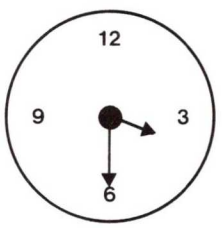
Materials - block graph paper.

Card 5: On the page of clocks show:
8:00 2:00
5:00 9:00
3:00 12:00

What do you see about the minute hand? Take your big clocks and show other times that the minute hand does the same thing. Tell what time you have.

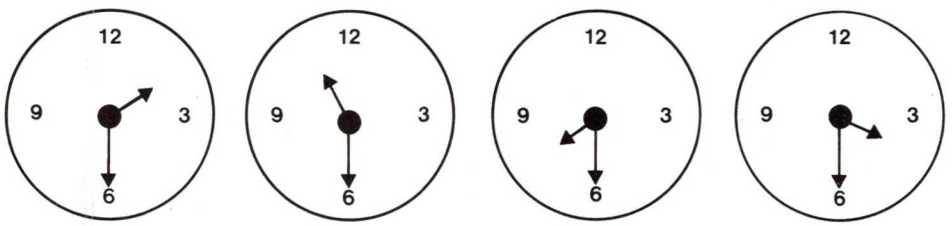
Materials - mimeograph sheet with six clock faces. Clock faces with hands from card 3.

Card 6: On your big clock put the minute hand at 6. Now move the hour hand. Can you tell what time you show in each case? We write this:



3:30

How would you write:



Show on your big clock:
6:30 9:30
5:30 10:30
1:30 12:30

Materials - clock faces from card 3 or small individual clock faces from a watch company.

Card 7: Can you hold your breath for 10 seconds? 10 minutes? 10 hours? Why? How can you find out who can hold their breath the longest? Why are there differences?

Materials - have a watch with a second hand available. Hopefully someone will think to ask for it!

Card 8: Can you find pictures of other ways people use to tell time? Ask your father or mother to help you. You can tell us about what you find out. Maybe you could make a model for the class. An attempt to involve parents!

Materials - vary with the class.

Time Unit: Grades II, III *(Penner)*

1. Can you tell how much time you spend playing in one day? One week? One month? How can you show this?

2. How much time do you sleep? Compare this with others. How can you show this?

3. Make a graph to show how many hours you spend on each activity during your day. What other way can you show your results?

4. In how many different ways can you measure time? Make a chart to show as many of these ways as you can.

5. How much time does it take to walk the length of the hall? hop? skip? move backwards? with eyes shut? downstairs? to school? with a heavy box? Guess your answers first. Compare with time taken by others. Show your results.

6. Using a TV guide, find the time between two specific programs. Find the time you would spend if you watched all the programs you like. Show this in some way.

7. Using a calendar, can you find out what a leap year is and why we have it? Report on what you find. Do all the months have the same number of days? Why or why not? How can you show this?

8. What do you do before breakfast? Between breakfast and school time? Before dinner time? After dinner time? After school? Before bedtime? Show this in some way.

9. What time do you get up? Who at your house gets up earlier? Later? Same time? Do the children in your class get up at the same time? How many get up earlier? Later? Show your results. Repeat this for bed times.

10. What things travel fast? Slowly? Find or draw pictures.

11. How long does it take you to travel across the playground? Your friend? Try this more than once. Show your results.

12. What things can you do for a longer time than your friend? Show this in any way you wish.

13. Make a sand timer with 2 bottles, sand, plasticine. Use it to measure the time taken to do various activities. Compare with other children. Record the results.

14. Make a water timer with a pan of water and tin can. Do similar activities to those with the sand timer.

15. String timer (pendulum). Make it using plasticine and string. Count swings. Time various activities by counting swings. Vary length of string. What happens? Record your results.

16. How many different clocks have you seen at home? At school? Outside? Show as many different kinds as you can.

17. Use the clock. Show a time on it. Write the time in as many different ways as you can. Repeat for at least six different times.

Time Questions: Grade III *(Risvold)*

1. Using a clock with a second hand, find out:

   a) How many times the second hand goes around in 1 minute, 5 minutes, 10 minutes. Is there a pattern?

   b) How many times the second hand will go around in 1 hour, 10 hours, 1 day.

   c) How many times the minute hand goes around in 1 hour, 2 hours, 5 hours, 1 day, . . .

   d) How many times the hour hand will go around the clock in 1 day, 2 days, . . .

