DOCUMENT RESUME

ED 127 167 SE 021 204

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TITLE Property Blocks: Games and Activities.
INSTITUTION Minnesota Univ., Minneapolis. Minnesota School Mathematics and Science Center.
SPONS AGENCY National Science Foundation, Washington, D.C.
PUB DATE 75
NOTE 24p.; For related documents, see SE021201-234
AVAILABLE FROM MINNEMAST, Minnemath Center, 720 Washington Ave., S.E., Minneapolis, MN 55414

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS Elementary Education; *Elementary School Mathematics; *Elementary School Science; Experimental Curriculum; Games; *Instructional Materials; *Interdisciplinary Approach; Learning Activities; Mathematics Education; Primary Grades; Process Education; Science Education
IDENTIFIERS *MINNEMAST; *Minnesota Mathematics and Science Teaching Project

ABSTRACT

This pamphlet describes the property blocks produced by MINNEMAST, and discusses their use in the development of thinking processes. Classification systems, including block diagrams and tree diagrams, are discussed. Sixteen classroom activities and eleven games which use the blocks are described. Suggestions to the teacher for further reading are provided. (SD)

PROPERTY BLOCKS

GAMES AND ACTIVITIES

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WHAT ARE PROPERTY BLOCKS?

Property blocks provide an opportunity for children to solve problems involving classifying, sorting, describing and noting the relationships among classes of objects. Experience with such problems will provide some of the familiarity and skill necessary to solve problems of a more abstract nature which occur in the study of mathematics, science and social studies.

Children will learn to identify patterns while playing with blocks. They see symmetries and congruence long before they can describe what they are doing in mathematical terms. They develop an intuitive "feel" which is important in recognizing the patterns which occur in certain mathematical operations.

The MINNEMAST set of property blocks contain 48 different pieces.

There are 4 colors:	red, yellow, blue, green
There are 3 shapes:	circle, triangle, square
There are 2 sizes:	large, small
There are 2 thicknesses:	thick, thin

Each block has 4 distinct properties and is unique in the set. This assortment allows children to classify the pieces in different ways.

For example they can be separated several ways into two sub-sets:

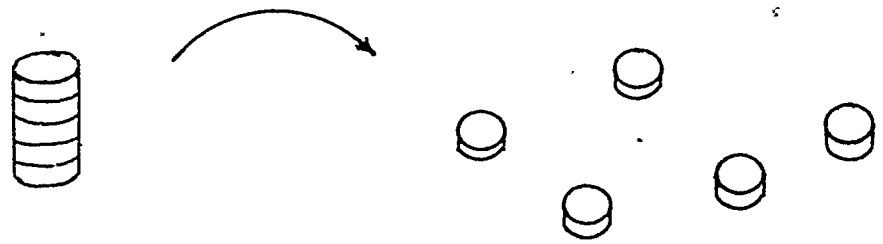
Circle shape	NOT circle shape
Red color	NOT red color
Thick AND yellow	NOT thick and NOT yellow
Thin AND blue AND triangle shape	NOT thin and NOT blue and NOT triangle shape

When the child separates the set into two sub-sets, he is learning that objects can be classified according to property, and that property can be used to define membership in a set.

THINKING PROCESSES

Studies have shown that children acquire the ability to conserve by actively sorting objects. To conserve, in this case means to know that the pile of red blocks remains the same (conserve it's identity as a set) even if the blocks are piled up, stacked, or spread out. The pile of blocks can have any defining property: shape, color, size, thickness or numberness. A pile of eight blocks has the property "eightness" whether the pile is close together or spread out.

One quickly notes that somewhere around age 5 or 6 the child begins to grasp the concept of conservation. In classic experiments several objects are moved into a compact pile. Then as the child watches, the pile is spread out.



Compact Spread out

If the child is asked, "Which pile has more objects?" the responses made indicate whether the child does or does not conserve. If the child repeatedly says, "It doesn't make any difference whether they are spread out or pulled together, there is the same number of objects", one surmises that the child grasps the conservation concept. If the child says, "There are more in that pile because they are spread out," one guesses that the child does not conserve.

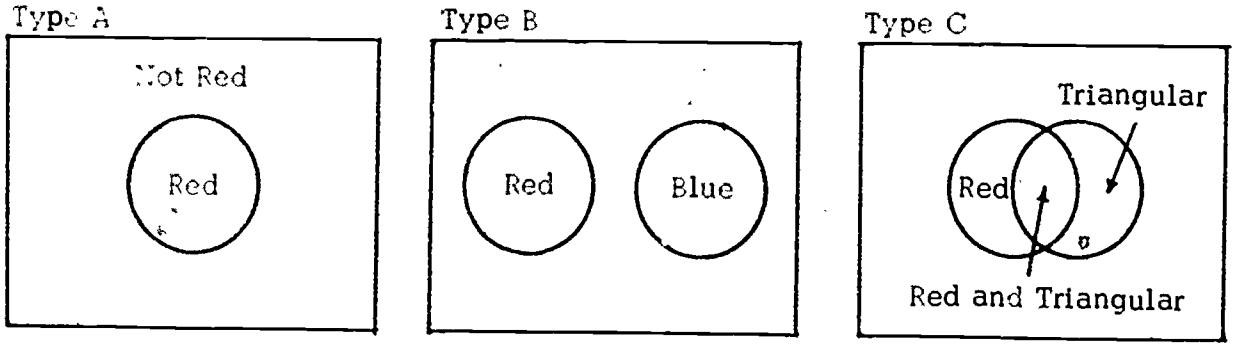
The simple problem 3 + 5, to the child who doesn't conserve may well have the answer 8, but as far as the child's conceptual understanding is concerned, the answer could well depend on how he perceives the 2 sets, 3 and 5 --whether they are spread apart or close together.

