THE LABORATORY APPROACH TO TEACHING
EIGHTH GRADE MATHEMATICS

by

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INTRODUCTION

Over the course of several years the author has felt a need for an organized set of laboratory exercises for use in mathematics on the Junior High School level. Though many teachers use this technique for isolated units, few examples of laboratory exercises are available for the student to discover underlying principles in mathematics.

Statement of the problem. The purpose of this sample set of laboratory exercises is to compile a set of laboratory exercises that can be used with the modern approach to mathematics. These exercises will be developed to motivate participation of all students in the class. Instead of drill the student will be directed to develop and test theories by the use of open-ended questions and experiments. Students will be directed to gain insight into the scientific method and how it works; to develop an interest and an inquiring type of mind and learn the necessity of accuracy.

Importance of the study. It is not what should happen in the classroom but what does happen in the classroom that affects the learning of mathematics. The laboratory approach will give mathematics teachers an opportunity to generate new interest and create a favorable classroom atmosphere where the students desire to discover mathematical principals and their individuality grows.

REVIEW OF THE LITERATURE

In the decade preceding 1962 only three references appeared in Education Index which were specifically related to the laboratory approach to mathematics. Though the laboratory approach in learning is not new as a method of learning, little interest during the period from 1952 was shown in using this approach in mathematics. The summary given here will generally be related to the advantages or disadvantages of the method.

Literature pointing to the benefits of laboratory exercises. Johnson and Rising, in describing the role of the laboratory exercise, stated several ways in which laboratory lessons are successful. They provide success for those who have not yet understood the concept. The individual work is beneficial for the exceptional student. Due to the relaxed atmosphere, better attitudes toward mathematics and the instructor are developed. The similarity of this approach and real life challenges helps mature the students' outlook. The participation of each student is where the real learning takes place.[1]

Lowry stated that when a student is allowed to discover for himself, even if it takes longer, the time is well

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[1]Donovan A. Johnson and Gerald R. Rising, Guidelines for Teaching Mathematics (Belmont: Wadsworth Publishing Company, Inc., 1967), p. 302.

spent for the student will understand better and remember longer the concept which he discovered.[1] The discovery method gives the student the opportunity to think through and develop for himself.[2]

Students learn most effectively when they are taught to discover ideas for themselves. They learn least effectively when they are told ideas in bits and pieces. Students associate learning with doing and appreciate the opportunity to experiment with mathematics rather than being talked to about mathematics.[3]

In agreement, Bruner says:

> We shall, of course, try to encourage students to discover on their own. Children need not discover all generalizations for themselves, obviously. Yet we want to give them opportunity to develop a decent competence at it and a proper confidence in their ability to operate independently. There is also some need for the children to pause and review in order to recognize the connections within what they have learned--the kind of internal discovery that is probably of highest value. The cultivation of such a sense of connectedness is surely the heart of the matter. For if we do nothing else, we should somehow give to children a respect for their own powers of thinking, for their power to generate good questions, to come up with interesting informed guesses.[4]

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[1]William C. Lowry, "Pupil Discovery in Junior High School Mathematics," The Mathematics Teacher, XLIX (April, 1956), p. 301.

[2]Ibid.

[3]Francis G. Langford, Jr., "Helping Pupils to Make Discoveries in Mathematics," The Mathematics Teacher, XLVIII (January, 1955), p. 45.

[4]Jerome S. Bruner, Toward a Theory of Instruction (W. W. Norton and Company, Inc., 1968), p. 96.

Why have a mathematics laboratory? There are a number of sound reasons: the laboratory method of teaching is one of the most successful in the physical sciences; each student is allowed to work at his own rate; the freedom allows more discussion of the problem among the students which leads to learning; it gives a flavor of change to the daily grind of the classroom routine.