   Make a table showing what you have learned.

2. a) Using a pendulum made from string and a weight, find out what happens as the length of the string is changed. How can you make a pendulum speed up? slow down?

b) How much time does it take for your pendulum to make 10, 20, 30 swings? Try different pendulums. Would a pendulum be good for measuring time?

3. How do you spend the number of hours in a week? Make a chart to show how 5 classmates spend the time in a week.

4. Could you use your pulse to measure time? How can you find out how many times your pulse beats in one minute? Does your pulse stay beating at the same speed? Why? Does everyone have the same pulse rate? Would pulses be good for measuring time?

Pendulum: Grades IV, V, VI *(Eremko)*

MATERIALS Stop watch (or watch), string, weights (balls, lead, etc.), tape measure, balance scale.

1. Measure how far a pendulum travels in each swing.

2. Does the swing of a pendulum vary with the length of a string?

3. Using different lengths, how many strokes in one minute? Half a minute?

4. Use different weights. Does a heavy "bob" swing faster or slower than a light "bob"?

5. Measure the size of the "bob." How does the size of the"bob" affect the swing of the pendulum?

6. Graph the relationship between the swing of a pendulum and time interval.

7. What every-day uses has a pendulum?

8. Using a stop watch can you estimate the length of a pendulum with 30 strokes per second? Sixty strokes per second?

9. How can a pendulum be used to measure time?

10. Using a pendulum, calculate how long it takes to walk 10 feet, 15 feet, 20 feet.

11. How long would it take to walk 50 feet, 100 yards, 400 yards, 1 mile?

12. Using a pendulum, discover how long it takes your classmate to run a dpecified distance.

13. Using a pendulum, determine how long it takes someone to complete a task. What is the fastest time? The slowest time?

14. How else can a pendulum be used to measure pace and time intervals?

15. If a pendulum made one swing every second, how many swings would it make in 30 seconds, 60 seconds, 10 hours, 24 hours?

Money Activities *(Inkster)*

1. Write out a list of sums, such as 25¢, $.33, $1.05, $.08, and so on. Using play money have the children illustrate how many ways they can show those amounts of money.

2. Cut out some pictures (baseball glove, chocolate bar, etc.) and make up questions concerning change. Have the children show in how many ways they can give you change for those items.

3. Write down some amounts of money. With coins, have the children illustrate how many ways they can show you this amount using the fewest coins, most coins.

4. Set up a "store" with various items priced. Ask in how many ways one can pay for them. Have your partner overpay you. Can you give him the correct change in more than one way?

5. Your partner gives you a certain amount of money and asks you questions such as, "If you had this much money what items could you buy?" "Would you get change?" "How much?"

Money Assignment Cards: Grade III *(Keddie)*

MATERIALS Real money (amount will depend upon the cards used), collection of toys for each group, foot ruler for each group, apparatus for weighing, masking tape for price tags. [A letter to the parents explaining your activity will usually provide much of the material.]

IMPLEMENTATION Vary the procedures to suit the topic, the children and yourself. Set up five or six activity centers all on the same assignment and five or six activity centers each on a different topic or different aspect of the same topic. Pairs of children can work together, either on an individual basis or with a friend. [This could be your week's work since the groups rotate each day.]

Activity alone is not enough. There must be discussion with an understanding teacher who can help pupils to verbalize their experiences and clarify their ideas. This can be done during the activity period when the teacher is free to circulate from group to group, talking with children individually.

The reporting session at the end of an activity period is also extremely important. It is then that children discuss their problems, listen to other groups describe how they worked together, and generally consolidate their learning, extend their vocabulary, improve their thinking skills, and develop their concepts of social cooperation.

