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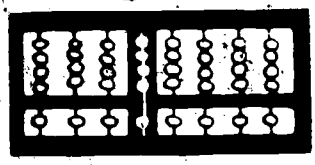
ABSTRACT

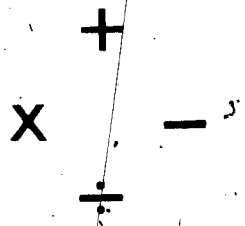
This guide describes activities and materials which can be used in a mathematics laboratory approach to a basic mathematics program for grades 1-6. Thirty-five activities pertaining to geometric concepts are described in terms of purpose, suggested grade levels, materials needed, and procedures. Some concepts included in the guide are: basic shapes, set classification, similarities, differences, symmetry, congruency, puzzle recreations, special properties of geometric figures, conservation, recognition of geometric shapes, geometric solids, geometric problem solving, geometric tool use (protractor, compass, ruler); pattern discoveries, measurements with polygons, vocabulary, relationships between area and volume, estimation, volume, fractional parts, and globe activities. The guide concludes with a list of selected manipulative materials for mathematics laboratory use. (JBW)

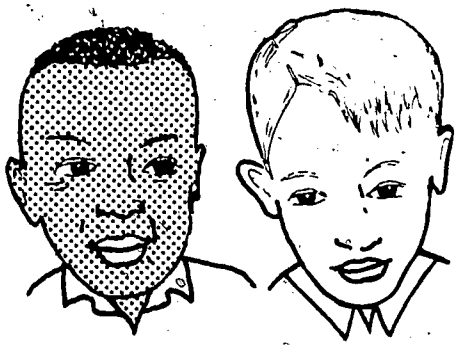
SUGGESTIONS FOR TEACHING MATHEMATICS USING LABORATORY APPROACHES

GRADES 1-6

EXPERIMENTAL EDITION







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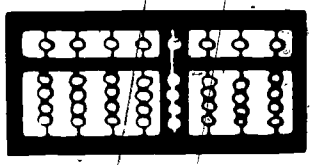

3. GEOMETRY

The University of the State of New York
THE STATE EDUCATION DEPARTMENT
Bureau of Elementary Curriculum Development

Albany, New York 12224
Reprint 1974

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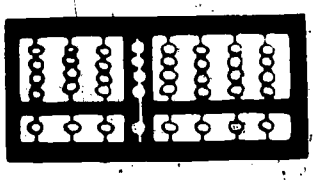
SUGGESTIONS FOR TEACHING MATHEMATICS USING LABORATORY APPROACHES

GRADES 1-6

EXPERIMENTAL EDITION



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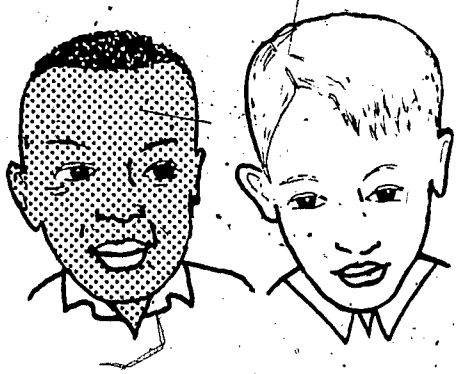

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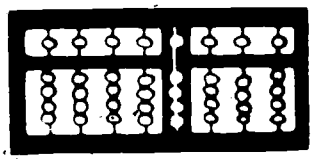

3. GEOMETRY

ESEA I TITLE

The University of the State of New York
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PREFACE

Substantial financial aid to local educational agencies for children of low income families was provided by the elementary and Secondary Education Act of 1965. Participating school districts have developed a variety of new educational programs to assist children with special educational needs. These programs are based upon local needs assessment with major parental involvement.

The three major priorities for compensatory education programs are bilingual education, reading, and mathematics. One of the highest priority programs under ESEA Title I is the subject matter area of mathematics. Experience has shown that children who have experienced difficulty learning in a traditional program often react with enthusiasm to a mathematics laboratory approach. This publication was developed to provide practical applications of this mathematics approach for use by classroom teachers. It should provide practical suggestions for teachers working directly with educationally disadvantaged children.

Irving Ratchick
Assistant Commissioner for
Compensatory Education

FOREWORD

The Bureau of Elementary Curriculum Development and Bureau of Mathematics Education in cooperation with the Division of Education for the Disadvantaged, ESEA Title I, have developed a variety of materials on the use of a Mathematics Laboratory approach on the elementary level. This joint effort has resulted in the release of two publications:

Teaching Elementary Mathematics Using Laboratory Approaches, which serves as a short introduction to the method

and

ESEA Title I, Anatomy of An Elementary Project, which gives a concrete example of the use of a Mathematics Laboratory approach with disadvantaged children.

Encouraged by the response of teachers and administrators to the original publications, a decision was made to move further in the direction of providing concrete activities for teachers who wished to move into the humanistic approach inherent in a Mathematics Laboratory program.

Fredric Paul of the Bureau of Mathematics Education and Peter A. Martin of the Bureau of Elementary Curriculum Development began the task of developing activities for teacher use. A committee of experienced teachers consisting of Claire Cohn, Helen Feder, and Pasquale Toscano, under the direction of Elaine Mintz was engaged as a writing team. Mrs. Mintz is director of elementary mathematics and the other three are teachers in the Plainedge School District. The material completed by this team was sent out for field testing to 11 schools throughout the State for use with children, As a result of a favorable reaction on the part of the teachers who used this materials, we have produced

experimental materials for use by school districts.

