The Learning Materials Workshop Blocks

An Educational Guide

by George Forman, Ph.D. and Karen Hewitt

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Acknowledgements

Blocks are lifeless objects until they are placed in the hands of children. We would like to thank all the children at Marks Meadow Elementary School (Amherst, MA), Cushman Hill Children's Center (Amherst. MA), the Human Development Laboratory School at the University of Massachusetts at Amherst, the University of Vermont Pre-School (Burlington, VT) and the Veletta School (Reggio Emilia, Italy) and all the other young children who have played with Learning Materials Workshop Blocks over the years. They have helped us see and understand the richness, intelligence and creativity of young minds as they make these objects come alive.

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I. Introduction

Blocks are an integral part of the early childhood curriculum. They are a basic material for a variety of learning encounters. This educational guide examines what young children and observant teachers can learn from block play and extended block activities.

The examples in this book are taken from observations of children ages three through eight years using Learning Materials Workshop Blocks (LMW Blocks) in classroom settings. Although the observations, educational rationale and suggested activities are based on the use of LMW Blocks, the guide has direct implications for other types of blocks found in many early childhood classrooms.

The guide is organized according to educational content rather than by type of block. This organization makes it possible to talk about real examples without being constrained by specific LMW Blocks sets. Appendix B includes separate descriptions and activities related to individual block sets. The reader is encouraged to use this guide as an orientation to the educational value of all the LMW Blocks, to see more and more high level thinking in children whatever set of LMW Blocks they are using.

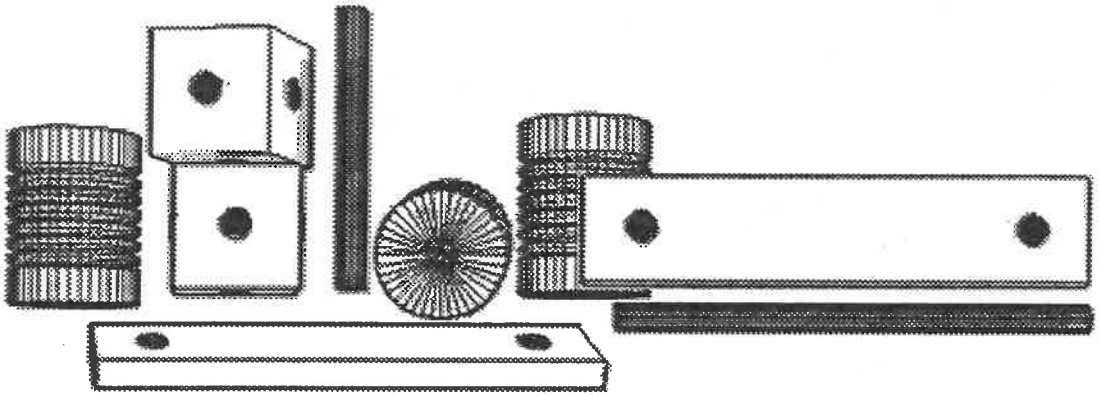
The LMW Blocks were developed by Karen Hewitt over the last ten years. Her background as an artist, an early childhood teacher and toy historian informs the design of these unique materials. The blocks have been used in early childhood classrooms throughout the United States and Europe. Dr. George Forman, Professor of Early Childhood Education at the the University of Massachusetts has been observing young children interact with the LMW Blocks at the Cushman Hill Children's Center, Marks Meadow Elementary School, the Human Development Laboratory School at the University of Massachusetts (all in Amherst, Massachusetts) and at the Veletta School in Reggio Emilia, Italy. Many of these observations were video recorded, and a video tape will be available to use as an accompaniment to this guide.

II. Description of LMW Blocks

The LMW Blocks combine many features that stimulate young children's imagination and help develop basic skills and concepts. They are carefully structured, designed with a variety of colors, sizes and shapes that encourage multi-sensory experiences and fine motor coordination.

The blocks are crafted out of hard wood (maple and birch) that gives an element of weight for ease in balancing. The modular parts have a variety of textures and surfaces (smooth, natural wood, shiny, painted surfaces and bumpy ridges) that are pleasing to touch and grasp. Differences in the wood grain appear on almost every piece. Wood is a "live," natural material that provides additional perceptual stimulation and aesthetic appeal.

The various modular parts are non-representational, non-specific and open-ended, presenting young children with elements to imagine and invent their own structures and designs. LWM Blocks present opportunities for a wide range of learning experiences during both child-initiated and teacher-guided play. Children should be encouraged to play freely with the blocks before any specific teacher-guided learning activities are introduced.