What changes are taking place in school curriculums? The need is from showing to doing, from our world to the student's world. Essential to all is the opportunity for the students to discover for themselves, so learning becomes a participation and creative process. The objectives in teaching mathematics at all levels are to give all students the opportunity to think for themselves, to appreciate the order and pattern of mathematics and the real world, and give them the needed tools for using mathematics.[1]

Biggs reports that in Great Britain if teachers are to provide the student with the first-hand experience of learning for themselves, the teacher must be convinced it is possible. After testing the materials themselves in the classroom the authors set about teaching teachers mathematics by the experiment and discovery method.[2] This seems

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[1]Edith E. Biggs, "Mathematics Laboratories and Teacher Centers - The Mathematics Revolution in Britain," The Arithmetic Teacher, XV (May, 1968), p. 406.

[2]Ibid.

to provide a stimulus for the teacher to use and appreciate this approach to learning in an abstract science.

Kersh has suggested that the superiority of the discovery method over the tell-to-do method is not adequately explained in terms of "meaningful learning," but the discovery learner is more likely to become motivated to continue the learning process or to continue practicing the task after the learning period.[1] What is teaching but the chance to capture the interest of the seeker and hand him the tools?

May reported on the Winnetka Public School learning laboratories project as follows:

> The three modes of mathematics--concrete, computational, and abstract--are built into as many of the mathematical units as possible. As the pupils work with concrete materials, they record their observations and then make generalizations from the data. They are encouraged to look at the patterns that have developed and then encouraged to predict results beyond the data they have acquired. The main idea is to keep students so motivated by their own work that they want to learn more. There is no failure, because all students are free to ask questions whenever they need help.[2]

The literature concerned with mathematics laboratories deals mainly with comments made by teachers and supervisors who have used and tested isolated laboratory exercises; however, tested results show that no great gain

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[1]Bert Y. Kersh, "The Adequacy of Meaning as an Explanation for the Superiority of Learning by Directed Discovery," Journal of Educational Psychology, XLIX (1958), p. 290.

[2]Lola J. May, "Learning Laboratories in Elementary Schools in Winnetka," The Arithmetic Teacher, XV (October, 1968), p. 501.

in transfer is recorded over the tell-to-do-approach to instructing students. Motivation to do further experimentation beyond the concept being taught and acquiring skills for later challenges are advantages of the discovery approach to teaching.

Literature stating limitations of laboratory approaches. Lowry mentioned that the very nature of a laboratory setting and procedure suggests a relatively slow and laborious task. He knew no way of hastening the thinking a student must do for himself.[1] Bittinger agreed with this thinking when he stated:

> The discovery approach should be used sparingly at first because of the time factor. It requires years to teach the discovery approach so students can really discover anything in a true sense. The method seems more useful for the student who will go on in more advanced courses.[2]

As with all methods of instruction some drawbacks are noted; however, the laboratory approach in mathematics is relatively new and needs further testing and study. Major criticisms seem to center around the time factor and the usefulness for all students.

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[1]William C. Lowry, "Pupil Discovery in Junior High School Mathematics," The Mathematics Teacher, XLIX (April, 1956), p. 301.

[2]Marvin L. Bittinger, "A Review of Discovery," The Mathematics Teacher, LXI (February, 1968), p. 145.

STRUCTURE OF A LABORATORY EXERCISE AND ITS SETTING

The laboratory exercises will be structured to create an interest in studying and realizing a principle of mathematics by leading a student to a desired conclusion by helping him organize his information logically. Since independent study is required of all individuals regardless of their occupations, the outline of these exercises is designed to be of interest to all students regardless of their future educational objectives.

It is the desire of the author that the structure of the sample lessons be such that a student could use these laboratory exercises as self-teaching devices for learning the concepts of mathematics which lend themselves to the discovery approach.

Introduction of topic. Each topic has been introduced as a question; for example, Does there exist a pattern? The topic could be familiar to the student or he need not have had any prior knowledge of any principle or pattern. The topics chosen for the exercises lend themselves to areas which are covered in the eighth grade text books.

Objectives for the exercises. The objectives are stated in terms of what change in behavior should occur. The objectives will state purposes of the exercises.