This publication is the third of four which are being developed for teacher use. Each will incorporate the latest thinking of the mathematics revision committee and may be utilized with any basic mathematics program. This publication is designed to serve as a stimulant to encourage teachers to open their minds and employ their imaginations in developing further activities. The classroom teacher in developing her own set of "task cards" will adjust vocabulary and choose concrete materials in terms of a close knowledge of the ability levels of her own children and the type and amount of manipulative materials available. Suggestions and reactions are welcome, and should be sent to Fredric Paul, Bureau of Mathematics Education, State Education Department, Albany, New York 12224.

Peter A. Martin of the Bureau of Elementary Curriculum, did the final editing and prepared the material for publication.

Robert H. Johnstone, Chief
Bureau of Elementary
Curriculum Development

Gordon E. Van Hooft, Director
Division of Curriculum Development

GEOMETRY

3.1. Shapes. Purpose: Sets, identification of basic shapes, geometric attributes, counting

Suggested Grade Level: 1-4

Materials needed: Junk, blocks, containers

Procedure: 1) Organize a "shape corner" with objects children collect - in class, outdoors, or at home - that can serve as 3-D geometric models. 2) Discuss: a) the relative sizes; b) distinguishing properties - number of sides, smoothness, ability to roll, similarities and differences, flat, curved, edge. 3) Display a sample shape. Ask children to find objects with a similar shape. 4) Ask children to sort the shapes according to their distinguishing attributes. 5) Ask children to make plasticene, paper, sand, etc. models like the objects from the "space corner". 6) Build a model village, farm, playground, etc. using basic shapes. Count pieces used. 7) Use shapes for tesselation projects.

3.2 Only One Way. Purpose: Set classification, similarities and differences

Suggested Grade Level: 3, 4

Materials needed: Attribute blocks

Procedure: Choose any block. Find a block that differs in only one way and put it next to the first block. Keep doing this until all the blocks are arranged in a single line with adjacent pieces differing from each other in only one way. Can you do the same thing in a circle? a figure eight?

3.3 Leaf Symmetry. Purpose: Symmetry, fractions

Suggested Grade Level 1, 2

Materials needed: Leaves, mirrors

Procedure: Have children collect leaves. A) Fold each leaf along its main vein. Do the two sides match? B) Place a mirror along the main vein of a leaf. Describe what you see.

3.4 "Blots and Snow FTakes". Purpose: Symmetry, recognition, informal fraction

Suggested Grade Level: 1, 2

Materials needed: Paint, paper, brush, scissors

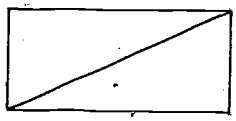
Procedure: For making symmetrical patterns. A. 1) Fold a paper in half. Open it. 2) Make a blot on a piece of paper. 3) Fold the paper along the crease. Rub the edge of your palm across the paper. 4) Open the paper. Tell what you see. B. 1) Fold a paper in half. 2) Cut designs thru the double layer of paper. Take care not to cut off the creased line. 3) Open the paper. Tell what you see.

3.5 Triangular Combinations I. Purpose: Matching congruent lengths, polygon identification edges, vertices, area conservation, angles, symmetries

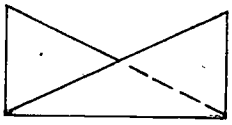
Suggested Grade Level: 1-6

Materials needed: 2 congruent, scalene, right triangles (transparent plastic material preferable)

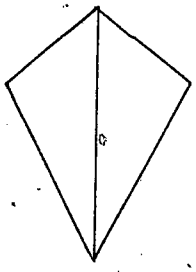
Procedure: Triangles can be used as basic building materials. Children can work assembling plane shapes made by matching the congruent edges of their 2 triangles. Clear plastic will permit improved visualization of overlapped polygons:



RECTANGLE



FIVE-SIDED CONCAVE POLYGON



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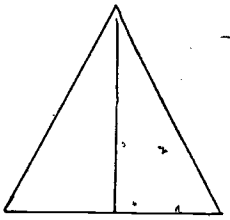


TRIANGLE

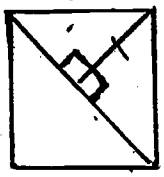
Children can make a record of the shapes they find by tracing them. Variation: Consider figures made by joining the triangle along parts of their edges and at their vertices.

3.6 Triangular Combinations II. Purpose: Same as Triangular Combinations I and similarity relations, puzzle recreations

Suggested Grade Level: 1-6

Materials needed: Triangles as shown in diagram, tangrams

Procedure: Have pupils follow comparable procedures as in the previous exercise. Notice the duplications of figures found in both cases and the new ones discovered here.



Tangrams - Traditional ancient Chinese tesselation puzzle.

