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ABSTRACT

Suggestions for studying the topic of variation of individuals and objects (balls) to help develop elementary school students' measurement, comparison, classification, evaluation, and data collection and recording skills are made. General suggestions of variables that can be investigated are made for the study of human variation. Twelve specific questions about the properties of balls are asked, with suggestions for experimental arrangements for answering them. Suggestions for other materials that could be studied in a similar manner, and the relationship of the topic of "variation" to other parts of the elementary science course are included. (AL)

TABLE OF CONTENTS

VARIATION

Introduction

Variation is a topic in P1 J1 Science suggested for study in year three. The concept that no two individuals are exactly alike can be easily developed through many practical studies. Because this topic is especially suited for developing the skills of measuring, comparing, evaluation, collecting and recording data as well as classifying objects it could be used in other years whenever the teacher finds a need to develop these techniques.

This booklet was prepared to be used as a manual to provide teachers with some idea as to what might be done in the area. It is not intended to be a course of study. The teacher should feel free to adapt any of these ideas to his particular circumstances or to proceed entirely along independent lines while pursuing this topic.

Perhaps the best objects with which to begin are the children themselves. They carry with them the laboratory needed for the study of human viariation.

The variety of materials which could be investigated is limited only by the imagination of the teacher and his pupils. Therefore only two areas have been selected and expanded in order to indicate how this topic might be developed. The type of activities listed could be applied to other materials in which the pupils become interested.

Equipment

In addition to the materials to be compared, a variety of measuring devices will be needed.

String, rulers, cloth tape measures will be useful for determining length, width, circumference, etc. Weighing devices such as bathroom scales, spring balances, equal arm balances could be brought from home or constructed by the pupils. Timing devices such as egg timers, the second hand of a watch or clock, a pendulum, metronome or even the pulse could be used. The child should have the opportunity to select the measuring device which he feels will do the best job for the task he has in mind.

Methodology

Once a particular material has been chosen by a group of pupils, it might prove helpful if they decide what could be measured. If balls have been selected then the circumference, the weight, the height of bounce, the number of bounces and even the volume could be measured.

Perhaps the next step is to have the pupils decide how these things which they have selected to measure can be measured, i.e. the circumference of a ball can be determined by using a piece of string or paper, and a ruler. The volume of an object can be determined by the change of level of water in a container when the object is immersed or by catching the amount of water it will cause to overflow from a full pail of water into a pan

and then measuring the water in cupfuls or some other container.

The use of Standard units of measurement is relatively unimportant for this type of study. Each group could evolve their own units so that lack of knowledge of ft., lbs., grams,cu. cms., etc. will not hamper the investigation.

The final step in arriving at something to investigate can occur when the pupils decide what they can find out about the material which they have selected for study. They can do this by relating one measurement to another, i.e. the diameter of balls and the height to which they bounce.

The data which the pupils collect can probably be best organized and presented in simple graph or chart form. Conclusions and predictions could be made by interpreting the graphs produced. In any case, definite attempts should be made to make the activities involved as quantitative as possible.

II Human Variation

Some measurements which the pupils might make are:

-- height
-- weight
-- length of arms, legs, feet, hands, fingers, etc.

These could be recorded on simple bar graphs using strip of paper, string, etc. to represent the actual measurements.

Other measurements which will require more complicated techniques could also be made. Some of these are:

-- the height to which one can jump from a standing position
-- chest expansion when breathing
-- the time required to run a pre-determined distance
-- the pulse rate when sitting, standing, after running for a period of time, after a fright

Observing, and counting the occurrence of characteristics related to genetics could produce more data. The pupils could investigate such things as:

-- the colour of eyes
-- the colour of hair
-- the curliness of hair
-- right or left handedness
-- the number of teeth and the number with fillings
-- size
-- sex, etc.

These measurements or observations, probably performed at first on one's classmates, could be extended to pupils in other classes and even to parents and friends at home, if more data is required and the activity is found to be sufficiently interesting.