Needed equipment. All equipment needed in the exercise has been listed on each exercise with a manufacturer's name given and specific name of instrument if it is not commonly found in the mathematics classroom. Proper storing facilities for all equipment should be available for ease of accessibility to students. The physical features of the room are important in the successful laboratory setting; for example, tables instead of desks are desirable.

Directions for the exercises. Directions have been given concerning what to do, what data to collect, and what pattern or principle is being sought. The students will collect the data during the class period and can reach a generalization before the end of a period; however, if such is not the case, the homework assignment could be to write out the generalization at home. When the experiment is long and laborious, it is advantageous to have the students work together to supply all the data necessary for the correct results. Each student may then use the accumulated data for his final generalization.

Tables for accumulated data. If students could be taught to organize data in a meaningful manner their experimentation would be an easy process in any discipline. The tables used with each laboratory guide sheet have headings indicating all possible useful information which can be obtained from the given objects which they are experimenting with and the instruments they are using. The tables indicate some processes the student will try and these will lead to a pattern that the student can recognize for himself. Tables are constructed to guide the student to a better understanding of the process of experimentation in the physical world using an abstract science.

Results of exercises. Open-end questions are useful in triggering the student's mind so as to find the desired conclusion; therefore, space was provided for the student to express any further implications he might see from the data or type of procedure used in the experiment.

The laboratory setting. The student should have prepared guide sheets stating what they are to study and what materials they need. Materials for the exercise should be easily accessible for the student. Rooms for the laboratory exercise need flexibility and tables are convenient for experiments. All students should participate in a meaningful manner in the exercises. The instructor should have prepared the students for a laboratory period by giving any special instructions which will facilitate the time available for the exercise.

A SAMPLING OF LABORATORY EXERCISES

The following are sample exercises which have been constructed for the purpose of giving eighth grade mathematics teachers another tool with which to encourage pupils who would terminate their mathematics at the ninth grade level. The areas which were selected lend themselves to this type of approach; however, others can and should be used. It is not the intention of this paper to develop a laboratory manual but only give an example set for your consideration.

RELATIONSHIP BETWEEN CENTIGRADE AND FAHRENHEIT TEMPERATURES

OBJECTIVES

a. The student will collect data on comparable centigrade and Fahrenheit temperatures.

b. The student will investigate whether there is a pattern in the data which can be expressed by a simple formula.

c. The student will graph on a coordinate axis the comparable temperatures and read other temperatures from the line formed by connecting the points.

EQUIPMENT

Science book, graph paper, pencil

DIRECTIONS

a. Using an appropriate source find the Fahrenheit temperature for boiling water and the centigrade temperature for boiling water.

b. Using the two temperatures from procedure a, form a coordinate pair in this manner (F^o, C^o).

c. Using the same source find the Fahrenheit temperature for freezing water and the centigrade temperature for freezing water.

d. Using the two temperatures from procedure c, form a coordinate pair in the manner (F^o, C^o).

e. Using these two coordinate pairs graph their points and draw the line which connects the points.

f. Now find corresponding centigrade and Fahrenheit temperatures by selecting a point on the line you drew in e and read the coordinates of this point. The coordinates are the corresponding temperatures. Record these in the data chart provided.

DATA

Temperatures	Freezing	Boiling	Others	
Fahrenheit				
Centigrade				

RESULTS

a. How many units difference is there between the freezing and boiling point of the Fahrenheit temperatures? ____________

b. How many units difference is there between the freezing and boiling point of the centigrade temperatures? ____________

c. Using the answers from questions a and b write a ratio of the difference in Fahrenheit to the difference in centigrade. ____________

d. Express the ratio in question c in simple form.

____

e. Multiply the ratio found in part d by the freezing point of centigrade. What is your result? ________

f. Is your answer to part e the freezing point of water on the Fahrenheit scale? (yes or no) If not, what must be added or subtracted from your result to obtain the correct reading? ________

g. Express what you have done in question e and f as a formula F = ________

h. Check your formula by using the results already obtained from your graph and recorded in the data table.