3.7 Guess My Rule. Purpose: Set Attributes, similarities

Suggested Grade Level: 3-5

Materials needed: Set of Geo Blocks

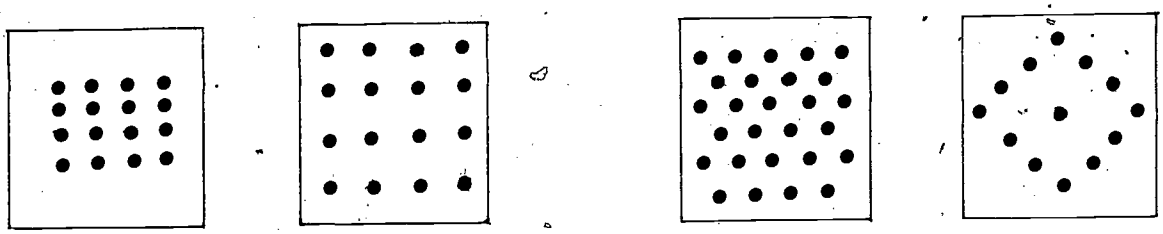
Procedure: Select two or more blocks which have a common attribute (both may be cubes, have five sides, etc.) One child asks another to figure out why they belong together. Find other blocks which belong. Vary, using other properties.

3.8 Geoboard Activities. Purpose: Recognition of basic geometric shapes, conservation, special properties of geometric figures - symmetry similarity congruence, parallels, perpendiculars, equivalence, angles, polygons, counting

Suggested Grade Level: 1-6

Materials needed: Geoboard, rubber bands, dot paper

Procedure: 1) How many different shapes can you make on geoboard with one rubber band? Two rubber bands? 2) Can you make a shape with 2 sides? Can you make a shape with 3, 4, 5, 6, sides? 3) List the names you know for shapes you have made. Find or make up names for the others. Copy your shape on dot paper. 4) Work with a friend. Can he make your shape? Can you make his design? 5) Rotate your geoboard and look at your shapes from different positions. What has changed? What has stayed the same?



3.9 Geobard and the Environment. Purpose: Recognition of standard geometric shapes in the environment, creation of geometric shapes
Suggested Grade Level: 1-4

Materials needed: None

Procedure: Using the environment ask: 1) Look around the classroom. Can you find any objects made with the special shapes you have studied? Can you show it on your geoboard or on graph paper? 2) Look around at home, outdoors, in magazines. Find other objects with special shapes you know. Draw them. 3) Compare your findings with others in the class.

3.10 Around The World. Purpose: Recognizing geometric shapes
Suggested Grade Level: 2-4

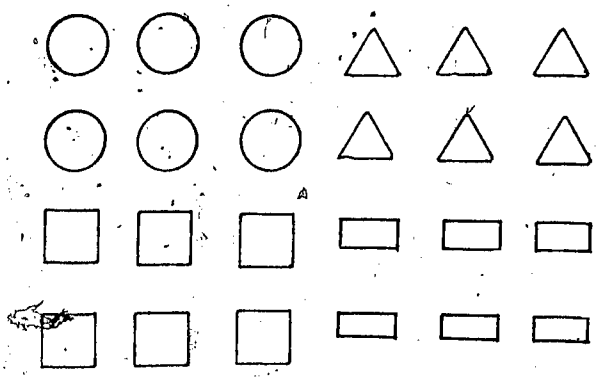
Materials needed: Magazines -- newspapers.

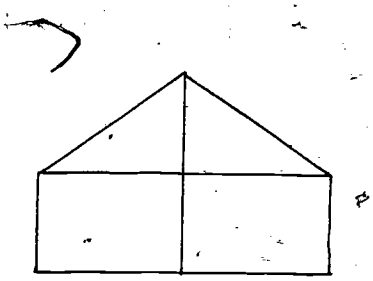
Procedure: Children collect pictures of objects for bulletin board display. Pictures should depict common geometric shapes. What Do You See in the World Around You?

3.11 What Can It Be? Purpose: Recognizing geometric shapes, set classification
Suggested Grade Level: 1-3

Materials needed: Geo Blocks

Procedure: Children can work alone or in pairs or small groups. The vocabulary should be familiar. 1) Think of a square. Can you find a block with a square face? 2) Think of a rectangle. Can you find a block with a rectangular face? How many different kinds of rectangular faces can you find? 3) Think of a triangle. Can you find a block with a triangular face? How many different triangular faces can you find? 4) What other shapes can you make by putting blocks together? 5) Can you make something that looks like a robot? a plane? a rocket? a house? 6) Can you sort the set of Geo Blocks by shape?





3.12 What Can You Build? Purpose: Equality, inequalities, altitude, symmetry, balance

Suggested Grade Level: 2, 3

Materials needed: Geo Blocks

Procedure: This is a good initial assignment after children have had sufficient time for free play and exploration. Building - Can you make something as tall as your chair, your desk, your friend? Can you make something that is all spread out? Can you make something that looks the same on both sides? On all four corners? Can you make something that will not fall down easily? Can you build a ramp?