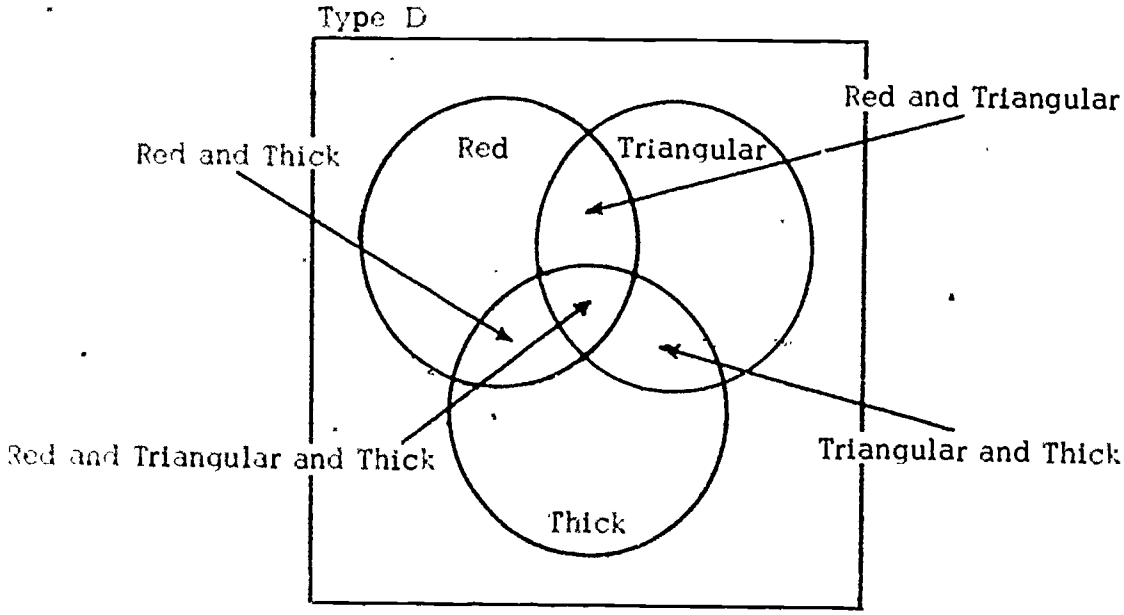
In addition to facilitating the ability to conserve, play with blocks helps children learn to sort, to classify and to develop early ideas of arrangement (symmetry) and configuration change (transformation).

CLASSIFICATION SCHEMES

Property Blocks familiarize children with systematic classification schemes. The following three formats are frequently used.

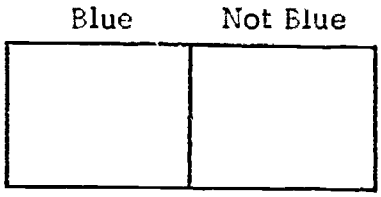
VENN DIAGRAMS Children are asked to place property pieces within the area which describes the particular block. As children progress from type A to type D diagrams they realize (although perhaps at the sub-verbal level) that different types of classification schemes are possible. Some will sort pieces using only one variable while others will utilize multiple criteria. Encourage them to progress from the use of single to the use of multiple classification variables. Encourage children to develop their own Venn diagram schemes.