PROBABILITY OF AN EVENT

INTRODUCTION

The purpose of studying probability is to learn how to solve problems where chance occurs.

EQUIPMENT

Deck of fifty-two playing cards, pencil

OBJECTIVES

a. The student will collect data on the number of successes of getting three cards in the same suit from a five card hand.

b. The student will state the probability of an event as a number.

DIRECTIONS

a. Use a deck of fifty-two regulation playing cards.

b. Shuffle and deal out five cards.

c. Record in the data collection table whether you were successful in obtaining three cards in the same suit or whether you were not successful in obtaining three cards in the same suit.

d. Shuffle and repeat fourteen times.

DATA

Trial	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Successful															
Not successful															

RESULTS

a. How many times were you successful? ____________

b. Write as a fraction the number of events over the number of trials. $\frac{\quad}{15}$ ______

Example: $\dfrac{\text{Number of successful trials}}{\text{Number of trials}}$

c. Express this fraction as a decimal. ____________

d. How does your decimal fraction compare with the fractions found by other students in the class?

____

e. Compile all the trials run by the class and make a comparison. How does this compare to the answer you had? ____________________

Example:

$$\frac{\text{Number of successful trials of all students in class}}{\text{Number of students in class times 15}}$$

BRAIN TEASERS

OBJECTIVES

a. The student will strengthen his arithmetic ability and deductive reasoning powers.

b. The student will learn the regrouping of numbers for addition and subtraction.

EQUIPMENT

Pencil, scratch paper

DIRECTIONS

a. Study the given numbers and determine whether the problem is addition, subtraction, or multiplication.

b. In the first three problems below the letter X indicates a missing number, but not necessarily the same number each time. In problem 4, each different letter stands for one specific digit.

c. With your knowledge of number facts fill in the missing numbers.

d. Check your answers to see if they satisfy the problem.

DATA

```
(1)  X,937     (2)  X3X54    (3)     3X3    (4)  FORTY
        8X           X8X9            6XX           TEN
       109          -----           ----           TEN
     4,X85           781X            X26         -----
     -----                          ----         SIXTY
     8,5X7                          1X5X
                                   2X7X
                                  ------
                                  X33X4X
```

SIMILAR TRIANGLES AND PROPORTIONS

OBJECTIVES

The student will investigate whether a proportion can be used to solve for the height of an object if the length of its shadow is known.

EQUIPMENT

Tape measures (nearest $\frac{1}{4}$"), source of light (such as floodlight), data collection table

DIRECTIONS

a. Measure and record the height of an object in column A of the data table.

b. Measure the length of the shadow of the object in direction a and record this in column B.

c. Measure the length of the shadow of a different object and record this in column C of the data table.

d. Repeat this an additional three times using different pairs of objects.

e. Solve the proportion A/B = D/C for each pair of objects and record the results in column D.

f. Now measure the height of the object mentioned in direction c and record this measure in column E.

DATA

Objects	A	B	C	D	E
1st Pr.					
2nd Pr.					
3rd Pr.					
4th Pr.					

RESULTS

a. Does the computed height equal the actual height of the unknown? ____________

b. Could you use the proportion to solve for the length of the shadow in each case? ____________

c. Could you use the proportion to solve for the length or height if the other were known? _______

d. Must the objects be perpendicular with the ground for this type of exercise to work? ____________

ADDING SIGNED NUMBERS

INTRODUCTION

Nomographs are mechanical computational devices which students will enjoy making and using.

OBJECTIVES

a. The student will learn the process of adding signed numbers.

b. The student will learn the properties of signed numbers and review material without boredom.

EQUIPMENT

Pencil, graph paper, ruler

DIRECTIONS

a. Using graph paper draw three vertical and parallel lines which are 21 units long and spaced 8 units apart.

b. Draw a horizontal line which intersects the center of each vertical line. Label this line 0.