3.13 Your Choice. Purpose: Geometric solids, properties

Suggested Grade Level 3, 4

Materials needed: Geo Blocks

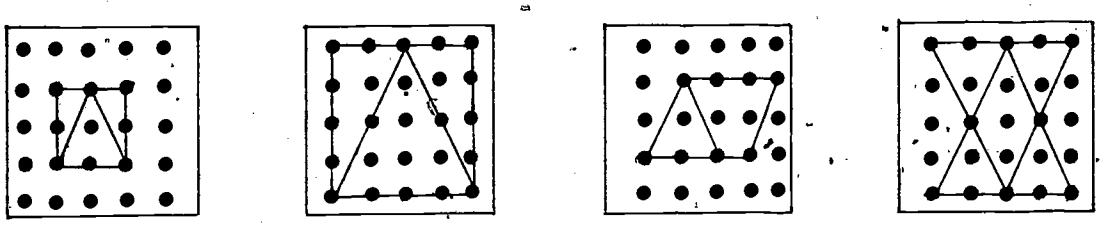
Procedure: Choose a cube. Record answers to the following: 1) How many faces has your cube? 2) How many edges has it? 3) How many corners? 4) What shape is each face? 5) Are all the faces exactly the same size? 6) Are all the edges the same length? Repeat using other solids.

3.14 Shapes and Sets. Purpose: Geometric shapes, relationships, set union, set intersection

Suggested Grade Level: 3-6

Materials needed: Rubber bands, geoboard

Procedure: 1) Using rubber bands construct a triangle and a square on the geoboard. Do not overlap figures. 2) How many nails are inside triangle? the square? 3) How many nails do the △ and the ▱ have in common? 4) Start with a triangle and square that overlap. Repeat the above experiment. 5) What puzzles can you make that use a geoboard?



3.15 What Do You See? Purpose: Recognizing geometric shapes.
Suggested Grade Level: 3,4

Materials needed: Set of geometric solids, plasticene

Procedure: Have child draw faces of different solids (cylinder, cube, pyramid, cone). Classmates guess which solid each face belongs to. Check with models. Some children may be interested in making models of solids from plasticene. They can then slice the model into sections and examine the interior faces.

3.16 Geoboard Looping. Purpose: Geometric problem solving, shape relationships, patterns and designs
Suggested Grade Level: 4- 6

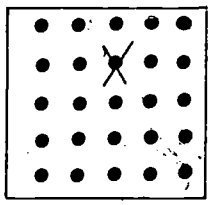
Materials needed: Geoboard, rubber bands

Procedure: With a single movement, by either looping over a nail or releasing the band from the nail can you make a parallelogram into a triangle?, a pentagon?, a rectangle? Can you make a triangle into a square?, into a rhombus?, into a parallelogram?, into a quadrilateral? Note: Tell why the task can or cannot be done.

3.17 Geoboard Tic-Tac-Toe. Purpose: Number pairs for graphing, problem solving
Suggested Grade Level: 3-6

Materials needed: Geobard, markers

Procedure: Let each nail point be uniquely named by an ordered number pair as shown in the diagram.



(3, 4 are the coordinates for point X.)

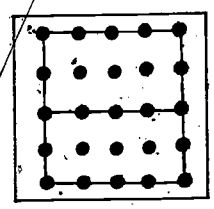
Markers are placed on the nails by the players taking alternate turns. The game is won when there are 4 markers in a row - horizontally, vertically or diagonally. As a variation each player names the nailpoint before he puts down his marker. If he gives the wrong name he loses a turn. Another variation, nail rows and columns may be extended beyond the geoboard. A third variation is to use graph paper to play the game.

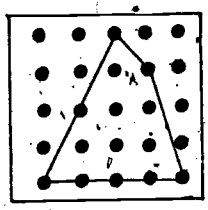
3.18 Geoboard. Purpose: Geometric shapes, comparisons, vocabulary, patterns

Suggested Grade Level: 3-6

Materials needed: Geoboard, rubber bands

Procedure: 1) How many squares can you make on the Geoboard? 2) Compare your answers with your classmates. 3) Make a triangle on your geoboard. Pull one of the sides out and loop it over a nail. What happened to the shape? How many shapes can you make with this movement? 4) Start with a shape that is not a triangle. Repeat the "pulling and looping"





3.19 "Symmetry". Purpose: Symmetry, congruence, shape analysis

Suggested Grade Level: 5, 6

Materials needed: Paper shapes

Procedure: Discuss symmetry - line and point - with students. Distribute paper rectangles, circles, squares, assorted triangles, parallelograms, and other polygons. Find symmetric parts by folding the shapes. Which shapes are not symmetric? Which shapes can be shown symmetric in more than one way? Have pupils examine objects in the room for symmetric properties.

3.20 "Solid". Purpose: Measurement units, geometric solids, operations with whole numbers and fractions

Suggested Grade Level: 5, 6

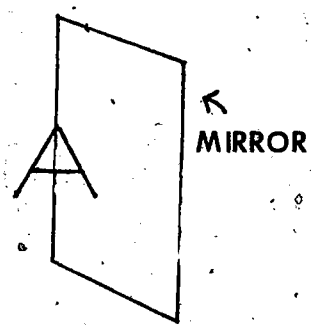
Materials needed: Assorted scales, clay, string, rulers

Procedure: Prepare at least 6 lumps of clay which weigh the same amount. Form each lump of clay into one of the following: sphere, a rectangular solid, pyramid, cone, cube, cylinder, etc. Ask pupils to compare the solids in as many ways as possible. (Anticipate that they will explore surface area, weight, girth, density, number of angles, edges, faces, volume, altitude, etc.) An estimate of these quantities should precede work with measuring tools. Encourage orderly data recording for eventual conclusions.