Once a significant quantity of measurements and observations have been accumulated and suitably recorded, attempts should be made to relate one set of data to another, i.e. Can people who have blue eyes jump higher than people who have brown eyes? or How is body weight related to pulse rate?

It is extremely important that the pupils be given the opportunity to experience that the processes of measurement leads to data and that data can be used to discover new ideas. This is a very important method of Science.

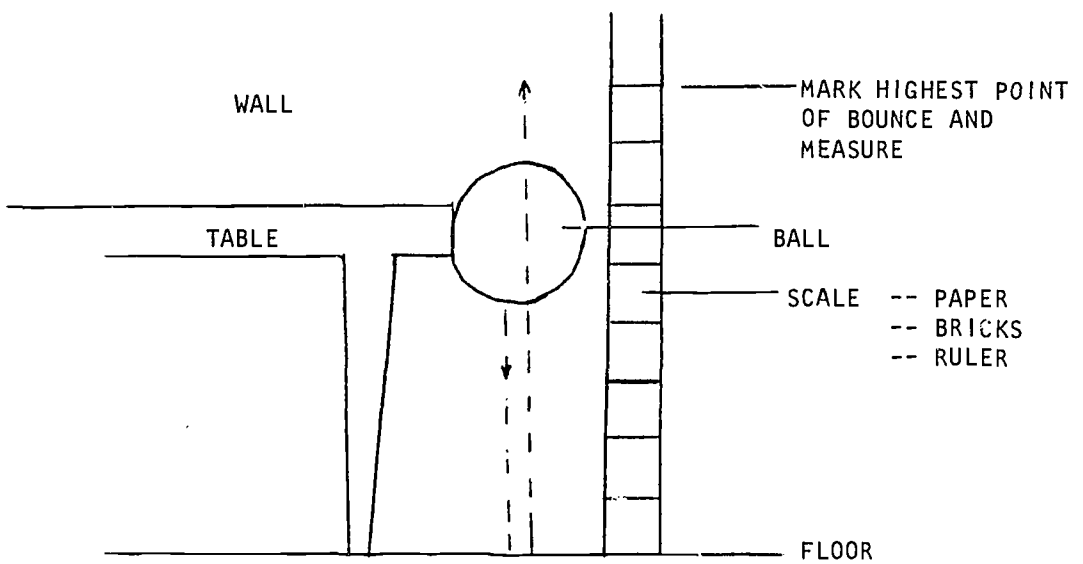
The more skillful students may wish to reverse the process. That is, to choose a problem or question first, and then make the necessary measurements, collect data and then reach conclusions which will be the answers to their original questions.

III SOME SUGGESTED ACTIVITIES WITH BALLS

1. How high does a ball bounce when released from objects of different heights?

You need a large air filled ball, a table, a window ledge, a chair, etc. A large measuring scale constructed from bristol board and calibrated by the pupils could be used to measure the heights of the ball's bounce. The number of bounces could be counted instead.

The pupils could construct bar graphs to show the results by cutting strips of cardboard equal in length to the heights of the objects used and also the heights the ball bounced. These strips could be pasted onto Experience Chart paper, and then comparisons could be made.



2. Do balls of the same size (Circumference) bounce the same height?

You need a variety of balls of the same type, i.e. air filled or solid rubber, pieces of string or paper to measure their circumference and the bristol board scale to measure the height which they bounce. You could release the balls from an object near a wall so that the scale could be attached to the wall. If the wall was made of bricks or blocks, you could measure the height of bounce by counting the bricks. Since circumference is an indication of size, the water method for finding volume could also be used here.

The results could be put in the form of a graph by a method similar to the one used in the previous activity.