ASSIGNMENT CARDS

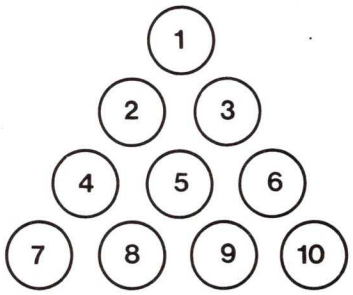
You If you had as many pennies as your age, how much would you be worth? What would be the least number of coins you could use to find your worth? Compare your results with those of your partner.
Coins Use your box of coins to find out how few coins can be used to make each of these amounts: 19¢ 41¢ 75¢ 91¢ 97¢
Coins Can you arrange your coins in patterns to show relationships between the coins? Tell about your results.
Coins Count all the money in your box. Share the money. How much is your share? Sell the toys to each other using your share of the money. One person will be the clerk and the other person will be the customer. Change the price of the toys as often as you wish.
Money Arrange your coins in piles. How much money is in each pile? Now make up an addition sum to find out how much money there is in all the piles. Can you make up any subtraction sums to prove that your answer is correct? Do this as many times as you like.
By the Foot Estimate, then find the value of one foot of each kind of coin that we use. Compare your results.
$1 Estimate, then find the weight of $1 worth of each of the coins we have used. Can you manage with just a few of each kind of coin? Compare your results.

Providing for Individual Differences

Assignment cards provide challenging material for the advanced pupil, without frustrating the child who needs more time to absorb and personalize learning. Activity centers using ability grouping can be used from time to time when it is evident that some children have failed to grasp the basic understanding. Often it is useful to use an advanced pupil as an "assistant teacher" with a weaker group. Games and puzzles put on cards may be used by those groups finished before the others.

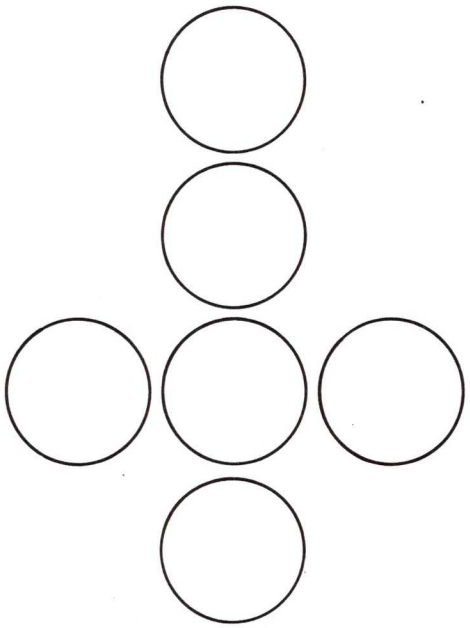
Sample Games and Puzzles

1. A triangle of ten pennies points away from you. Moving only three pennies, make the triangle point toward you.



2. I purchased some drawing supplies and spent 25 cents for 25 articles. I bought four kinds of articles: paper at two sheets for a cent, pens at one cent apiece, pencils at two for a nickel, and erasers at a nickel each. How many of each kind did I buy?

3. Six coins are arranged like this:



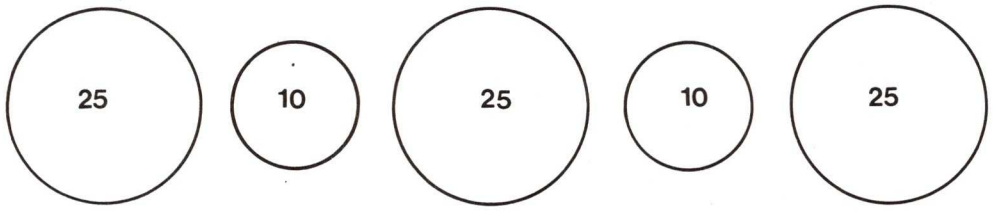
Move just one coin to another position so that the two rows (horizontal and vertical) contain four coins each.

4. A college student, Mr. Kantstand Prospeaurity, wishing to be subtle about how much money he needed, sent the following telegram to his father:

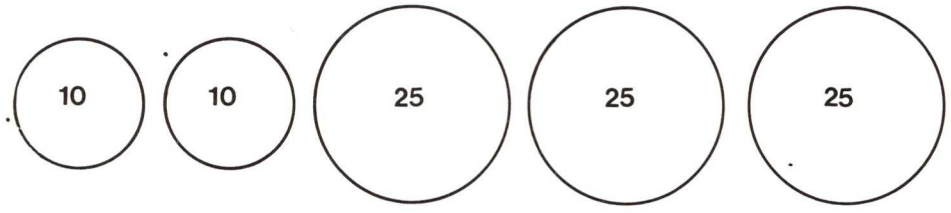
$$\begin{array}{r} \$SE.ND \\ MO.RE \\ \hline \$MON.EY \end{array}$$

If each of these letters stands for a digit, how much money did Kantstand want?