3.21 "Alphabet Symmetry". Purpose: Symmetry, congruence
Suggested Grade Level: 5, 6

Materials needed: Paper, mirror from mirror cards, mirror cards

Which letters of the alphabet have an up and down (vertical) line of symmetry? Which have an across (Horizontal) line of symmetry? (If you're not sure, use a small mirror to find the line of symmetry. When you look into the mirror you should see the entire letter.) Ex:



--HIDE--

Which symbols of the first 10 counting numbers have lines of symmetry? Can you find symmetric words?

3.22 Environmental Symmetry. Purpose: Symmetry, congruence.
Suggested Grade Level: 5, 6

Materials Needed: Paper

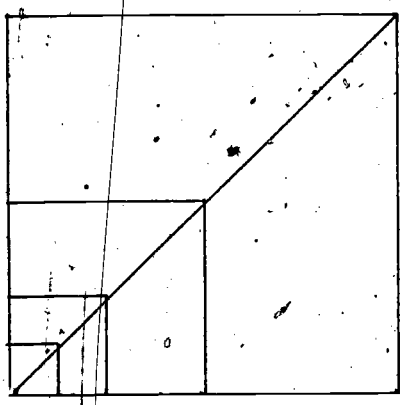
Procedure:
1) Make a list of at least five things in nature that are symmetric.
2) Make a list of at least five man-made things that are symmetric.
3) Is your friend symmetric? How many ways?
4) Make a list of things and ask your friend to mark them "S" for symmetric and "N" for non-symmetric? a brick? a tree? a chair? etc.

3.23 "Math - Art". Purpose: Geometric tool use, operations with whole numbers and fractions; ratio, linear measurement, function rules, informal similarity, congruence relations

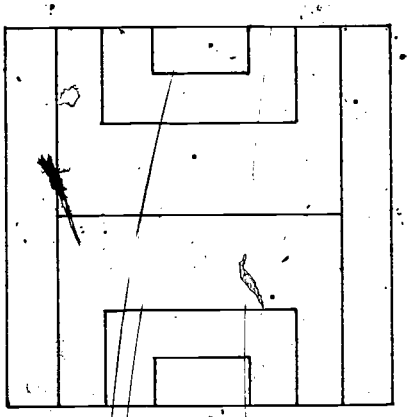
Suggested Grade Level: 5, 6

Materials needed: Protractor, compass, ruler

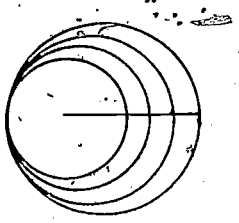
Procedure: Have students create symmetric and asymmetric designs using protractor, compass and ruler. Suggest that designs be based on mathematical functions.



Double the side length



Symmetric Design



Radii increase in arithmetic progression

3.24 "Carbon Copies". Purpose: Congruence
Suggested Grade Level 5, 6

Materials needed: Rectangular cards, other congruent sets

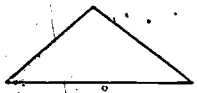
Procedure: The teacher should distribute a set of rectangular cards. Consider the following with the students: 1) How do the sizes and shapes of the corners compare with each other? 2) Are your hands the same size and shape? your feet? 3) What are other examples of objects which match in size and shape? 4) What industries depend on shape and size duplication? Why? 5) What measures should you take to guarantee making congruent figures?

3.25 "The Eternal Triangle". Purpose: Triangle classification and properties.

Suggested Grade Level: 5, 6

Materials needed: Environment

Procedure:



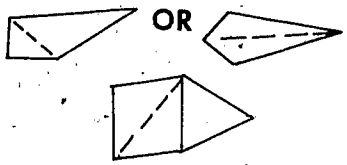
Why are triangles important in our world? How do triangles differ from each other? List the many different kinds of triangles you can find in your classroom, playground, at home.

3.26 "The Triangle Toils". Purpose: Pattern discoveries, applied uses of triangles.

Suggested Grade Level: 5, 6

Materials needed: Geostrips

Procedure: Consider practical applications of triangular forms. Make a triangle and a rectangle using geostrips. Which is a rigid shape? How can the other shape be made rigid? Make a set of polygons and find the least number of diagonals you need to make the shape rigid. Chart the results.

Polygon - No. of sides	No. diagonals for rigidity	No. of triangles	Diagram
Triangle - 3	0	1	
Quadrilaterial-4	1	2	
Pentagon - 5	2	3	
etc.			

Can you find any patterns?

3.27 "Cut!". Purpose: Polygon properties, area, angles

Suggested Grade Level: 5, 6

Materials needed: Paper, scissors, ruler

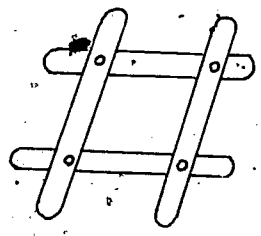
Procedure: Have students take rectangular sheets of paper and see how many different geometric shapes they can make using only one straight line cut. Try it with 2 cuts, 3 cuts, etc. Have students label each figure. Have pupils reassemble the original rectangle with the cut pieces.

3.28 "Polygon Properties". Purpose: Polygon properties, measurement, inequalities, similarity, congruence.