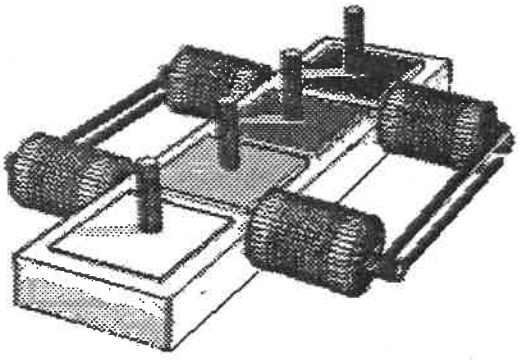


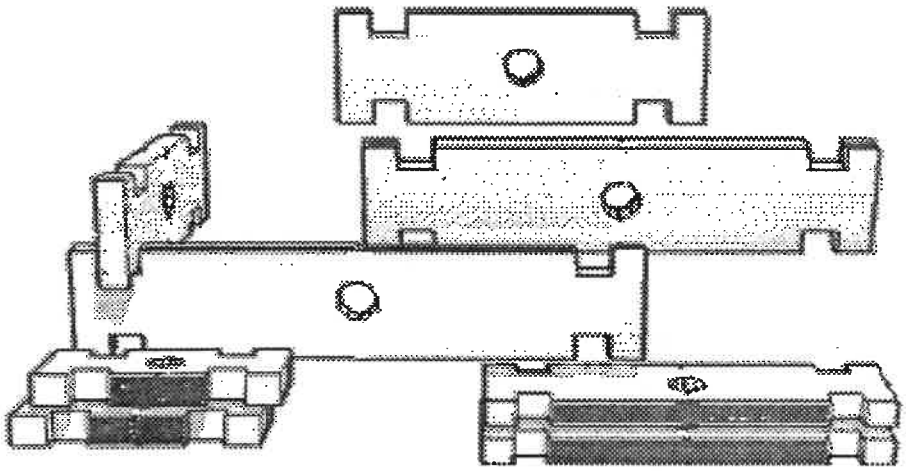
A. Cubes, Bobbins, and Beams

The CUBES, BOBBINS, AND BEAMS have holes into which dowels, of two lengths, may be inserted. These features make it possible to build machine-like structures, with the addition of highly saturated colors and a modern geometric look. With a few rubber bands attached here and there these machines simulate working models of fanciful inventions. [32 pieces]

B. Thingamabobbin

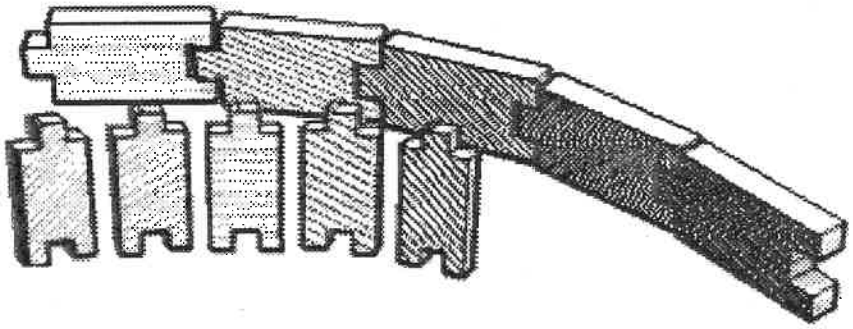
The THINGAMABOBBIN features a sturdy base painted with four squares (red, yellow, blue, green), four round bobbins and six dowels. The various parts provide the possibility of making numerous kinds of structures that are usually anchored to the base. Younger children match and stack color dowels and bobbins while older ones will create cars, gear machines and other imaginative structures. [11 pieces]





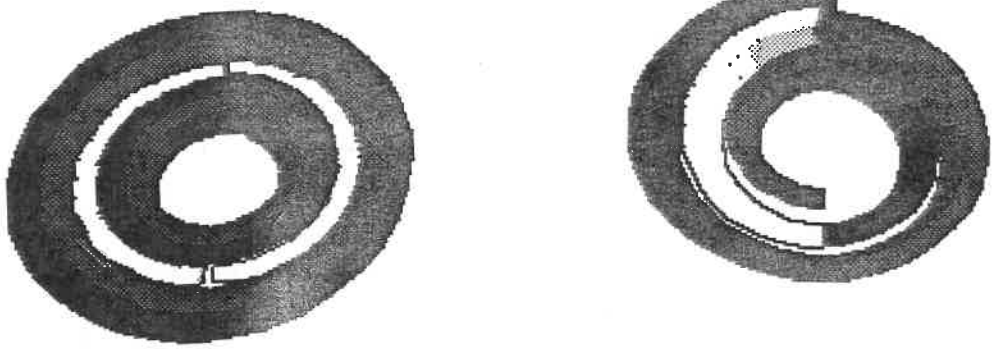
C. Stackbuilder

The STACKBUILDER set, at first glance, looks like the classic Lincoln Logs. However, these blocks take the building-log concept several steps further. The logs are more like slats, thus encouraging children to stack them even without notching them. The colored edges, tips colored on one side, middle colored on the other, orient the children to the possibilities of making variations in their layouts. The slat shape of these blocks also makes the consequence of placing the block flat different from the consequence of placing the block on edge. The stacking slats come in colored pairs: purple, blue, green, yellow, orange, and red. [19 pieces]