5.



In four moves, and moving two coins at a time (always a dime and a quarter), position the coins as follows (without reversing the order or moving the coins to fill up spaces).



Solutions

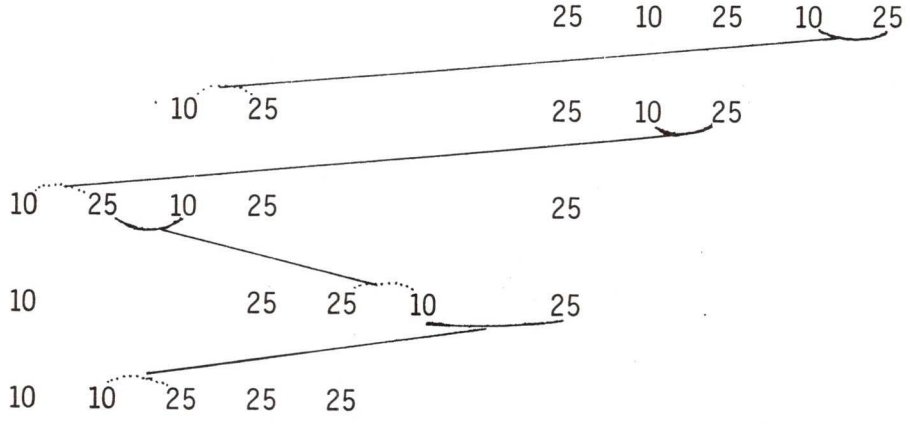
1. Move 7 to the left of 2, 10 to the right of 3, then 1 below and between 8 and 9.

2. Fourteen sheets of paper (7¢), 8 pens (8¢), 2 pencils (5¢), and 1 eraser (5¢).

3. Place the top coin on top of the center coin.

4. S = 9, E = 5, N = 6, D = 7, M = 1, O = 0, R = 8, Y = 2.

5.



Capacity: Grades I, II, III *(Kennedy)*

PURPOSE To introduce children to liquid measurement.

MATERIALS Several different sized containers--egg cup, tea cup, bowl, juice container, milk bottle, pan, jar, one-half gallon jug, pail, measuring cups, pint containers, quart containers, gallon containers, tablespoon, teaspoon, one-half pint containers, materials for making charts and graphs.

WORKSHOP A (rotating groups)

1. Using several different sized containers, find out which one holds the most water. Find out which one holds the least water. Make a picture showing the containers in order of capacity.

2. Using several different sized containers, estimate how many cups in each. Measure the actual cups in each container. Record your results.

3. Using several containers (different from those in group 1), which do you *think* holds the most? Which do you *think* holds the least? How can you find out if you are right? Record your findings.

4. Can you use spoons to measure water? How can you find out how many tablespoons in a cup? How can you find out how many teaspoons in a cup? Illustrate your findings.

WORKSHOP B (rotating groups)

1. Special measures: cup, pint, 1/2 pint, quart. Find out which holds the most. Find out which holds the least. In more than one way measure a pint, a quart. Illustrate your findings. Make a chart to show how much milk your mother buys each day and for a week.

2. Use several containers. Estimate number of pints in each. Find out the correct number of pints in each. How close did you guess the correct number of pints? How many things can you think of that are sold by the pint?

3. Estimate, then find a relationship among the three-containers (pint, quart, gallon) at your station. How many different ways can you measure one gallon? Do you know what things are sold by the gallon? How far do you think a car would go on a gallon of gas?

4. How many cups in one pint? Find out the number of cups in one quart without counting the cups. Find out the number of pints in one gallon without counting the number of pints. Illustrate how you found out.

Can You Find Volume? *(Gunn)*

A closed container, such as a can or box, divides space into three sets of points--the points forming the simple closed container itself, the points forming the interior of the container, and the points forming the exterior.

The volume of the inside of a large hollow object can be measured by comparing it with a smaller object and counting the number of times the smaller object is contained in the larger.