3. Does the material of which the ball is made affect the height it will bounce?

You need a table, chair or ledge so that all the balls can be released from the same height. You also need a variety of balls whose size is relatively uniform but which are made of different materials, i.e. solid rubber, air filled, styrofoam India rubber, plastic and so on. Record the height to which each type bounces and graph the results in the same manner as the two previous activities.

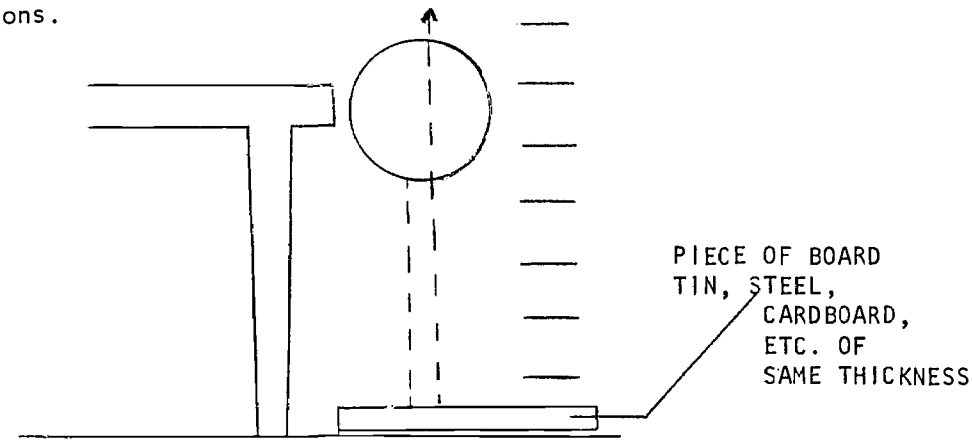
4. Does the weight of the ball affect the height which the ball will bounce?

You need a variety of balls of the same material but of different weight. A variety of ball bearings might be useful here. Be sure to release the balls from the same height for each test. The data collected can be readily expressed in graph or chart form if the weight of each ball is measured as well as the height it bounces.

5. Does the material on which the ball is dropped affect the height to which the ball will bounce?

You need one ball, an object from which it can be released, a scale to measure the height which the ball bounces and a variety of materials, wood, tile, cardboard, steel, plastic styrofoam, sponge, etc. for the ball to land on.

Release the ball from a standard height, the edge of a desk, for each test. Collect data and compare the results in order to reach some conclusions.



6. Does the thickness of the material on which the ball is dropped effect the height to which the ball will bounce?

You need a ball, an object from which it can be released, a scale to measure the height of bounce and several materials which the ball can strike. These materials should be of a type to which layers of the same thickness can be added, i.e. layers of newspaper, cardboard, wood, tin, etc.

6. (Continued)