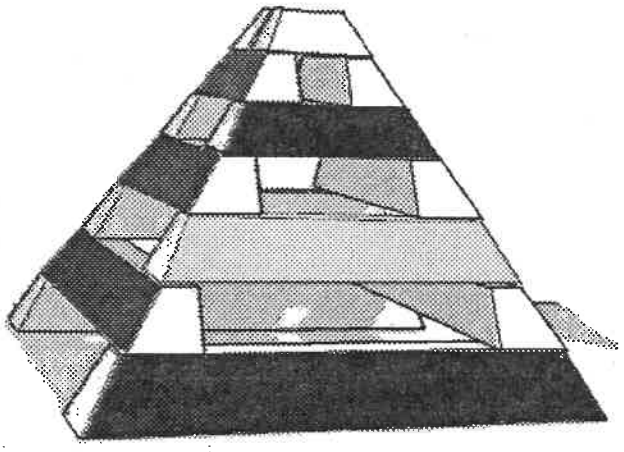
D. Colorframes

COLORFRAMES is a set of forty-two different handcrafted, hardwood, notched modular units painted in forty-two different colors. The units can be organized in numerous ways by using the three different color attributes - hue (red, orange, yellow, green, blue, purple, red-purple); value (from light to dark); and intensity (from the least to the most saturated). [42 pieces plus hardwood tray and color chart]



E. Arcobaleno

The ARCOBALENO means "rainbow" in Italian. It is a unique building set of sculptural blocks. These colorful blocks are each a half circle, but with six different radii. The blocks are beveled, that is, curved inward when you look at them in the tray. The bevel increases the number of aesthetic variations that are possible when the child places the blocks first one way and then another. [12 pieces plus hardwood tray]



F. Pyramid

The PYRAMID blocks are designed not only to make the structure seen in the figure above, but also a hundred other combinations of designs and representations. Similar to ARCOBALENO, this set has blocks that vary in length and are cut on a bias. This crafting of the blocks opens the possibility for discovering progressions not obvious in the shape of a single block. There are fourteen beveled rectangles that decrease in length with only the beveled surface colored. This design feature helps children orient the blocks into designs that take advantage of the cut of each block [14 pieces]

III. Observing Children's Construction: Children Approach Blocks in a Variety of Ways

It is important to observe what children do as opposed to what teachers do with children. To understand children's learning, it is often necessary to step back and watch their spontaneous play and problem-solving.

Children use blocks in a variety of ways:

- to create DESIGNS - arrangements with no particular function.
- to build FUNCTIONAL STRUCTURES - things that move or shelters and enclosures.
- to build REPRESENTATIONS of real objects - sailboats, animals and people.
- to rearrange PATTERNS - recombining a given set of blocks into different arrangements.
- to act out NARRATIVES - using the blocks to tell a story.
- to encounter and solve PROBLEMS.

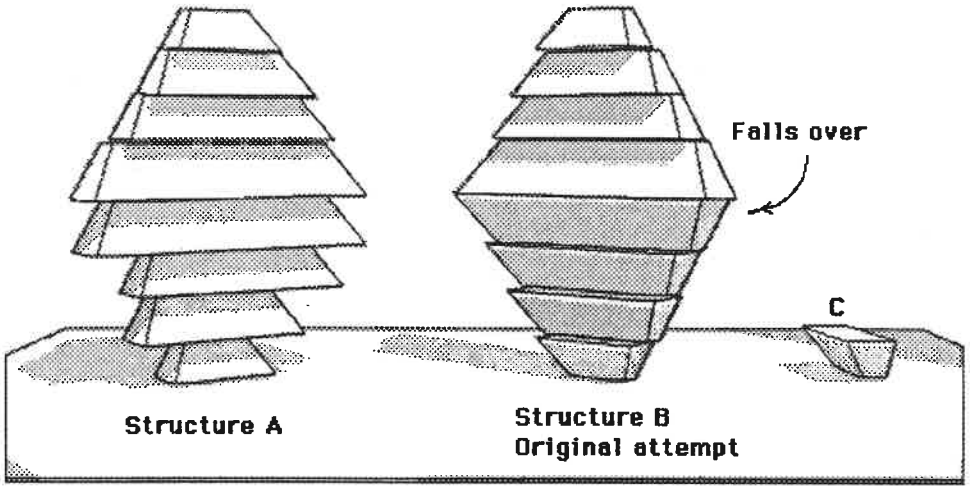
Each of these types of play will be described with some comment on their educational importance.

A. Creating Designs

ARCOBALENO, PYRAMID, AND COLORFRAMES are often chosen by children to create a variety of design ideas.