1. Use box A and a number of one-cubic-inch blocks (blocks measuring 1" high, 1" long, 1" wide). How many blocks are required to fill the box? This is the volume of the box in cubic inches.

2. Measure length, width and height of box B. What is the area of the base in square inches? Cover the base area with one-inch cubic blocks. How many did you need? Now finish filling the box with one-inch cubic blocks and complete the chart below.

Measurement of Volume

1. Number of cubes in bottom layer ____
2. Number of layers ____
3. Volume of box in cubic inches ____

3. Using the information gathered from exercises 1 and 2, can you arrive at a mathematical shorthand for finding the volume of a rectangular box?

4. Using the pieces of wood provided, construct several solids and estimate and then measure their volume. Can you use mathematical shorthand to determine or verify your findings in every case?

5. a) Estimate the volume of the triangular prism D in cubic centimeters.
   b) Measure the area of the base and the height. Calculate the volume to the nearest cubic centimeter.

6. Find the volume of cylinder C. Show your work. (Remember when using blocks to find area, 1/2 or greater counts one, <1/2 not counted.)

7. a) Construct a cube with a base of 4 inches by 4 inches, and a height of 4 inches.
   b) Construct a square-base pyramid 4 inches high, with a base 4 inches by 4 inches.
   c) Compare the volumes of their interiors. (This may be found by filling the pyramid with sand and pouring into the cube until the cube is full.)
   d) Graph the results and devise a mathematical shorthand for calculating the volume of a square base pyramid.

8. a) Construct a triangular pyramid with the same size base and height.
   b) Compare their volumes. (This may be done as in 7(c)).
   c) Graph your findings and devise a mathematical shorthand for finding the volume of regular triangular pyramids.

9. How would you find the volume of a stone?

Introduction to Area: Grade III *(Kennedy)*

1. *Materials* 3 x 5 inch index cards.

   Activity Estimate how many index cards are needed to completely cover your desk. Count the number of cards actually needed to cover your desk. In the same way, estimate and measure the number of cards needed to cover the front of your work book, a wide textbook. Show these findings on a pictograph.

2. *Materials* Equilateral triangle tiles with three-inch sides (tagboard).

   Activity Estimate how many triangular tiles are needed to completely cover your desk. Count the number of triangular tiles actually needed to cover your desk. In the same way, estimate and measure, in triangular tiles, the front of your work book, a wide textbook. Show these findings on a pictograph.

3. *Materials* One-inch square tiles (tagboard).

   Activity Estimate number of square inches in a given piece of paper. Count the number of square inches actually needed to cover the paper. Estimate and measure, in square-inch tiles, the front cover of your reader, your work book. Show these findings on a pictograph.

4. *Materials* Area kit including several area cards and a grid (8x8" ruled).

   Activity Estimate the number of square inches in each area card. Measure the number of square inches in each area card. Use the grid. Find out which one has the largest area, the smallest area.

Area Card	*My Guess*	*Measured Length*

5. *Materials* Geoboards and elastic bands.

   Activity Make your own geometric figures and find the areas. On the given graph paper draw your geometric figures and mark the area. Can you make any geometric figures that you can't find the area of?

POSSIBLE OUTCOMES

1. These activities may heighten students' concepts of "greater than" and "less than." For example, at stations 1, 2, and 3, students may discover which object measured needs the most cards or tiles to cover it and thus find out which is the largest. Similarly they discover the smallest.

2. By comparing results from the three stations, they may discover which is the largest and smallest unit of measure.

3. They may also point out that, using a grid (station 4), is easier for small surfaces and that it is a more accurate measure.

4. These activities will give practice in counting when measuring and counting out the number of cards or dishes.

5. The concept of area and a unit measure will be developed.

6. Students will gain practice in estimating.

Perimeter and Area *(Myers)*

OBJECTIVES

1. To explore more areas of measurements relating to perimeter and area.

2. To develop a continuous activity program in area and perimeter through different shapes.

3. To foster the interest that the group already has from past experiences in measurement and fractions.

4. To enable the class to discover, through activity, the relationships between area and perimeter in rectangles and squares.

Open-ended Questions

1. a) Use a part of your body to measure. Give this unit of measurement a name. Use it to find the perimeter of a rectangle and a square. Make two models of each shape on paper.

   b) Here are a number of rectangles and squares. Arrange them in order of size, first the rectangles, then the squares.

   c) Measure their perimeter and area and record your answers in a table. (Remember that to find area you count the number of small squares used to cover the big rectangle or square.) Make a graph to show the relationship between area and perimeter.