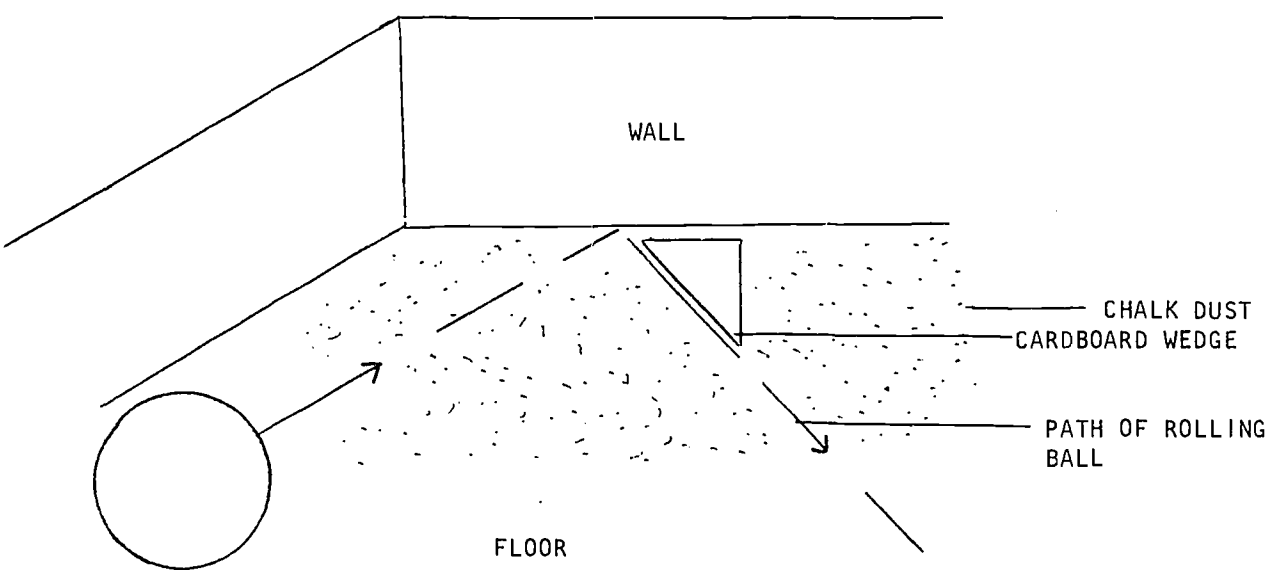
Start with one layer of each material and add others as the testing progresses. The height of bounce could easily be related to the thickness of the material by plotting the data collected on a graph.

7. Does the amount of air in a ball affect the height to which it will bounce?

You need an air filled ball with a valve, i.e. a basketball, volleyball, or soccerball. Release the ball from a standard height each time. Let a small amount of air out before releasing the ball. Repeat several times letting more air out each time. If the air is released for a specific time period, i.e. 3 seconds, fairly uniform changes in pressure should result for at least 3 or 4 trials.

8. Does the size, weight, or the material of which the ball is made affect the way in which a ball is reflected from a surface?

You need a variety of balls, and floor or table top which ajoins a wall, some chalk and some cardboard. Sprinkle the chalk dust on the floor or table. Roll the ball through the chalk dust so that it strikes and rebounds from the wall. Cut cardboard wedges to match the angles made between the paths left in the chalk and the wall. Compare the two angles. They should always be the same.



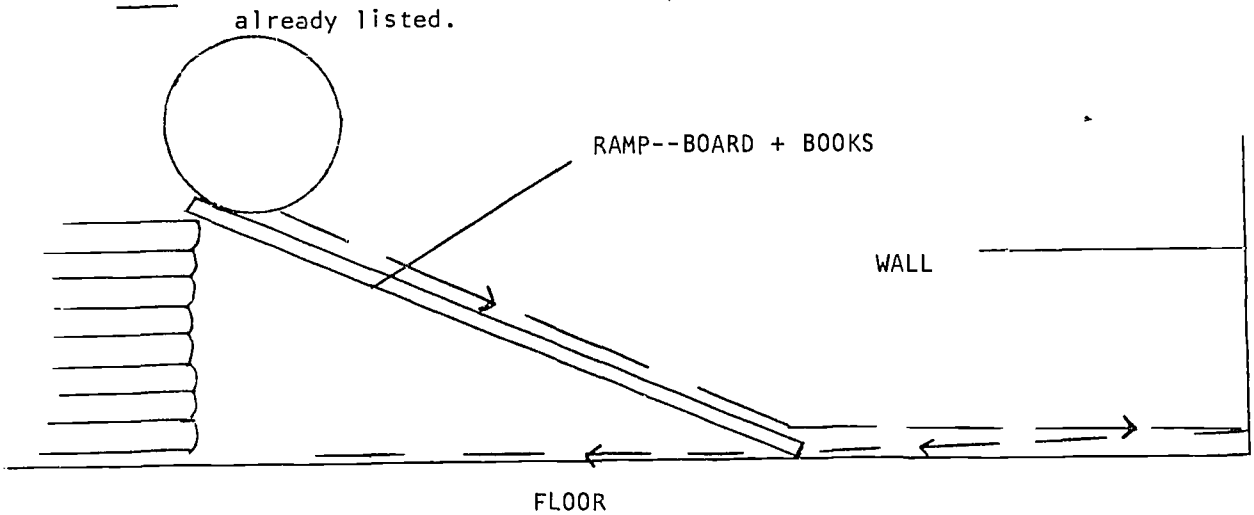
9. Does the size, material, weight, etc. of a ball affect the distance it will rebound when it rolls and strikes an object?