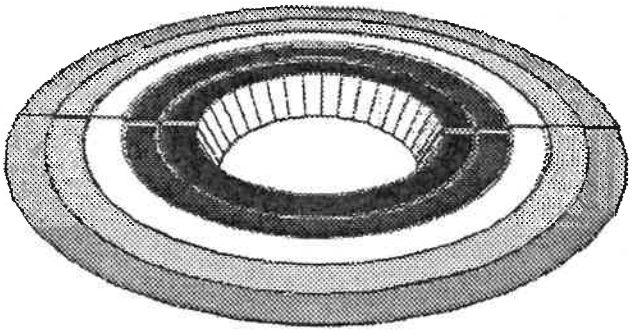
1. Designs with PYRAMID

A design in the vertical plane (e.g. building up from the table) is part object, part design. As an object it holds the interest of something that can be lifted, could fall, can be walked around, and can be part of a theme, such as a building. But Jane (age 6), who designed Structure A on the following page, also was intrigued with the progression of the blocks, both the widening out to the middle height and the tapering in toward the top. These more formal features of the design are an attitude the child has towards the blocks. This attitude, which is one of studying progressions, symmetries, and balance, are fundamental to the development of logic and math.



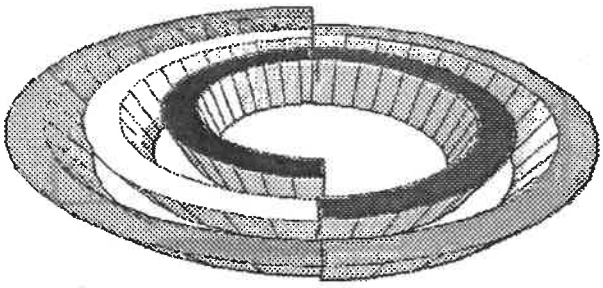
The constraints of the physical world also entered into her decisions. Note that to make the structure stand, she could not use her original idea, which was to make Structure B above. This structure does not balance because the base edge of the bottom three blocks is too narrow (see side view of single block on the right). Therefore she had to invert the bottom three blocks as in Structure A, and when she did this she was intrigued with the way that the bottom three blocks tapered inward per individual block while tapering outward as a group.

"Oh, I made something like a tree," she said. This somewhat paradoxical progression resulted from the interaction of her interest in a progression and the physical demands of balancing a vertical structure.



2. Designs with ARCOBALENO

Most children, who first use ARCOBALENO, will simply try to put it back together, curves up, flat on the table. (See figure above.) They are treating ARCOBALENO as a jigsaw puzzle; that is, they are interested in making the pieces fit into a whole object again.



The design in this figure. demonstrates that the child has gone beyond the basic approach of mending "broken" wholes.

The curves of ARCOBALENO in the horizontal plane become arches when oriented in the vertical plane. But the arches are not the familiar two vertical columns supporting a bridge. The ARCOBALENO arches are preformed and self-sustaining. Thus the children do not "read" these arches as a door or window in a taller wall. Rather they more likely place the other curves nested underneath each other or side by side. This latter placement yields several types of tunnels, as you will see later.

Here is an observation of Andy, age 5, who tried to design a bridge across two ARCOBALENO curves. This objective presented him with a problem to solve. First he placed the two red curves facing the same direction, about three inches apart (Figure A).

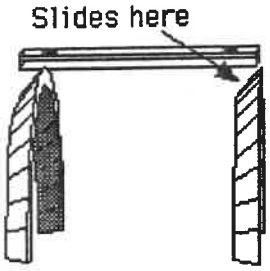


Figure A

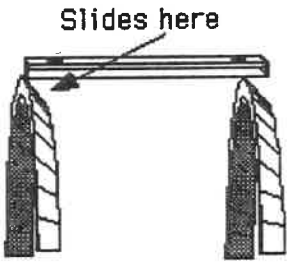


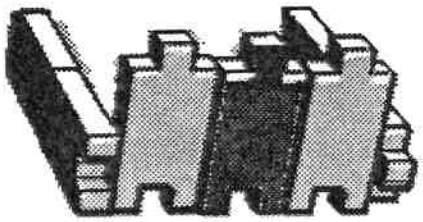
Figure B

Figure C

The bias of the curve on the right (in Figure A) made the bridge slide down. This happened several times before the child began to experiment with the orientation of the two arches. He seems to cling to the rule that both arches must be faced the same direction. Therefore he changes the arches from both slanting down to the left (as in Figure A) to both arches slanting down to the right (as in Figure B). Then in a break with the "same direction" rule, he figures that the two arches should have their larger edges face as in Figure C. This works and he is satisfied.

This problem, as small as it is, highlights an important principle about the design of the LMW Blocks. By making the blocks asymmetrical, children frequently will have to think more clearly about the orientation and placement of their blocks. Blocks, such as Unit Blocks, are basically rectilinear. This means that one side of the block often serves an objective as well as any one of three other sides of the block. This is not true for many of the LMW Blocks, as you have just seen above. Certainly there are advantages to both types of blocks, but it is important to be aware of the challenges and givens of the set of blocks with which you work.