Suggested Grade Level: 5, 6

Materials needed: Scissors, fasteners, cardboard rectangles (1/2" x 4", hole punched at each end) or geostrips, checkerboard, graph paper, ruler

Procedure: If available, have students use geostrips. Otherwise, have each student cut a set of a dozen cardboard 1/2" x 4" rectangles. Discuss open and closed, concave and convex, geometric polygons. Discuss regular, equilateral polygons, and others. Ask pupils to assemble a set of regular polygons with the strips. Working on a checkerboard or graph background, pupils can investigate the following: 1) What happens to the perimeter as the number of sides increases? 2) What happens to the area as the number of sides increases? 3) What happens to each angle as the number of sides increases? Encourage graph and tabular presentations of the findings. Enrichment: Pupils can pursue investigations with convex and non-equilateral polygons.

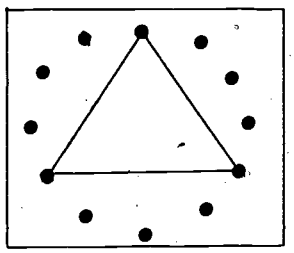


3.29 Polygon Properties and Circles. Purpose: Polygon properties and nomenclature, patterns

Suggested Grade Level: 5, 6

Materials needed: 12-nail, circular geoboard

Procedure: Find the kinds of polygons you can make on a 12-nail circular geoboard. Name them. How are they alike? different? How many polygons could you make if you had a 20-nail circular geoboard? a 50-nail circular geoboard?



3.30 "Edges, Faces and Vertices". Purpose: Number patterns, geometric shape investigations, introduction to algebra, data organization

Suggested Grade Level: 5, 6

Materials needed: Solid geometric models

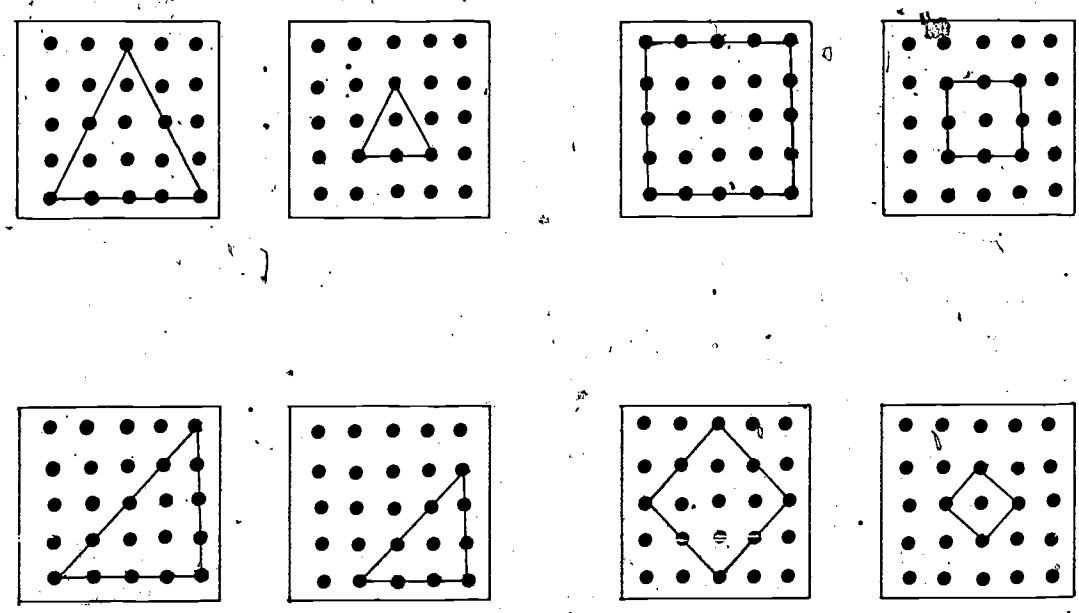
Procedure: Encourage pupils to rediscover Descartes' formula relating number and geometry, $E + 2 = F + V$. Discuss definitions for the parts to be considered. Initial investigations should be made with flat-faced solids. Further explorations can be made using solids with curved surfaces.

3.31 "Polygons". Purpose: Polygon properties, inequalities, similarity, congruence

Suggested Grade Level: 5, 6

Materials needed: Geoboards, rubber bands, polygonal models, assorted graph paper

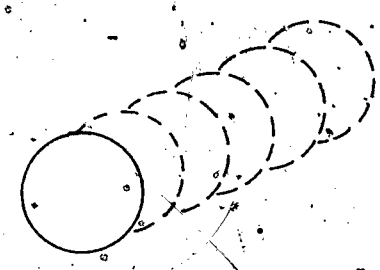
Procedure: Have students form various polygons on geoboards. 1) Estimate, then measure the perimeter of each. 2) Which is the largest? 3) Which is the smallest? 4) Are any the same shape? 5) Do any have the same perimeter? 6) What is the altitude measure? 7) Pose further questions involving comparative measures of these shapes. 8) Compare polygons made on the geoboard with plastic, wooden, or paper polygonal models. 9) Compare the geoboard polygons with shapes found in the classroom, on the playground, at home.



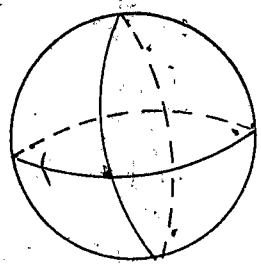
3.32 Spinning through Space. Purpose: Relations among 2 and 3 dimensional figures, relationship between area and volume
Suggested Grade Level: 5, 6

Materials needed: String, assorted, standard plane shapes, triangles, circles, rectangles

Procedure: Have students attach a string to a plane shape. Spin the shape. What 3-dimensional shapes are generated by the spinning motion? If the string is attached in a different place, will a different shape be generated by the rotation? Have the pupils use the same plane shape and slide it a set distance along their desks. Compare the new solid generated by the slide (translation) motion.
Ex: Circle generations.