You need a variety of balls, a board, some books, a wall and a tape measure or ruler and string.

9. (Continued)

Use the board and books to make a ramp down which the ball can roll. Be sure to start the ball from exactly the same point on the ramp each time in order to keep the force constant. Measure the distance the ball rolls after striking the wall.

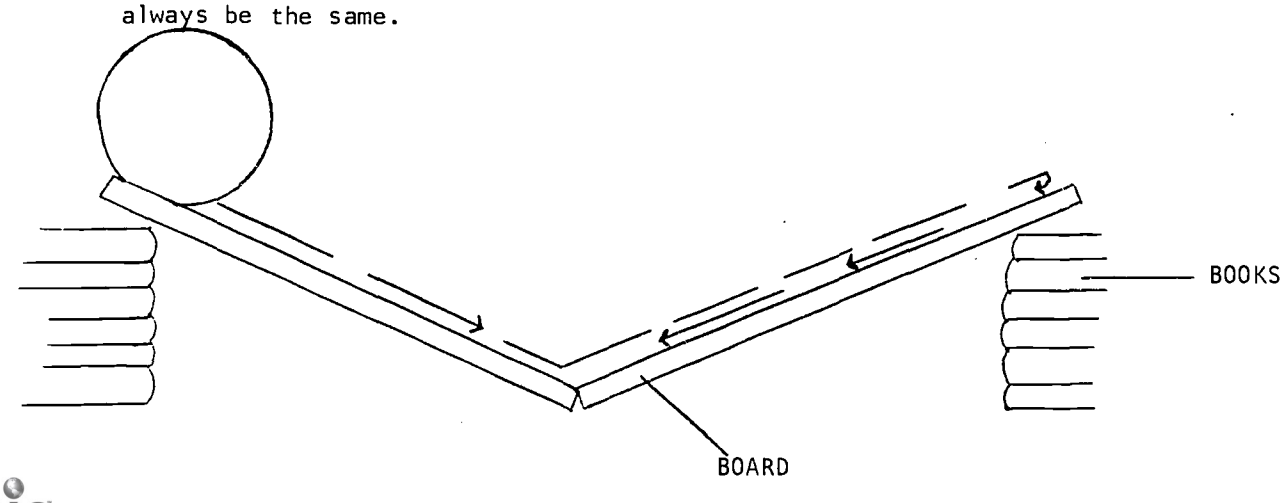
NOTE: This method could be used to perform most of the activities already listed.



10. Does the size, weight, material, etc. of a ball affect the time in which a ball will continue to roll?

You need two boards of the same length, some books, a timing device, and a variety of balls.

Use the books and board to make two ramps of identical height joined together at the bottom. Start the ball rolling from the same point each time. Measure the time taken for the ball to stop rolling down one ramp and up the other and come to a stand still. The time should always be the same.