3. Designs with COLORFRAMES



The design work with the COLORFRAMES occurs primarily when children attend to the color variations on the blocks. The COLORFRAMES are often laid out in a two-dimensional pattern as "a nice floor" or as walls for a three-dimensional house. The children's interest is focused on the choice of color rather than on questions of structure. Often you will observe a child searching for a specific color block among a large array of color choices. Some children will alternate the design with the COLORFRAMES laying flat and on their side. Children prefer to have the "color side" appear on top rather than the natural wood side. If you point out the variation of the patterns on the wood some children will incorporate this "guided discovery" in their own designs.

B. Building Functional Structures

1. Structures with CUBES BOBBINS BEAMS

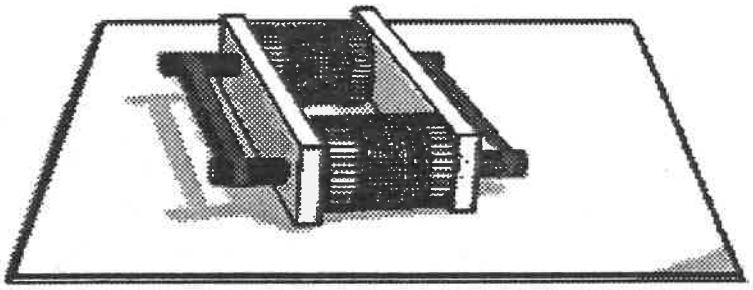
The blocks in CUBES BOBBINS BEAMS have an industrial look and provoke children to make functional structures more than visual designs. The BOBBINS are actually modeled from real bobbins in the spinning industry. The holes in the BEAMS and CUBES are similar to the nuts and parts that go on bolts, represented by the DOWELS. Children attempt to make "working" models of fanciful machines. The rubber bands serve to hold their assemblies together and even provide the spring for machine action.

We have found that the children are more animated when working with CUBES, BOBBINS, AND BEAMS. The children will make vehicles, and vehicles call for movement, and movement calls for social interaction. The vehicles, as you might have guessed, sometimes have things sticking out of them, looking all too much like guns and cannons. You

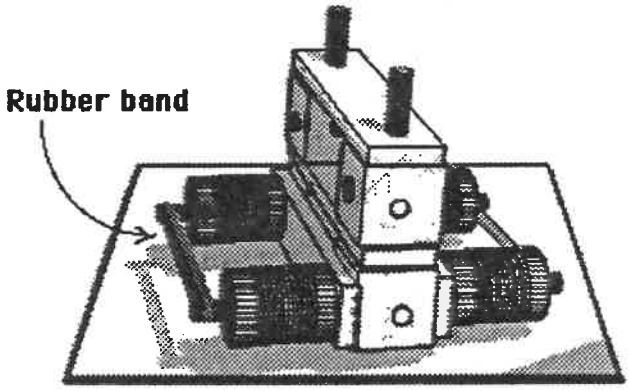
have to decide yourself about aggressive play and super-hero play, but on the plus side, children do make some wonderfully intricate machines when motivated by socio-drama.

Tommy, age 5, is motivated to build some sort of vehicle that rolls on

Tommy, Age: 5



the BOBBINS. This goal has several components. First he has to make some sort of chassis, a frame to keep the wheels together in a working assembly. Second, he has to figure out how to use the DOWELS in the double roll of an axle and as a component of the chassis.

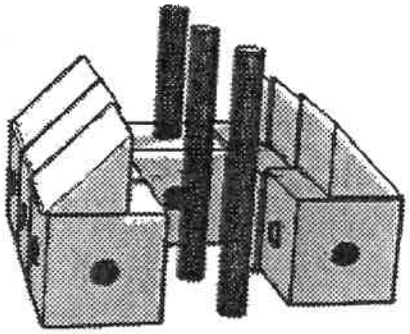


Ann, Age: 6

If the child wants anything more than a flat-bed vehicle (as did Ann, age 6), she has to invent some system for attaching the upper components of the vehicle onto the chassis. And if this is not enough, she also has to figure how to make the whole system stay together so it can be treated as a moving vehicle and rolled along the floor or table with great abandon.

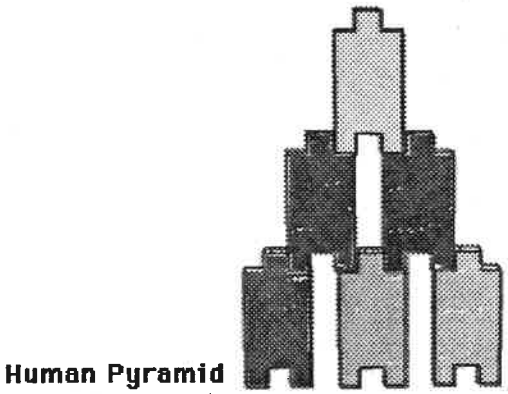
2. Structures with PRISMS, CUBES and DOWELS

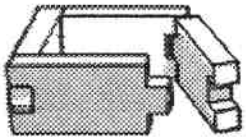
When these three block-types are combined, children often make little villages and other structures that contain or direct the flow of other objects, like small cars, animals, and miniature people. The PRISMS are treated as a roof peak here and tower crown there. The CUBES are rooms with built in windows. The DOWELS are smokestacks, chimneys, logs for a bridge, telephone poles, and even highway curbing. The children attend to the shape of the block as an indicator of its function: the hole to see through, the height of the chimney to get the smoke up and away, the rounded curb as better than a sharp corner, and the pitch of the roof so rain and snow will roll off the house.