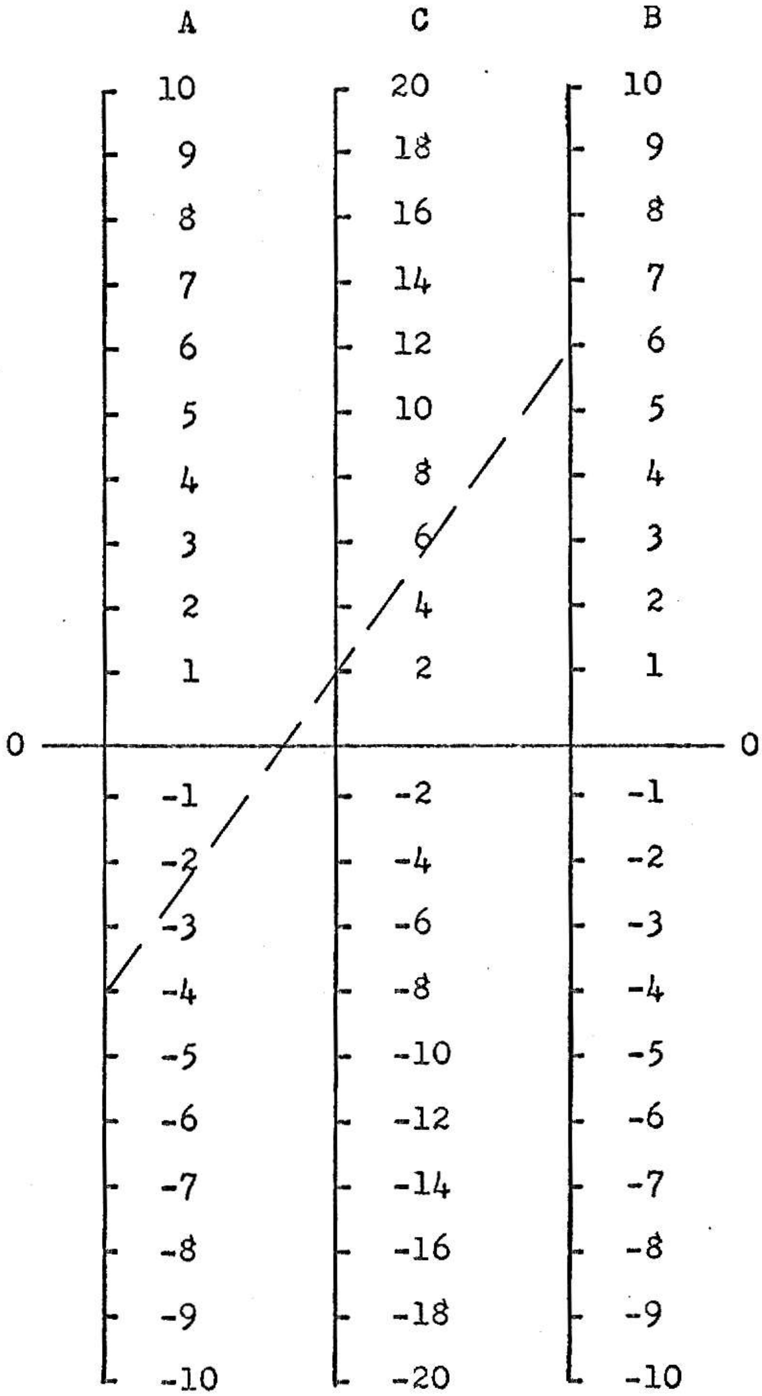
c. Starting from the left label the vertical lines A, C, and B, respectively.

d. Starting at the top number each interval from 10 through -10 for line A.

e. Starting at the top number each interval from 20 through -20 using only even numbers for line C.

f. Starting at the top number each interval from 10 through -10 for line B.

Example:



DATA

Find the sum of (-4) + 6 by drawing a line between the (-4) on A and +6 on B.

The point of intersection on line C is the answer.