2. a) How many words are used in a newspaper column? Find out the actual number of words after you have calculated it. Explain on a chart how you did this.

b) All newspapers have advertising space. What fraction of this paper is in advertising?

c) Some advertising space is used for clothes, cars, etc. What percentages of advertising space is used for these?

d) If advertising costs $1,050 per page, how much does the newspaper collect for advertisements?

3. a) Measure the shadow of a piece of squared paper two inches in length when you hold it one foot, two feet (and so on) from a wall.

b) How large would the shadow be when it is 12 feet from the wall?

c) Find the relationship between the size of the actual square and the shadow.

d) Compare the shadows in terms of length of sides.

e) What can you say about perimeter and area of the shadows?

4. a) There are some circular objects in the classroom. Can you measure their circumference, diameter, radius?

b) Can you find the relationship between these measurements?

c) How could you find the area of any of these objects?

Weight Measurement: Grades I, II *(Bortnik)*

The following activities may serve as introductory mathematics corner activities for the development of interest in the measurement of weight. The only special equipment needed for these activities is a balance scale and a box of plasticine.

1. How many things can you find that are heavier than a reader? Record your findings.

2. How many things can you find that are lighter than your shoe? Record your findings.

3. Try to make two balls of plasticine balance each other. Change the two balls into two boats. What happens? Be sure to record your findings.

The following activities should give further practice with the concepts of heavier and lighter, and introduce the idea of a standard measure. Each group of two or three children will make a simple balance from a coat hanger, two paper cups and some strings. They will be reminded to check that the two sides are evenly balanced or be encouraged to make it balance by using a piece of

plasticine. Other materials required are nails of the same size, sawdust, sand, dried peas or beans, a box of cereal, and some marbles. Each group of two or three will do the two following activities.

4. Choose two materials from the measuring table. Fill one paper cup with one of the materials. Fill the other paper cup with the other material you have chosen. When both cups are full do they balance? Be ready to tell the class what you have found out.

5. Choose either a box of marbles or a box of nails. Fill one of your paper cups with one of the materials from the measuring table. Fill your other paper cup with only as many nails or marbles as you need to make the two cups balance. Be ready to tell the class what you have found out.

The following activities should provide the children with experiences with standard units of measure. Most groups of two or three would use the balances previously constructed from clothes hangers and weights of less than five ounces. Some groups would use commercially built balance scales or more sturdily built wooden balance scales, and pound or half-pound weights. The children would rotate so as to have practice with different weights.

6. Find things that are heavier than the weight you have. Find things that are lighter than the weight you have. Record which weight you have used as well as the things that are lighter and heavier than it.

For the following, groups of four or five would rotate so as to do each of the activities. A variety of scales (bathroom scales, commercially built balance scales, spring scales) and a set of weights are required for these activities. Activities should be matched to particular scales.

7. How many ways can you find to balance a pound weight by using different sets of ounce weights. Record your findings. Can you see a pattern in the kinds of weights used to balance a pound? (Could be matched with commercially built balance scale.)

8. Guess the weight of six different things. Weigh them carefully. Record your results. (A balance scale.)

9. Weigh your partner. Add your weight to your partner's weight. Try to prove that your answer is right. By how many pounds has your weight increased since you were born? Be sure to record your findings. (Bathroom scale or the scale in the nurse's room.)

10. Count out 30 pennies and weigh them. How heavy are 60 pennies? How heavy are 5 pennies? Find out how heavy 20 pennies are in two different ways. (A balance scale or a spring scale and a bag with a string around the top.)

11. You have a pint carton, a set of scales and some weights. Use these to help you to find out the weight of a two-quart carton filled with water. The two-quart carton weighs five ounces. Describe how you found the answer. (Balance scale.)

12. Weigh equal amounts of six different things. Show the results by using a graph. (Balance scale or a spring scale.)

The following activities may be done by those children who finish early.

13. Make a record to show what your mother buys by the pound.

14. Can you find things that are sold in ounces? Make a record that shows what you have found.

15. Make a record that shows where you see people using scales.

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