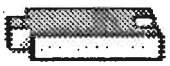


3. Structures with COLORFRAMES

Children use COLORFRAMES as interconnecting links in an enclosure or length of road. The structure is built and then something is done with the structure: e.g. a car is driven along the road or a toy person works inside a pretend kitchen. The COLORFRAME is read as a hinged door that can swing open, as a boat with a notch for a paddle wheel, or as human pyramid of pieces standing on shoulders beneath.



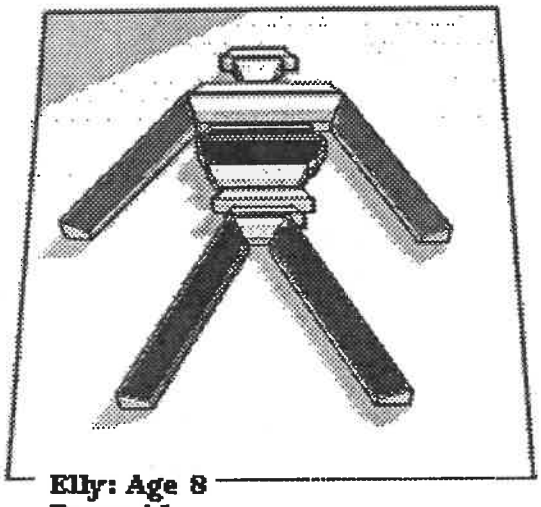




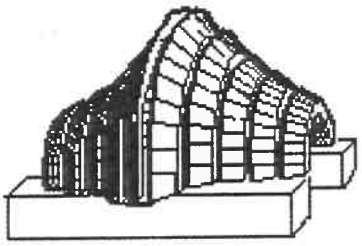
Note that the layout of the blocks in this section was driven by the child's concern for how things work, the relation between shape and function. In the section on design we saw a different attitude toward laying out the blocks, strictly the composition of blocks to other blocks. In the next section we will discuss yet a third force that drives the layout of the LMW Blocks, the visual correspondence between the blocks layout and some real object.

C. Making Representations of Real Objects

The entire line of blocks, when combined, offer unlimited opportunity for the children interested in rendering likeness. Some of the individual LMW Block sets have the cut and color of mosaic tile. The PYRAMID blocks are a good example. Children can make colorful boats, airplanes, and furniture with these blocks CUBES BOBBINS BEAMS also lend themselves to representations of real objects, like cars, robots, counter top appliances, and industrial devices.



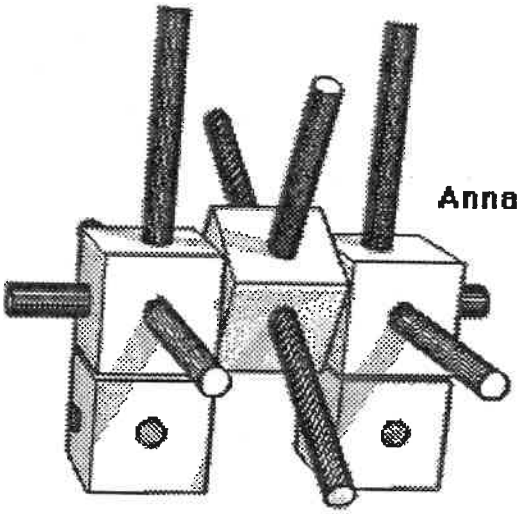
Elly: Age 8
Pyramid



Jenny: Age 7
Arcobaleno

Observation:

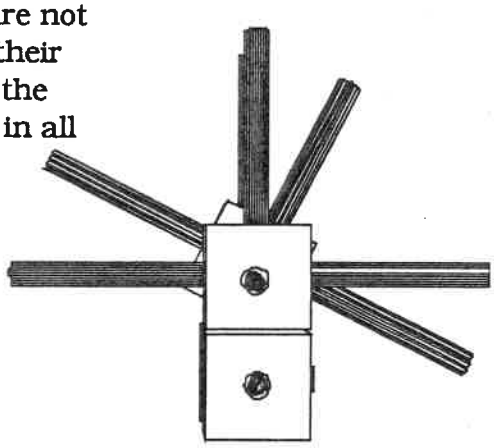
A group of seven-year-olds were using the LMW Blocks to play a block version of Pictionary™. The children have cards that have object words printed on one side. These object names are reasonable choices for rendering using the blocks. Anna received a card containing the word "porcupine." This is what she made, using the CUBES and DOWELS.