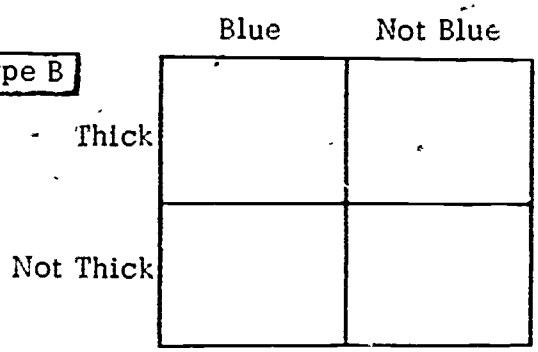


BLOCK DIAGRAMS

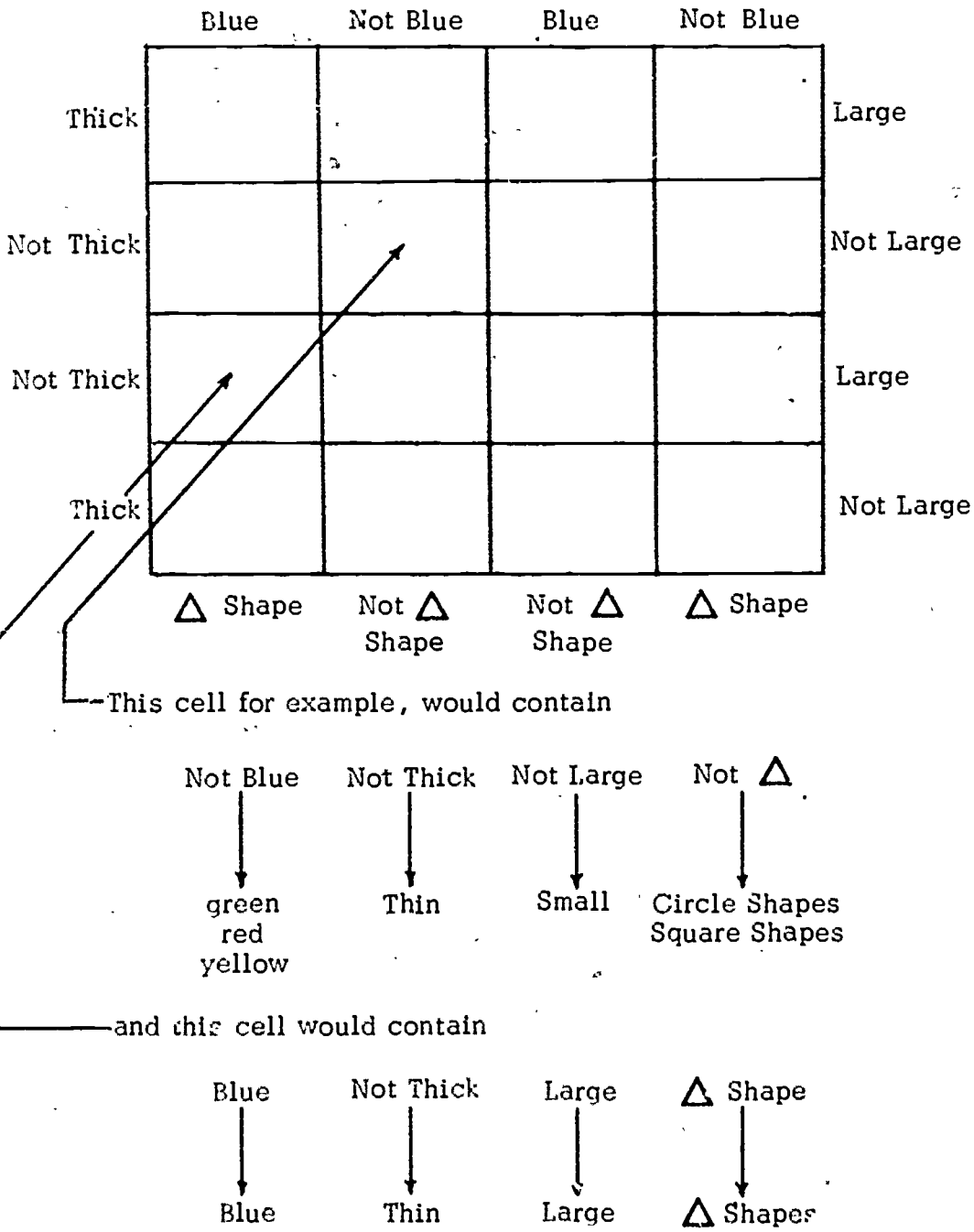
Type A



Type B

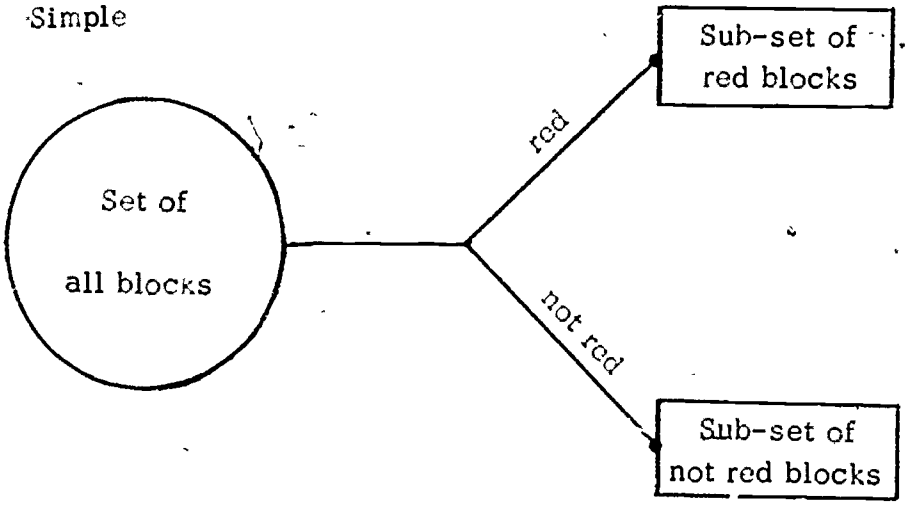


Type C

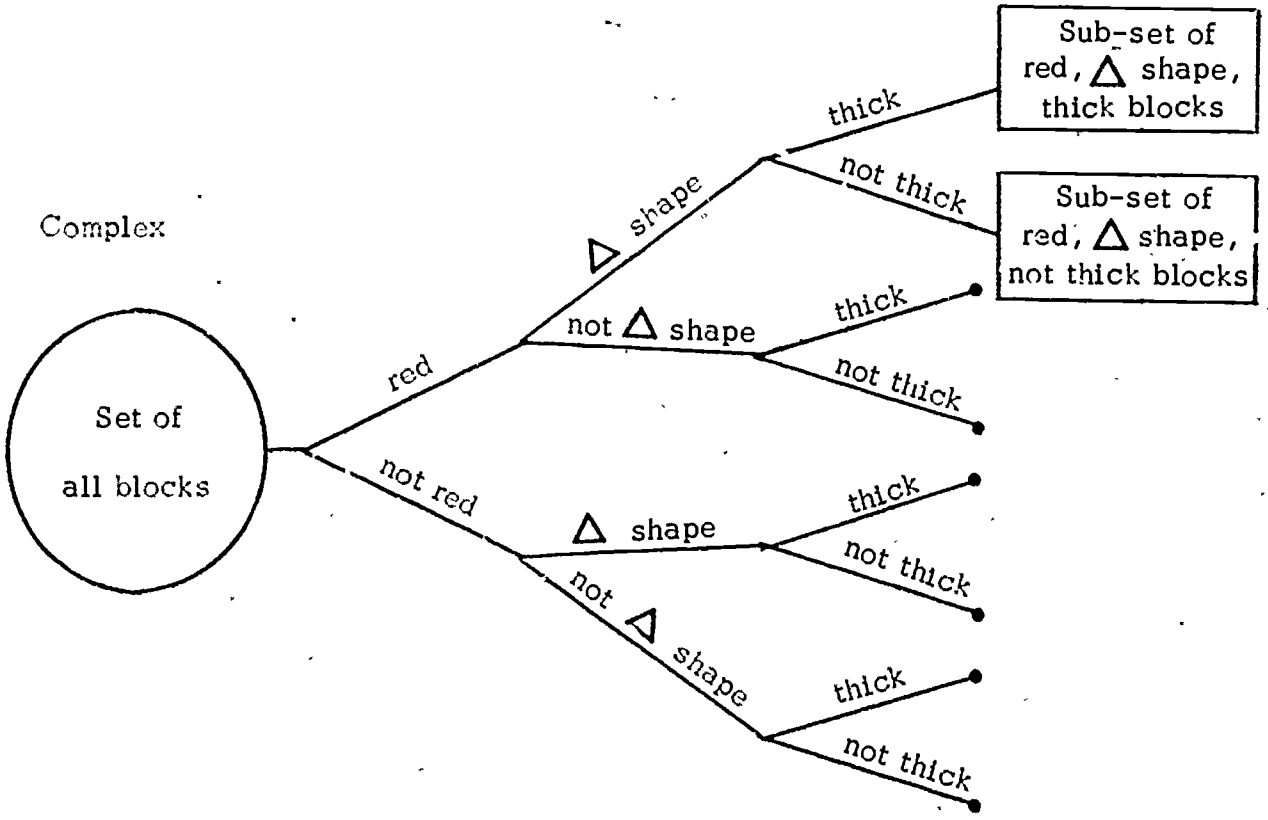


TREE DIAGRAMS

Simple



Complex



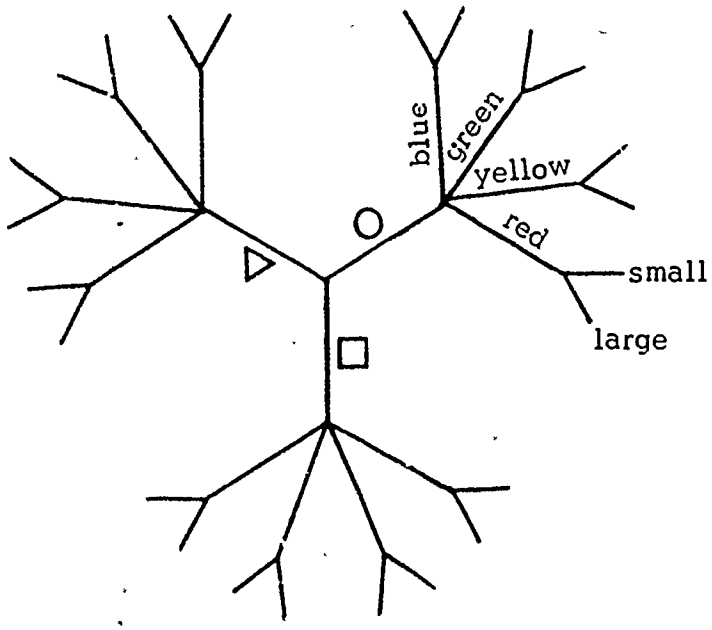
This format can be extended to include many variables. Tree diagrams can be constructed from strips of tagboard (1" x 12") fastened with brads. Trees can be laid out on a floor using masking tape. Small cards labeled appropriately, for example (blue, not blue), can be placed on the strips or masking tape. The "trees" can be used for different, though structurally similar, classifications by exchanging labels.