Translation



Rotation

3.33 "Polygon Covers". Purpose: Estimation, measurement units, area
Suggested Grade Level: 5, 6

Materials needed: Assorted plane geometric forms (cardboard, plastic, wooden), geoblocks, pattern blocks, assorted graph paper, cubical blocks, balance scales, tesselation materials, pellets, junk

Procedure: Distribute models of geometric shapes. Discuss the meaning of area and the need for establishing some basic measurement unit. Have pupils devise feasible units and then investigate the following:
1) Can you guess which figure has largest area? Mark it largest. 2) Ask, can you guess the one with the smallest area? Mark it smallest. 3) Rank the models between the smallest and largest in order of area. 4) Are any areas the same? Mark them same. 5) Find the measure of the area of each shape. Compare your answers with your guesses. Note: Include irregular shapes as well as traditional Euclidian forms for these investigations. Pupils are not expected to use formulas to calculate measures.

3.34 "Growing Cubes". Purpose: Multiplication, exponents, measurement-linear area, volume, functional patterns

Suggested Grade Level: 4-6

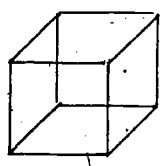
Materials needed: Uniformly sized set of cubes, (Dienes N.A.B.)

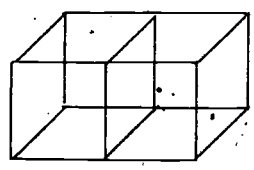
Procedure: Take a small cube as your basic unit of measure. Build a cube with 2 units in length, width, height. Build a cube with 3 units in length, width, height. Continue building a series of larger cubes. Keep a record of the number of cubes you use.

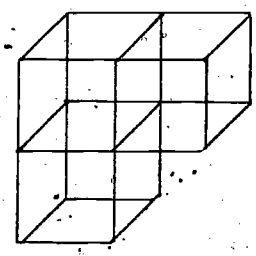
Ex:

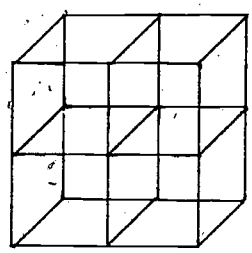
# of units along each edge	#squares on each face (area)	Total surface area	#unit cubes used (volume)
1	1	6	1
2	4	24	8
3	?	?	?

What patterns can you find? Can you guess how many cubes you'll need for a cube whose edge has 10 units? 20 units? Try it. How do the surface areas compare to the volumes?









3.35. Globe Activities. Purpose: Area, measurement, fractional parts, ratio, map measuring, reading graphs, plotting points, map and chart reading, time zones

Suggested Grade Level: 5, 6

Materials needed: Globe, assorted grid paper, clay, string, tape measure, map measure, large map, letters, postcards, atlas

A. Discuss devising ways to calculate the area of regions on a globe and reasons for doing so. Explore the limitations of flat maps. Consider "tiling" a globe with grid paper or make clay facsimiles. Develop appropriate measurement units. Refer to an encyclopedia or atlas for data confirmation.

B. Using the scale of miles on the globe - 1) one inch on the globe stands for how many land miles? 2) now using a string to measure, find approximate mileage; a) Denver to San Francisco, b)New York to Chicago, c) Chicago to Los Angeles, d) New York to Miami, etc. Try some on your own. Note: Find distance around earth at equator. Check your answer with an Atlas in the library.

C. Tell in what large city you would be - 1) in Pennsylvania at 40° N. Lat., 2) in Louisiana at 30° N. Lat., 3) in Canada at 50° N. Lat., 4) in Mexico at 20° N. Lat., 5) in E. Argentina at 35° S. Lat., 6) in Brazil near Tropic of Capricorn, 7) in Ecuador at 0 line of Lat.

D. Using Latitude to estimate distance (distance from one line of latitude to the next is 70 miles). 1) Find the place where 30th line of latitude N. crosses Northern Florida. If you were to go from there to Southern Pennsylvania, how far would you travel? 2) How far from Houston, Texas to Winnipeg, Canada? 3) How far from Belem, Brazil to Buenos Aires, Argentinz? 4) Check your figures with a map measurer or string and tape measure.

E. Longitude: Name one country for each Meridian - a) 0°, b) 90° W, c) 90° E, d) 120° W, e) 120° E.

F. In what continents are the following places: a) 30° N. Lat. - 90° W. Longitude; b) 50° N. Lat. - 0° longitude; c) 30° N. Lat. - 30° E. Longitude. In what body of water is 0° Lat. - 0° long.?

3.35 Continued.

G. Suppose treasure was buried at the following places. What countries would they be in? 1) 40° N. Lat. - 120° W. Long., 2) 20° S. Lat. -140° E. Long., 3) 30° N. Lat. - 60° W. Long., 4) 0° Lat. - 20° E. Long., 5) 20° N. Lat. - 0° Long.