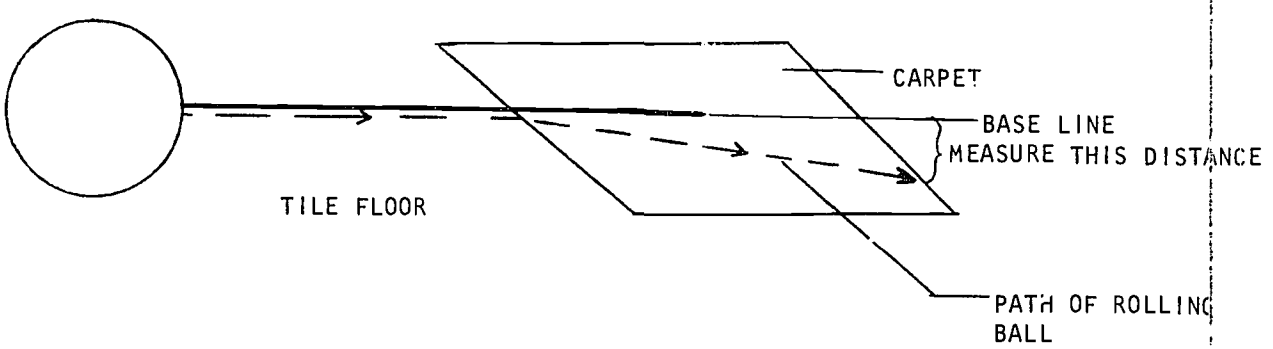
11. Does the size, weight, material, etc. of a ball affect the way in which it will curve when rolled from one type of surface to another?

You need a variety of balls and a variety of surfaces, i.e. tile floor, concrete floor, asphalt road, grass, gravel, wood floor, carpet. Find a place where the two surfaces are ajoining. Use the ramp method to roll the balls from one surface to the other and keep the force constant.

The pupils will discover that the greater the change in the texture of the two surfaces, the greater will be the curve in the path of the ball.

If the speed at which the ball rolls is increased, i.e. by making the ramp steeper,the curvature will be changed.

The amount of curvature could easily be measured by using a ruler to find the distance which the ball has deviated from a base line at a selected distance from the end of the ramp.



12. Does the size, weight, material, etc. of a ball affect the distance a ball will travel when it rolls from a table to the floor?

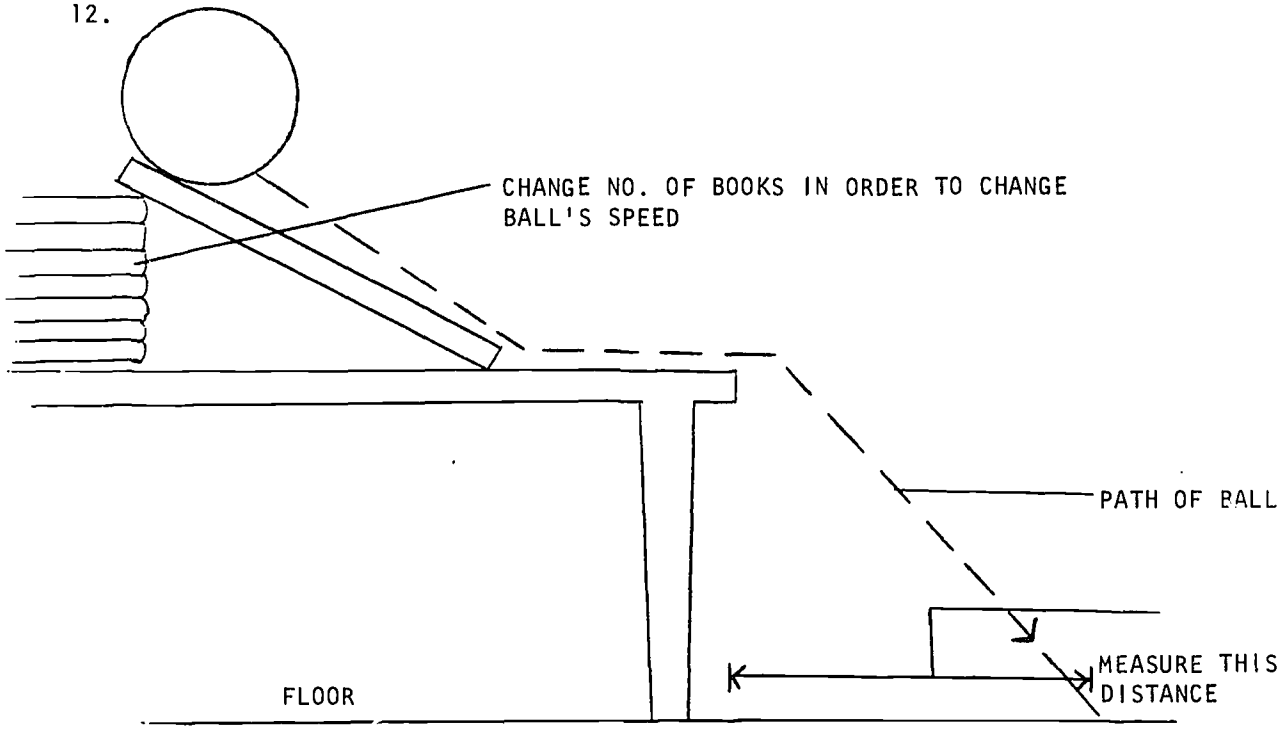
You need a ramp, a variety of balls, a table and a suitable measuring device such as a ruler.