SUB-SYSTEMS

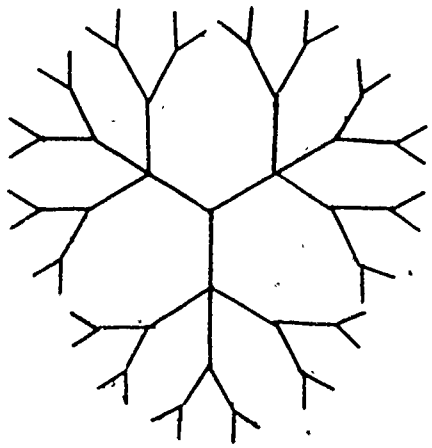
For younger children the Property Blocks can be subdivided so as to contain a number of blocks smaller than 48 and yet have the sub-sets continue to embody the parts of "logical structure" of the original set.

For example:

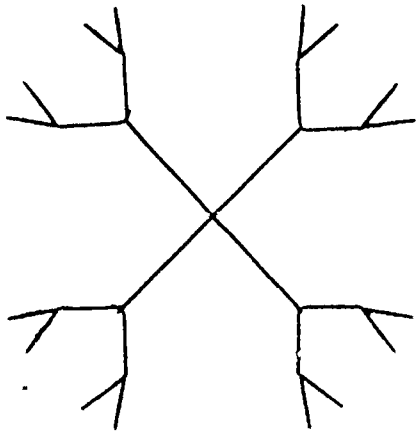
a) 24 piece set. Remove all thin blocks. This set will then be a 3 x 4 x 2 x 1 system. (i.e. shapes, 4 colors, 2 sizes and 1 thickness).



b) 36 piece set. Remove all blocks of one color. We now have a 3 x 3 x 2 x 2 system. How many extremities in the appropriate tree diagram? (We hope you said 36). The tree diagram for the 3 x 3 x 2 x 2 system follows:



c) 16 piece set. Remove all triangles and squares. The resulting blocks comprise a 4 x 2 x 2 system.



d) Other sets may contain 4, 8 and 32 blocks. What blocks would you remove to construct these sub-systems of blocks?

ACTIVITIES AND GAMES

The games and activities which are suggested in this booklet are similar to those found in many elementary school science and mathematics programs. They can be used to enrich your current teaching or to extend suggested activities of other programs.

In this guide, geometric names are used for property blocks. However, any terms are useful if they are understood by the children. No one set of words should be enforced. Terms such as "the one with 3 points" or "the round one" are equally as descriptive as "triangle shape" or "circle shape."

Acquaint yourself with the blocks. Take out the 48 pieces and play with them yourself. Build patterns and go through some of the suggested activities and games. When you introduce the blocks to the children, give them plenty of time to play with the blocks before engaging in any of the more "formal" activities. Although the blocks were designed for building patterns on flat surfaces encourage the children to stack the blocks, sort them, talk about them, and arrange them to resemble familiar objects - buildings, trucks, wagons, dishes and many more. It is always exciting to see how very creative children are when left to their own imagination.

As you and your children work with the blocks, many additional problems, games, relationships, and arrangements will arise. And these "in-house" developed activities may be far more useful to you than the ones described here. The guide introduces you to some activities and helps you recognize the potential uses for property blocks in your individual situation.

ACTIVITIES

MATCH ME	Hold up a block and have the children hold up one that matches. Then hold up another and ask for a color or shape or thickness match.
DESCRIBE ME	Go through the set holding up a block and asking children to describe it. Discuss the properties: shape, size, thickness and color.
FEEL ME	Drop a block into a sock. Have the children reach in and describe the block. Discuss feeling and seeing in describing shape and color.
ASK FOR ME	Hide the blocks. Have each child ask for a certain block by describing it. Lead children to discover that each block is a unique combination of shape, thickness, size and color.
FIND THE RIGHT BLOCK	Give each group of children a set of blocks. Ask for certain blocks. ("Find a red one.") Then ask for blocks with 2, 3, or 4 attributes. ("Find a block that is red, small and square.")
I'M NOT	Hold up a block. Ask children to tell you what that block is. NOT.. (e,g. a red, small, thick, triangular block is <u>not</u> blue, <u>not</u> yellow, <u>not</u> thin, <u>not</u> a square, etc.)

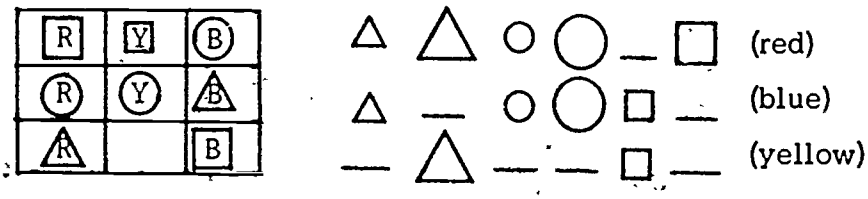
DIFFERENCES

Hold up two blocks and ask children to describe their differences. After each child understands the idea "difference", start the game. Hold up one block and ask the children to hold up one that differs by one property, then 2 properties, then 3 properties.

Children can play together. Each has a turn, holds up a block, and asks for a block that differs in 1, 2 or 3 properties. If the one asked does not hold up a correct "differ", the asker gets the block. If the block is correct, the asked gets the asker's block. The child with the greatest number of blocks at the end of a given time is the winner. Children can play this in pairs — an asker pair and an asked pair. Encourage the askers pair to help each other and the asked pair to help each other.

PATTERNS

Lay out a pattern of blocks like one below. Have the child copy and/or complete the pattern — and tell why the block selected goes in the empty space.



HIDE AND GUESS

Lay the blocks out in front of a small group. Hide something under one of the blocks. The children should ask questions to determine under which block the object is hidden.

WHO'S MISSING

Remove one block from the set of blocks while the children have their eyes closed. The children should determine which block is missing. At first, you might have them ask questions about the missing block. Later, have them determine which is missing from the remaining blocks. It's fun to watch the processes they use and it's good practice in sorting.