H. Imagine that a ship has sent an S.O.S. from the following places. Identify each spot on the globe. 1) 0° Lat. - 0° Long., 2) 40° N. Lat. - 180th line of Long., 3) 70° Longitude; 4) 50° S. Lat. - 150° W. Long., 5) 30° S. Lat. - 60° E. Long.

I. Using lines of longitude to tell time. 1) Assuming that it is noon in Greenwich, give appropriate time for each city; a) Washington, D. C., b) Rio de Janeiro; c) Los Angeles; d) Rome; e) Cairo; f) Calcutta; g) Tokyo; h) Sydney

J. When it is 9:00 a.m. in St. Louis, Missouri, what time is it in Seattle, Washington? When children in Fairbanks, Alaska are beginning their school day, what are children in Chicago, probably doing? If the President of the U.S. makes a national T.V. address at noon in Washington, D. C., at what time do the people in Portland, Oregon hear him? If the Queen of England is to make a speech in London at 1:00 p.m., at what time will the people in Ottawa, Canada hear her broadcast?

K. Collect letters, postcards, stamps, etc. from all over the world. Prepare a bulletin board with a large map at the center. Scatter mail around the map with strings to place of origin. Use map measurer to determine how far each letter traveled and label each.

Geometry

Selective Manipulative Materials for Math Lab Use

Geometry:

Improvised materials: Bank books, coins and bills, graphs from newspapers and social studies textbooks, invoices from local businesses, lattices, mailorder catalogs, Napiers rods, nomographs, restaurant menus, score cards, slide rule made from ordinary rulers and yardsticks, spinners and dice, supermarket price lists, baseball batting averages and other sports data, ecological problem studies, egg cartons, industrial and fine arts and home economics project involving measurement, time tables, also, acorns, beans, bottle caps, buttons, classroom equipment (books, erasers, pencils, window panes, desks, chairs, floor tiles, etc.), corks, discs, fingers, foot and handprints, graph paper, horse chestnuts (conkers), ice cream sticks, leaves, money, number lines, pebbles, pine cones, sample swatches of various materials, seasonal paper cut-outs (pumpkins, snowmen, hearts) seeds, shells, straws, telephone directories, tiles, toothpicks, twigs. Plus the body used for measuring thumb, foot, cubit, pace, etc.), boxes cartons, other containers, geo-strips, paper patterns for solids, polydominoes, and treasure hunts related to coordinate grids.

Improvised Games: Tower Puzzle

Tangrams

Sprouts

Dot-to-Dot

Scan

Commercial Materials: Assorted containers for solid and liquid measures, barometer, balance scale (pan and spring), calipers, carpenter's level, clinometer, clocks, compass (circular and magnetic), density kit, drawing templates and stencils, funnel, globe, geometric solid and plane figures, hour glass, hypsometer, magnets, map measures, measuring spoons, meter stick, metronome, micrometer, microscrope, mirrors, montessori metric rods, pantograph pedometer, pendulum, plumb bob, protractor, rulers (assorted scales), sphigmomonometer, standard weights, stethescope, stop watch, string, sundial, surveyors' land chain, tape measure, thermometers, telescope, transit, trundle wheels, T-square, 2 and 3 dimensional geometric models, yardstick.

Commercial Games: Attribute Games, Inch By Inch, Vectors, Mirror Cards, Moby Lynx, Battleship, One-Two-Three Think, Symmetry Dominoes, Shape Dominoes, See-Saw, Scan, Tower Puzzle, Tangrams, Tasmania, Origami.

General Supplies:

Paper - ruled, unruled
graph - squares (1/10", 1/4", 1/2", 1"), isometric
gummed shapes
construction, art, newsprint, tracing
brown wrapping, wallpaper, carbon
library card - 3" x 5", 5" x 8"
corrugated cardboard

Thumb tacks, paper fasteners, clips pins, cellophane and masking tape, glue, paste, scissors, strings, rubber bands, sponges, laces, yarn, straw, pipe cleaners, plasticine or clay, pencils, paints, brushes, crayons, stapler, stamp pads, filing folders, tool chest, balsa wood, screws, nails, styrofoam forms.

Storage Containers: 1) Cardboard boxes, rectangular and cylindrical (covered with vinyl wallpaper for strength and color): 2) baskets, crates, and bushels from the produce markets; 3) wire hangers and clothespins or clamps for display and paper storage; 4) emptied aluminum, tin, cardboard, plastic food containers - checked for sharp edges and then painted; 5) commercial containers.

Dominoes: Many variations on traditional dominoes are now available for teaching concepts of matching, counting, arithmetic operations, and geometric discrimination.

Squared Materials: Cardboard sets consist of single units, strips of ten, and blocks of 100. They may be used to reinforce place value concepts, as concrete representations of numbers, and for addition and subtraction of numbers with and without exchange. Comparable procedures may be developed with graph paper.

Stencil Graphs (Lattices): Perforated plastic sheets come on a window shade roller. The device is hung over a chalk board. The shade is pulled down and rubbed with an ordinary chalking eraser. The shade is then lifted and a chalked lattice is available for further marking.

Teacher Discovered Materials: In addition to the above selective listing of Math Lab Materials, teachers will find an almost endless variety of both commercial and everyday common materials available to them. For this reason, space has been left in this booklet where teachers may list other materials they have discovered which may be used with a Math Lab Approach.

ADDITIONAL MATERIALS

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