RESULTS

Use the nomograph to find the answers to the following problems:

(-8) + 2	(-10) + (-6)
(7) + (-8)	(6) + (4)
(-8) + (-9)	(-8) + (10)

THE AREA OF A TRIANGLE

INTRODUCTION

Triangles are interesting and useful geometric figures. Triangles are frequently used in the construction of bridges, television and radio towers, and buildings. Structures of this shape are rigid; that is, their shapes cannot be changed regardless of the pressure applied to the sides except by actually breaking them. This is not true of other polygonal structures. Because of its frequent application to problems in life, let us study the triangle further.

Fill in the following blanks with the appropriate response. If necessary use a mathematics dictionary to find the definition.

a. The side upon which the triangle rests is called the ____________.

b. The perpendicular distance from the side upon which the triangle rests to the opposite vertex is called ____________.

c. The number of equal square units contained in a plane figure is called the ____________.

OBJECTIVES

a. The students will determine whether or not there exists some pattern or relationship between the base and height of a triangle and the area inclosed by the triangle.

b. The student will determine the exact formula for the area of a triangle using the relationship of the base and height.

DIRECTIONS

a. Draw the base of a triangle the specified number of units long on the graph paper you have been provided.

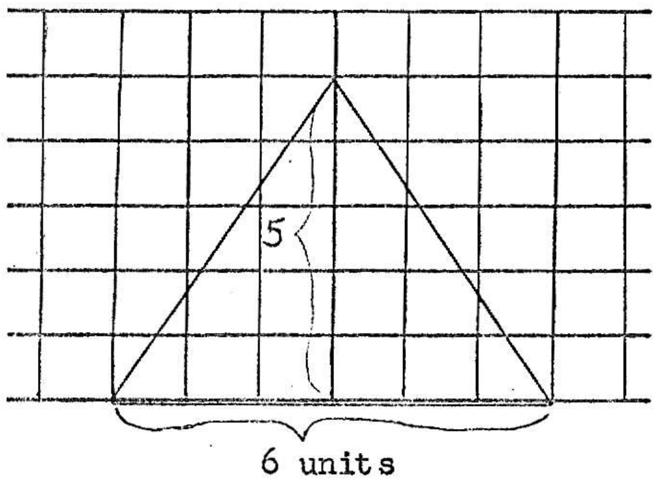
b. Move a specified number of units above the line on your paper and place a dot.

c. Connect the dot with the end points of the line on your paper.

d. Find the area of the triangle by counting the square units inside the triangle.

e. Record the following information in the table provided: length of base, height of triangle, and area of triangle.

Example: Base = 6 units, Height = 5 units



Information to be recorded: Base = 6, Height = 5 Area = 15 sq. units.

DATA

Exercises:
2. Base = 9, Height = 8
3. Base = 4, Height = 6
4. Base = 10, Height = 5
5. Base = 12, Height = 4

Record the data from the exercises and do the indicated operations.

Length of base	Height of triangle	Area	Base + height	Base - height	Base x height	Base ÷ height
6	5	15	11	1	30	1 1/5

RESULTS

a. Do you find a pattern for any of the operations? If so which operation? ________________

b. What is the pattern? Express this in your own words.

____

____

c. Express the pattern as a formula in algebraic form.

____

SUM OF THE ANGLES OF A POLYGON

OBJECTIVES

a. The students will record the sum of the angles of five different polygons.

b. The students will formulate a simple algebraic formula for determining the sum of the angles of any polygon.

EQUIPMENT

Ruler, paper

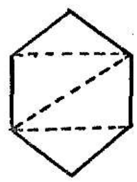
DIRECTIONS

a. Draw five polygons each with a different number of sides and with no less than four sides.

b. In the appropriate blank give the name of the corresponding polygon.

c. Draw diagonals which do not overlap and divide the polygon into triangles.

Example:



d. Record the number of triangles and the number of sides the polygon has.

e. Using the fact that the sum of the angles of each triangle will be 180° find the number of degrees in the angles of each polygon.