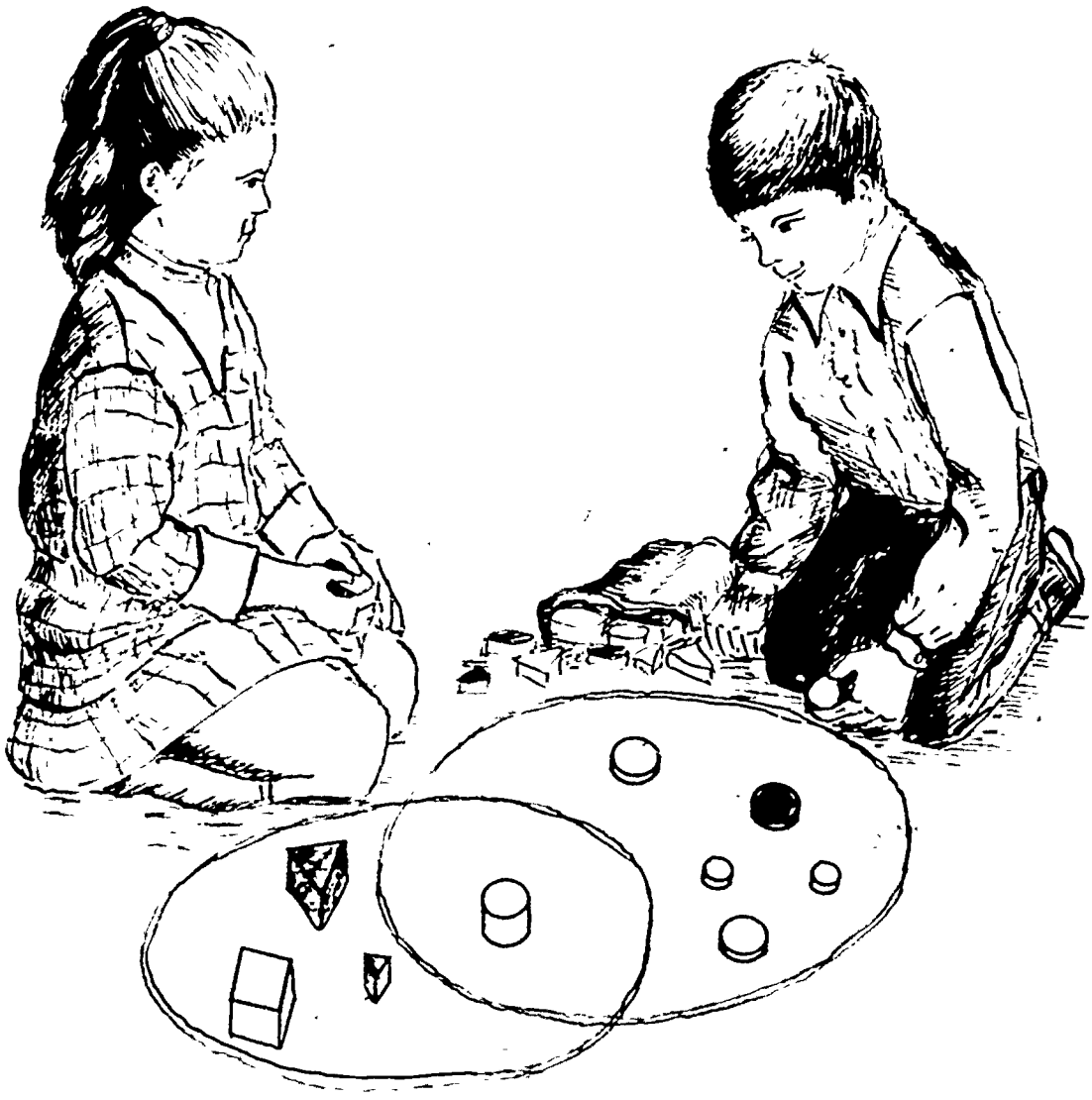
SORTING

Ask a group of children to sort the set of blocks into sub-sets. You might begin by having them sort the blocks into sub-sets based on 2 values of the same property. (e.g. red and blue, thick and thin, triangles and squares). Then ask about blocks which fit in neither sub-set.

Next you can have them sort into sub-sets, one having the property, the other not having the property. For example:

Blue	Not blue
Triangle	Not triangle

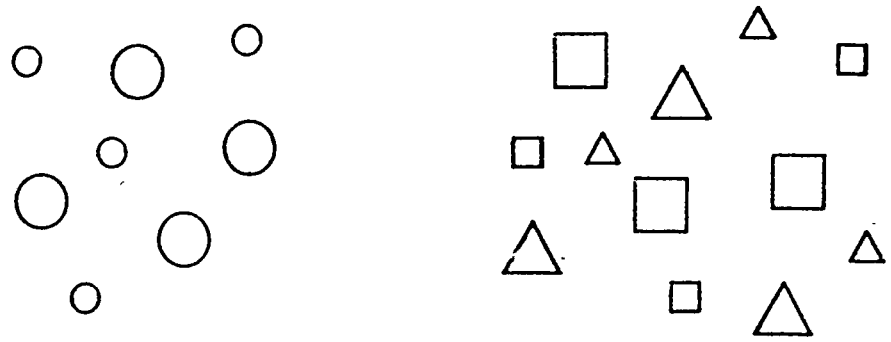
Ask if there are any blocks that do not go in either sub-set.



Continue with two property sorting. For example:

Large, red	Not large, red
Thin triangle	Not thin triangle

Now ask children to sort blocks into 2 sub-sets. Explain that they should think of the properties to be used. Have other children guess how the 2 sub-sets are defined. For example:



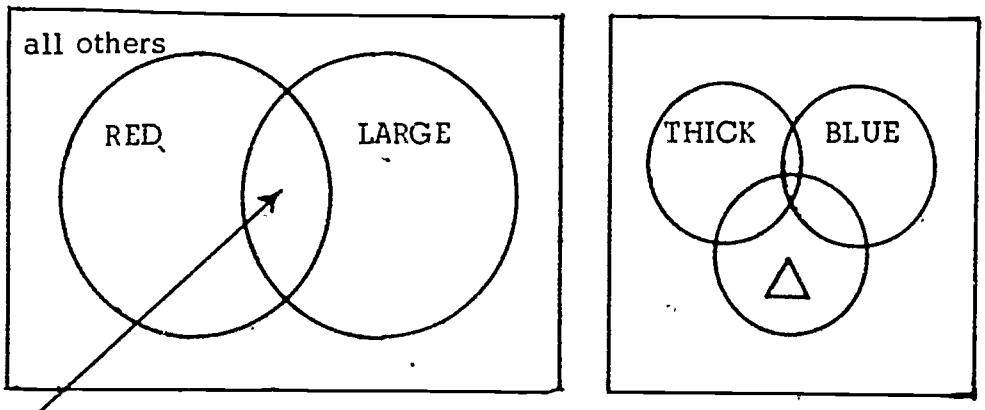
Substitute other collections for sorting such as:

Buttons	Bird seed
Shells	Beads
Rocks	Leaves

VENN PENS

You can make large cardboard charts for the children to use in their spare time.