Use the ramp on top of the table to ensure that the ball moves with uniform speed. Measure the distance from the edge of the table to the point where the ball strikes the floor. This distance will vary according to the weight of the ball.

If a stop watch is available, the time taken from the point of release till the ball strikes the ground can be measured. It should always be a constant.

NOTE--If things do not work exactly the way they should, just keep in mind--that's the way the ball bounces!

12.



THE APPLICATION OF VARIATION TO OTHER TOPICS

Variation is the keynote to the study of biology. Investigations such as the number of seeds in a variety of seed pods could lead to much knowledge about such dispersal. Counting the number of seeds which will grow when they are planted, can be used to find out about germination.

Measuring the height to which a species will grow under a variety of conditions such as temperature changes, various amounts of light, fertilizer, types of soil, etc. could result in the discovery of much information about plant growth.

Leaves

In order to study leaves, the pupils might be taken on a short field trip around the blocks nearest the school. Have the children pick up samples of every leaf they see (within reason of course!). Upon returning to the classrooms, quantities of the leaves collected could be placed on tables and attempts made to group them. This skill is called classification and it is closely related to the study of Variation.

Allow the pupils to form their own criteria for grouping the specimens obtained. They will probably choose colour, size, edges, number of sections, arrangement of veins, texture, length of stem, and all the other aspects upon which the actual classification of leaves is based in the study of biology. Once the base for classification of leaves has been discovered, research could be done to find the terminology used but this is relatively

unimportant for pupils of this age.

Rocks

Use a similar method to the one utilized to obtain leaves, in order to obtain rocks and stones.

The stones might be grouped according to size, colour, weight, texture, composition (size and type of particles). Attempts could be made to arrange them in a line from largest to smallest, light to dark, etc. Charts could be compiled so that comparisons can be made. Correlations with mathematics such as sets and sub sets can be discovered. A large amount of information related to geology may also be investigated in this manner. The finding that certain aspects upon which the pupils' classification of rocks was based, especially colour, size and shape are not valid is a very important discovery.

Other Objects

There are many other things in a child's physical environment which readily lend themselves to study from the point of view of Variation.

The approach already described could be used to discover what the pupils can find out by working with the following:

-- a variety of types, colours and shapes of paper, cloth, books, springs or bottles.

For other suggestions see P1 J1 Science P. 5.

Dear Reader:

The Science Department would greatly appreciate your criticism of this unit. We would be very interested in any ideas which might be added to this booklet in order to make it of greater help to either teachers or pupils. What more effective activities could be used to replace those which we have suggested. What new or additional investigations did your pupils carry out? What other resource materials could you recommend?

Please feel free to use this page when communicating with us.

Sincerely,

Dan Wentworth and Bill Mastin