DATA

POLYGON	NUMBER OF SIDES	NUMBER OF TRIANGLES	SUM
Hexagon	6	4	720°

RESULTS

a. Compare the number of sides each polygon has with the number of triangles formed in each polygon. Is there a pattern? Yes or No

b. Tell what the pattern is in your own words.

____

c. If "N" represents the number of sides of a polygon, how could you express the number of triangles contained in the polygon?

____

d. Express in your own words using the statement made in (c) the number of degrees in the angles of a polygon.______________________________

e. Write an expression which will give the number of degrees contained in the angles of a polygon using the representation for the number of triangles you stated in question (c). ______________

DISCOVERING THE SUM OF THE ANGLES OF A TRIANGLE

OBJECTIVES

a. The student will find the sum of the three angles of a triangle.

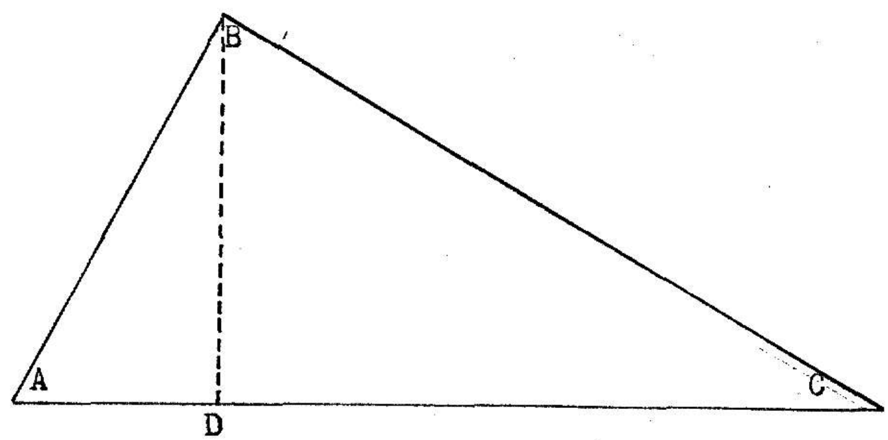
b. The student will find the area of a triangle by folding paper.

EQUIPMENT

Protractor, ruler, scissors

DIRECTIONS

a. Copy the following triangle making sure to label it as indicated.



b. Cut the triangle out as carefully as possible and proceed to part c.

c. Now fold point B down to touch AC at point D.

d. At the points where it is folded on AB and BC fold in till points A and C touch D.

RESULTS

a. What do angles A and B and C form on the back of your folded triangle? ______________________

b. What then is the sum of the three angles of a triangle? ________________

c. You could also show the area of this triangle. How could this be done? ____________________

____

____

STATISTICAL CODE DECIPHERING

INTRODUCTION

Code breaking is the most important form of secret intelligence in the world today. It produces much more trustworthy information than spies, and this intelligence exerts great influence upon the policies of governments.

Our purpose is to study just one of the methods for breaking codes.

OBJECTIVES

a. The students will appreciate the value of frequency tables and of statistical treatment of data.

b. The students will appreciate the value of mathematics in military intelligence.

c. The students will develop deductive reasoning ability.

EQUIPMENT

Paper, pencil

GIVEN INFORMATION

The frequency of occurrence of letters of the English alphabet by percent:

LETTER	PERCENT	LETTER	PERCENT	LETTER	PERCENT
A	8.0	J	0.5	S	6.0
B	1.5	K	0.5	T	9.0
C	3.0	L	3.5	U	3.0
D	4.0	M	3.0	V	1.0
E	13.0	N	7.0	W	1.5
F	2.0	O	8.0	X	0.5
G	1.5	P	2.0	Y	2.0
H	6.0	Q	0.25	Z	0.25
I	6.5	R	6.5		

The order of letters of the English alphabet by frequency of occurrence:

E T A O N I R S H D L U C M P F Y W G B V J K Q X Z

DIRECTIONS

a. Make a frequency table for all the letters given in the message.

b. Check for double letters in given words.

c. Check for most frequently occurring letters and substitute from your given frequency table.

d. List possible words which might fit the context of the message you are given.

e. Match these with the words in the note for length.