A child sorts a set of blocks into the appropriately labeled area.



Ask which blocks go here. Point out that they must be both red and large.

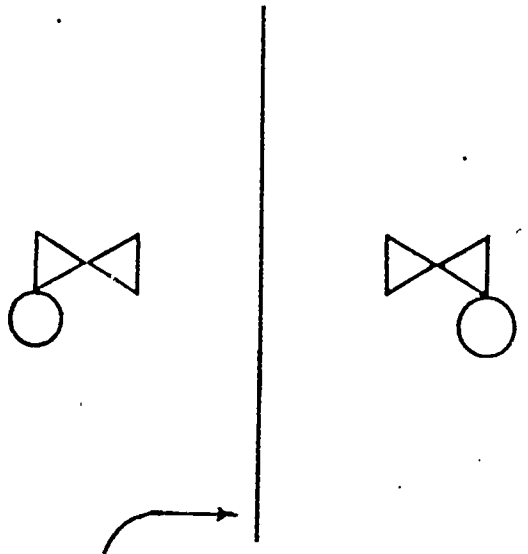
SPOT THE PATTERN

Have children make patterns with the blocks. You might wish to have them make some which exhibit various forms of symmetry.

1) Bilateral:

Lay these down one piece at a time.

Children place these on other side of the axis generating the reflected pattern

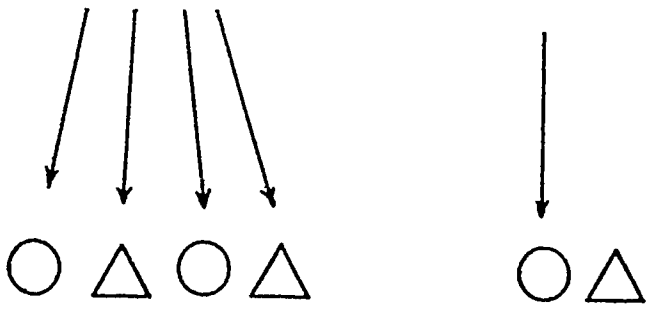


A piece of string or yarn can serve as the symmetry axis

2) Translational:

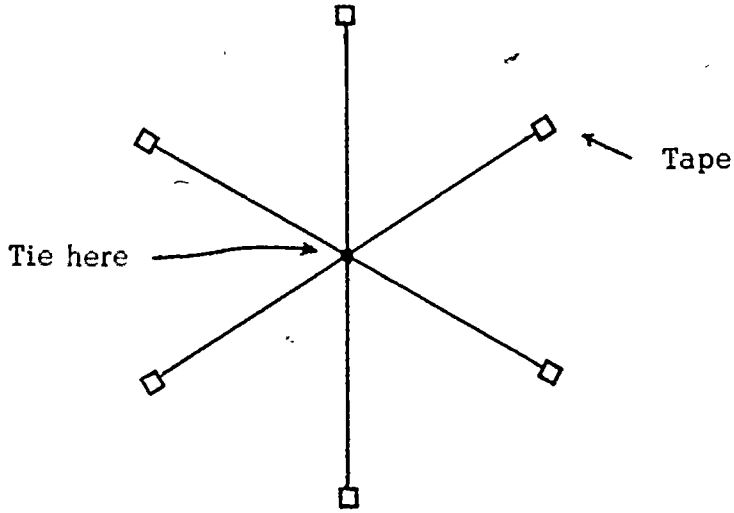
Lay these down

Then ask the child to continue the pattern

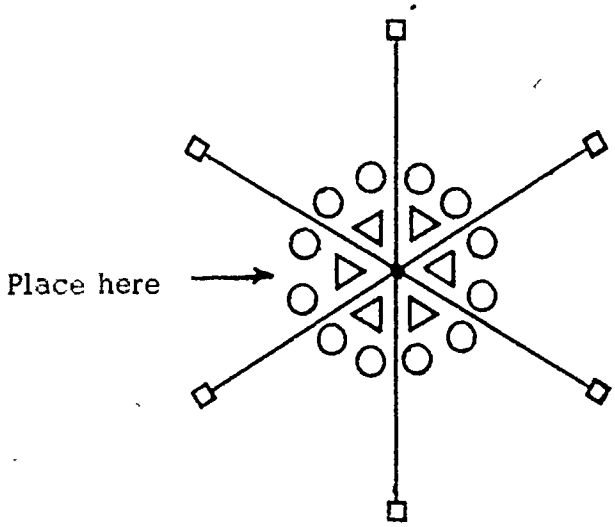


3) Radial:

Tie 2 or 3 pieces of about 16 inch yarn together at the center. Then stretch this out to fasten on the floor with masking tape.



Place a block in one pie shaped wedge. Ask the child to repeat the pattern:



Then children complete the other wedges

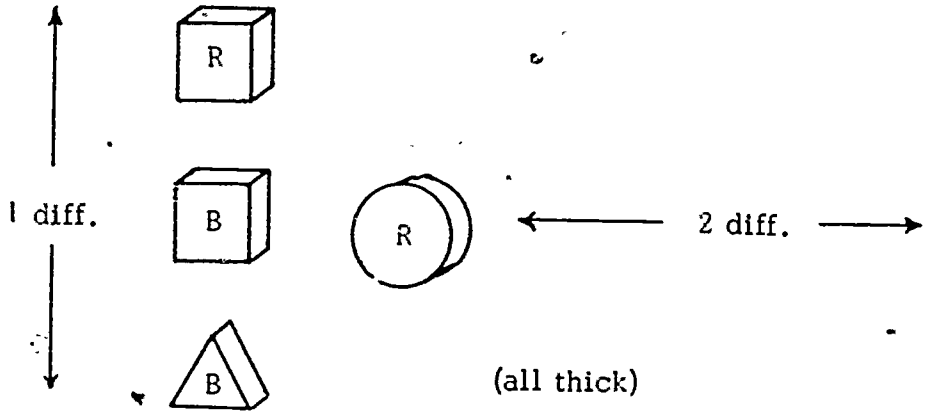
These symmetrical pattern generating activities can be greatly expanded. The children will need more than one set for these.