Anna, Age: 7

The educational significance of this game can be revealed by looking at the decisions that Anna had to make to produce this representation. It was obvious to Anna, but not necessarily to a younger child, that the representation would not look literally like a porcupine. So her first decision was to discover an essence of the porcupine that could somehow be rendered in the blocks. Porcupines are brownish grey, they ball themselves up when frightened, they have quills, they have beady little eyes, they waddle when they walk, and they forage at night. Anna knew that her medium was blocks, so she thought about color and shape. Had Anna been asked to mimic the animal, as in a charade game, she would have chosen some other essence, such as the porcupine's waddle or rolling up into a ball. Anna is making critical decisions about the relation between a referent (the real porcupine), the medium (the blocks scattered in front of her) and the symbol (the arrangement of the blocks).

The most quill-like items in the LMW Blocks are the short DOWELS. The DOWELS are not pointed like real quills, so she relies on their length, the way they are separated, and the way that they radiate out from the body in all directions. Anna has also deliberately **twisted** the middle section of quills. She did this to break up the alignment of the DOWELS. Anna felt that the irregular DOWELS would look less like some type of machine.



Anna's representation also required

solutions to some interesting physical problems. The mid-section of the body kept falling between the feet until Anna discovered how to use one of the longest DOWELS to connect all three of the CUBES making the torso. She also decided to treat part of this dowel as part of her symbol. The front end was the porcupine's nose, the back end its tail. Anna should be given extra credit here for using a dowel both to solve a physical problem (support) and to solve a representational problem (the nose and tail). The representation of real objects with the LMW Blocks present children with interesting challenges that have great educational value.

D. Rearranging Patterns

1. Patterns with ARCOBALENO

At times, children seem to be intrigued not with a particular structure, but with how that structure can be changed. A child may place four CUBES in a tower, then take them down in order to make a row with them, then convert that row into a 2 x 2 matrix. When children do these permutations, let them continue as much as possible. These combinations and recombinations of geometric blocks embody important relations that the child will later understand on a more abstract level.

Observation:

Christine, a five year old, works with the ARCOBALENO for over twenty minutes. She first uses ARCOBALENO to make the nested bowl (larger edges up). She makes this by placing the two smallest (blue) curves together, then around those she places the two green curves, and so forth. What is interesting here is the way she pairs the blocks to make the structure. She uses this pairing strategy in the other rearrangements also. Next she takes the whole nested bowl and splits it in half into two rainbows. Therefore, what she has constructed as a series of pairs can now be split into two halves.

Figure A

For some reason, she now places the smallest curve on edge, making a vertical arch. She starts to place the green arch directly over the blue arch, but decides instead to place the second blue arch next to the first with the largest sides facing in. This makes a tunnel effect using one pair of blocks as a peaked arch. At this point she now has her rule of

construction intact. She continues this rule until all blocks have been placed, pair by pair, to make a tunnel that goes from blue (smallest) to red (largest). At this point she lowers her head to peer through the completed seriated tunnel of peaked arches.

Figure B

Now an amazing variation takes place. After placing all of the curves back in the wooden container, she takes them out again, to build the same series. She has arranged the set of curves into two rainbows, flat on the table. She picks up one half-set (no two colors or sizes the same), and begins to lay out the graduated tunnel again. But she understands that she must leave a space between each block because the second set will have to intersect the first.

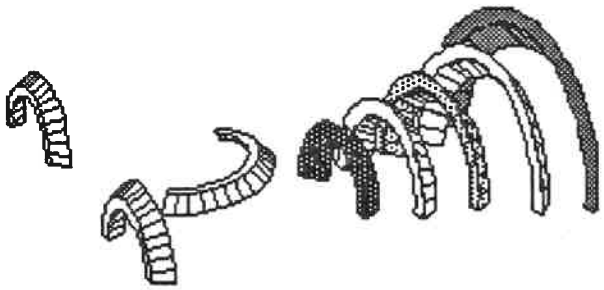


Figure C

So, after placing red, orange, yellow, green, blue from the first set (Figure C); she comes back and places red, orange, yellow, green, and blue from the second set in between each of the previously placed blocks, again yielding the tunnel of peaked arches shown in Figure B. Christine had internalized her rule of construction so well that she knew exactly where to leave the spaces in the first series. Remember, she had built this series the first time by pairing identical curves face to face. Thus we see that Christine understands this seriation rule independent of some rote method for constructing it.

But Christine does not stop here! She continues to amaze us with the general nature of this seriation rule. She disassembles her tunnel by taking away the two blue curves. She uses these two curves to make a bowl-like circle. Then she takes away the two greens and makes another bowl-like circle and moves this circle adjacent to the

first. This process is continued until Christine has constructed a row of five bowl-like circles seriated from smallest to largest (Figure D). She is careful to both place the two curves together to make a well-formed circle and to place the circle in the row of smaller circles to make a well aligned row.