DATA

The message you have been given was found in the pocket of a jewelry store thief who was fatally injured in a shoot-out with police. Decipher the code as quickly as you can.

Mtv nogdcfnl tgsv uvvf lufm mc bcfncf dvvm pl mtvkv cf dcfngy.

LETTER	TALLIES	PERCENT	LETTER	TALLIES	PERCENT
A			N		
B			O		
C			P		
D			Q		
E			R		
F			S		
G			T		
H			U		
I			V		
J			W		
K			X		
L			Y		
M			Z		

SUMMARY

The intent of this paper was to develop a set of laboratory exercises which would motivate participation of mathematics students in grade eight. In place of drill the students have been directed in the exercises to develop and inquire rather than memorize.

The acute need for more individualized instruction in mathematics is imperative and the laboratory approach creates a favorable atmosphere where individuality grows. One of the important reasons for using a laboratory approach is that it generates new interest in mathematics.

Though there was interest in the laboratory approach prior to the 1960's, little was written about this approach in the period from 1952 to 1962. Since 1962 a considerable amount of writing about the laboratory approach has appeared in the literature.

Many successful aspects of the laboratory approach were stated in the literature reviewed. The laboratory approach provides success for those who have not yet comprehended the concept; easily definable goals are set up so achievement is obtainable; the similarity of the laboratory exercise to real life gives the student a challenge which helps mature the student's view toward learning; and students learn by doing rather than by being told.

There is a definite change in school curriculums today. The students are not being shown but are doing.

We are attempting to make the student a producer of information rather than just a consumer of information.

According to the literature the limitations of the laboratory exercise are: It is relatively slow and laborious, it is hard to know whether a student can really discover anything, and it is slanted toward the student who will go on in more advanced courses.

The structure for the laboratory exercise developed for this report was: An introduction when needed, objectives for the specific exercise, needed equipment, directions for the student to follow, tables for accumulation of data, and questions for analyzing the results.

The laboratory setting should be flexible with storage easily accessible and tables conveniently located for doing experiments. All students should be prepared by the teacher and each student should have a guide sheet.

Exercises which were developed were: The Relationship between Centigrade and Fahrenheit Temperatures, The Probability of an Event, Brain Teasers, Similar Triangles and Proportions, Adding Signed Numbers, Statistical Code Deciphering, The Area of a Triangle, The Sum of the Angles of a Polygon, and Discovering the Sum of the Angles of a Triangle.

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THE LABORATORY APPROACH TO TEACHING
EIGHTH GRADE MATHEMATICS

by

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The purpose of this report was to compile a sample set of laboratory exercises which apply to the teaching of eighth grade mathematics.

This was undertaken to generate new interest among students and create a favorable classroom atmosphere where the students' desire to inquire is stimulated.

The benefits of laboratory exercises are: It provides success for those who have not understood the concept, better attitudes toward instructor and mathematics are developed, goals are set up so a student can attain success, the approach is similar to real life situations, all students participate, and students learn best by doing rather than being told.

The limitations are (1) the relatively slow and laborious task, (2) we do not know if students can discover anything in a true sense, and (3) the discovery approach is aimed at more advanced students.

The exercises developed for the report were structured as follows: An introduction when necessary, objectives for the exercise, needed equipment, directions for the exercise, tables for accumulation of data, and open-end questions leading students to desired results.

In the laboratory setting the student is furnished a guide sheet, tables for doing experiments are available, and storage areas are easily accessible.

The sample exercises covered a selected number of areas. They are: The Relationship between Centigrade and Fahrenheit Temperatures, The Probability of an Event, Brain Teasers, Similar Triangles and Proportions, Adding Signed Numbers, Statistical Code Deciphering, The Area of a Triangle, The Sum of the Angles of a Polygon, and Discovering the Sum of the Angles of a Triangle.