ONE PROPERTY, TWO PROPERTIES

Begin with one piece. Ask a child to place a block on either side of that one which differs in only one property.

(all thick)

It gets more difficult as they play a 2 or 3 or 4 difference game. Children might also like to play a one difference game in one direction and two differences in the other direction.

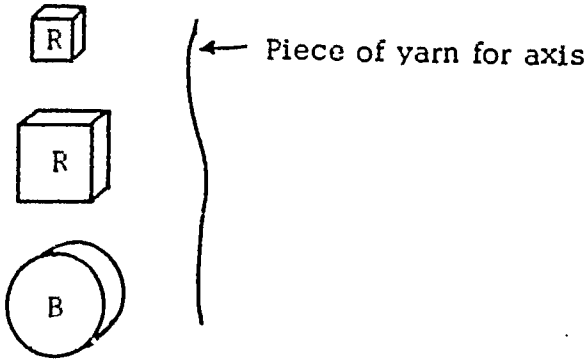


ALIKE OR DIFFERENT

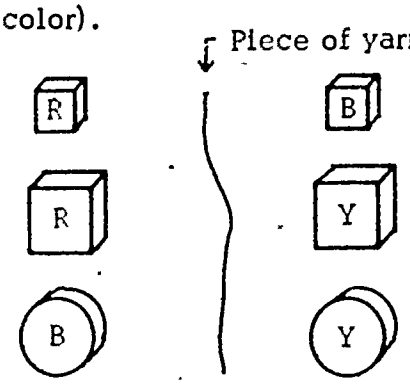
Hold up two blocks, asking how the two blocks are alike or different.

MATCH ALL BUT ONE

Have a child lay out a simple pattern of two or three blocks.



Ask him to repeat the pattern again but to change some one property (e.g. color).



Children enjoy the challange as they change more than one property or use more blocks.

GAMES

PROPERTY DIFFERENCE — Have one child lay out a pattern of blocks. His partner should then lay out a similar pattern, changing one (or 2 or 3 or 4) property of each piece as he lays out.

MAKE UP RULES — Ask a small group of children to divide the blocks fairly among themselves and note the sorting used. Ask the children what rules they used for fair division.

KNOTTY NOTS — Ask children to make a pile of blocks which are <u>either</u> yellow <u>or</u> thick. If they are asked to remove the not-yellow from such a set, they should notice something interesting about the remaining blocks.

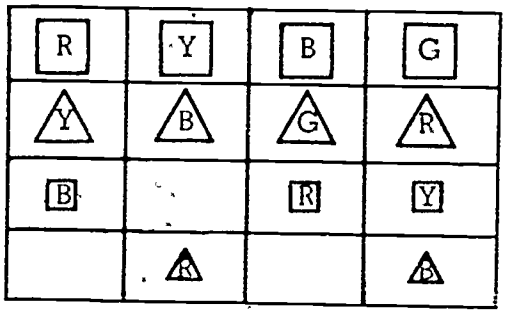
(yellow <u>or</u> thick) - (all not-yellow) = yellow <u>and</u> thick

I WANT — Divide one set of blocks, giving half of the set to each of two groups. Seat these small groups on either side of a low screen. The groups should take turns asking the other group for a certain block. If a child successfully describes one of the other team's blocks, he receives it for his team's set.

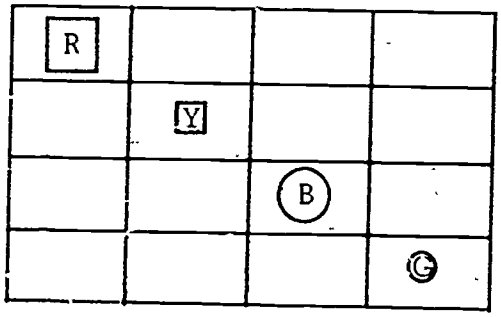
PATTERN CARDS

Make oak tag pattern cards which are in various stages of completion. Invent your own patterns. Have the children complete the cards using property blocks or a deck of 24 cards cut from appropriately colored construction. paper. (Omit thickness property.)

Patterns can be simple

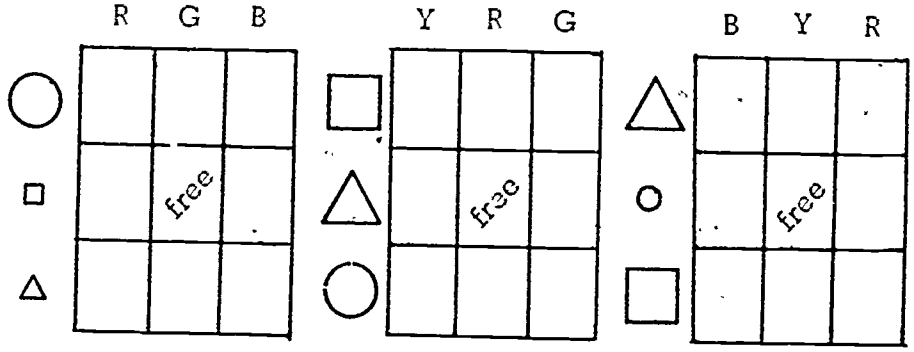


or complex and challenging



SHAPE BINGO

Make 3 x 3 "bingo" cards from oak tag and alter in a systematic way the row and column labeling on each. For example:

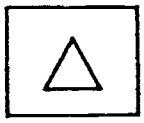


etc.

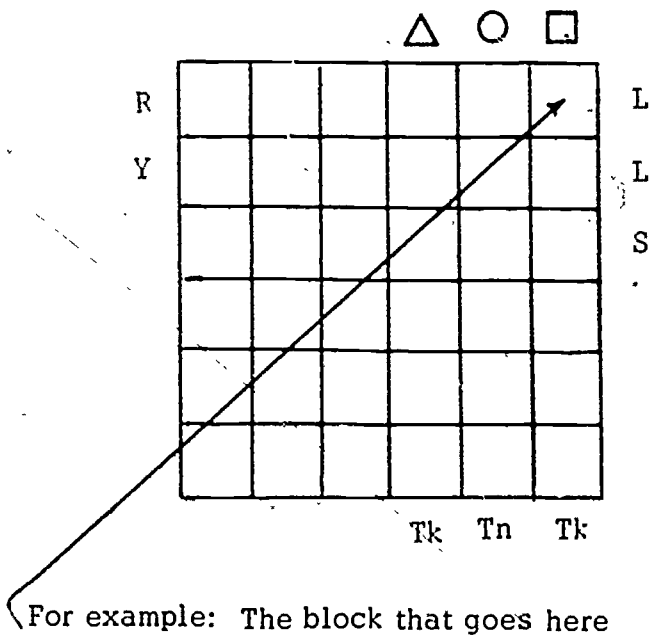
Supply each card with a set of markers. (Corn, buttons, or bits of construction paper.) One child is appointed caller. He pulls a property block from a sack and describes it - giving size, color and shape. Each child who has a matching 2 property intersection on the card marks it with a marker. The winner, of course, is the first to get three marks in a row, column or diagonal.

MATRIX I

Prepare shape, color, size and thickness cards from 3" squares of oak tag as follows:

SHAPE	COLOR	SIZE	THICKNESS
			
Make 6 (2 each)	Make 6 (2 each of yellow, red and blue - omit green)	Make 6 (3 large, 3 small)	Make 6 (3 thick, 3 thin)

Lay out a 6 x 6 matrix (4" squares) on the floor. You can use narrow masking tape or colored chalk. Place the description cards in one sack and the property blocks in another The children can play in pairs or groups. One child draws a description card and places it at the left side of the matrix. A second child draws a description card and places it at the top of the matrix. (If the second card was the same kind as the first, both shape cards, for example, it is replaced in the sack and another card is drawn, so that it is any kind but a shape card.) The remaining cards are then placed on the top and side of the matrix as illustrated. There are many variations depending on the first two draws. Remove all green blocks and set aside.



For example: The block that goes here is a large, thick, red square shaped one.

Now the children, one at a time, draw property blocks and place them in the correct intersection.

If the placement is incorrect, they must pick up the block and wait for a turn the next time around. The child then draws and places one block. If the placement is correct, the second block may be placed.

MATRIX II

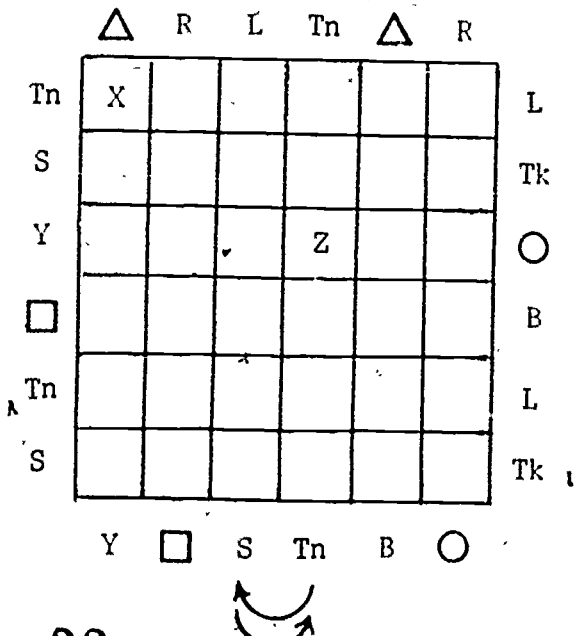
The first player draws a card and a block. The card is placed and the block is held. The second player draws a card and a block, places the card and holds the block. When enough cards have been placed so an intersection is described with a shape, size, color and thickness card, the player, whose turn it is next, may place a block and a card. The child must draw a block and a card each time. He must play the card and may place as many blocks as he can. When both the card sack and the block sack are empty, the first player to place all blocks correctly wins.

MATRIX III

Two teams of 2 players each. Play as in MATRIX II. One player from each team draws cards, the other draws blocks. Placement of the second layer of cards is part of the winning strategy.

MATRIX IV

Several players work cooperatively. First they shake up the cards. Then they place them around the matrix just as they come from the sack. They lay out all the blocks. They then look for intersections labeled with 4 properties. (See X intersection in illustration.) Each time they place one block they may interchange 2 adjacent cards. For example, when they play in the X intersection, they may exchange the small card and the thin card enabling them to play in the Z intersection. The children win if they can place all the pieces. The "game" wins if they can't.



RUMMY, OLD MAID, AND MATCHIT

Make a set of 24 cards from oak tag. Paste a construction paper "block" on each. Vary color, shape and size. Each card will be different. (For OLD MAID, make an extra card with a picture on it.) Four children can play. The cards are mixed and dealt so each child gets 4 cards and the center pile contains 8 cards. For RUMMY, the player draws a card from the pile, lays down, if possible, pairs face up, and discards one card on a discard pile face down. The second player may draw one card from the top of either pile, lay down pairs, and discard. Pairing may be by one property, or 2 properties depending on which rule the children wish to follow. The first player out of cards is the winner.

For OLD MAID, the picture card is added to the deck. All cards are dealt. The first child lays down as many pairs as possible. The second child draws a card from the first child, and then lays down pairs. The game continues until one child is left with the "old maid" card which can't be paired.

For MATCHIT, the cards are dealt as before. The first child places a card face up in the center of the table and describes its properties - "yellow, large, circle." The next player must match one or 2 properties depending on the rule the children decide on. If the player can match, he plays the card. If he can't match, he must draw one from the center pile and let the next child try to match. The winner is the first player out of cards.

If your children develop a new property block game, send us a description. We will print it in the newsletter.

If blocks are accidentally torn they may be repaired by using Duco type cement carefully. Individual replacement blocks are available at 25¢ each postpaid.

FURTHER READING

ESS UNITS, Attribute Games and Problems

Pattern Blocks, Webster, McGraw Hill, 1968.

Mosiac Shapes, Learning Research Assoc. Inc., N.Y. 1970.

MINNEMAST UNITS,

2, Curves and Shapes

3, Describing and Classifying

5, Introducing Measurement

7, Introducing Symmetry

8, Observing Properties

10, Describing Locations

14, Exploring Symmetrical Patterns

Minnemast Project, University of Minnesota, Minneapolis, Minn.

Association of Teachers of Mathematics, Notes on Mathematics in Primary Schools, New York, Cambridge University Press, 1967.

Ranucci, Frnest R. "A Tiny Treasure of Tessellations", the Mathematics Teacher, Volume LXI, No. 2 (Feb. 1968) pp 114-117.

Sharpe, Evelyn, Thinking Can be Childsplay, Avon Paperback, 1969.

Valens, Evans G. The Number of Things: Pythagoras, Geometry and Humming Strings, E. P. Dutton and Co., N.Y. 1964.

Walter, Marion, "Some Mathematical Ideas Involved in the Mirror Cards", The Arithmetic Teacher, (Feb. 1967) pp 115-125.

Weyl, Hermann, Symmetry, Princeton University Press, Princeton N.J 1952.