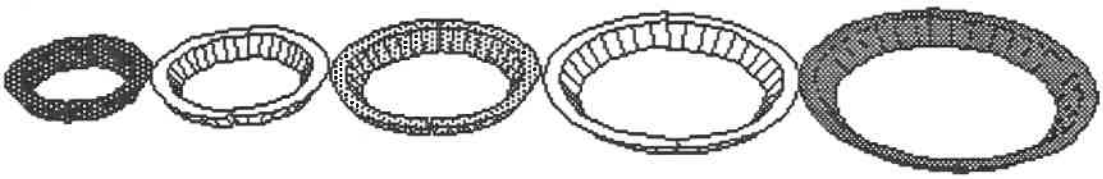


Figure D

She quickly reconstructs the tunnel that began her play, with each pair of curves making the familiar peaked arch (largest edges abutting in the pair). Then by design she inverts the red pair, making the two curve arch look like a grooved arch. She then inverts each remaining pair in turn, which makes a comment on the pair variation without changing the overall theme of making a seriated, grooved arch tunnel (Figure E).

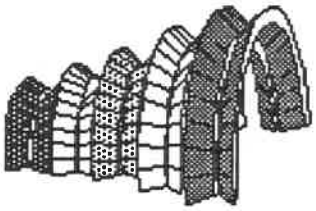


Figure E

She smiles at her newest variation and confirms its wholeness by bending her head down and looking through the length of the tunnel. She continues her play for another five to six minutes, but she seems to search for some new organizing rule that she never finds. Beyond this point in time, her play deals more with matching edges with blocks stacked instead of on-end as in the tunnel. Eventually she slips into symbolic role play with the blocks becoming an enclosed structure only, instead of a set of blocks to pace through variations.

This detailed observation is important for understanding the value of block play. The example is not infrequent among task- oriented children and shows an understanding of how children learn mathematical relations. Take for example the separation of the seriation rule from the method of producing that series, first with pairs, then with each subset in turn. Here Christine is consolidating her understanding that a relationship is more than a particular act or a particular memory of a past action. The action bows to the rule. The physical acts change across

block constructions, but they still serve that same rule. This is the essence of math, in that math is a system of relations and is not a list of remembered actions such as repeatedly "taking away an apple from a bushel of apples." She is doing more than *generalizing* across several physical acts, she is *inventing* new acts because she knows in advance that these new acts will also yield the seriated product that she desires. In this latter sense, the block play embodies the rule but is not the rule. The rule is more abstract than some aspect of a previously remembered action.

E. Acting Out Narratives

The LMW Blocks can be memory "place holders" for children telling a story. The blocks remind them of what they want to say. The blocks also stimulate new ideas. The spatial layout of the blocks can be "read" as a path through a story line. The blocks are changed, the story line changes. The story line changes, the blocks are changed to fit. The two-way interaction between building a block structure (a physical activity) and building a story (a narrative activity) is as fascinating as watching a novelist at work.

Observation:

Three seven year old boys used the PLAYFRAME set of LMW Blocks. The boys, somewhat under the leadership of Andrew, have decided to build a baseball stadium. The story deals with the preparation for the game.

Andrew: "This, all of this, is the baseball stadium" (Enclosure made with BEAMS, CUBES, AND DOWELS.)

Tim: "I'll build the hot dog stand." (Puts annex on Andrew's stadium.)

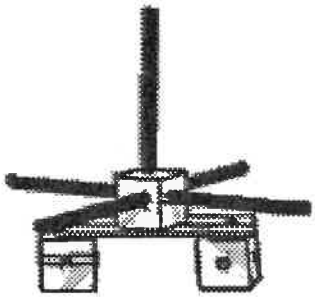
Matt: "I am making a pitching machine." (Uses CUBES AND DOWELS.)

Andrew: "When the stadium fills up, the ball players will come out here." (Small space between two CUBES.)

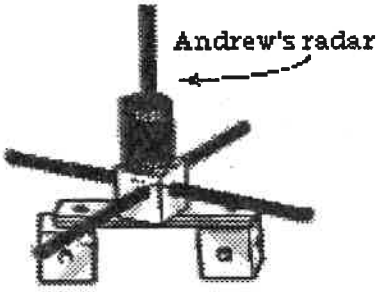
Matt: "My pitching machine will get the batters ready before the game starts."

Andrew: "Here let's add this. It's radar. It tells you how fast the ball comes out of the machine. (Matt accepts this addition of the BOBBIN that Andrew slips on a vertical DOWEL.) Now, the batter that hits the fast ball will be first when the game starts."

Tim: "Look at the locker room that I built. Hey, Andrew, see my locker room." (Made with COLORFRAME blocks.)



Matt's pitching machine



Andrew: "The people are starting to come in the stadium. We better make the gates bigger."

Matt: "Bigger, bigger. There's a big crowd. This is the game of the century."

Tim: "What can this be?" (Refering to a small horizontal square enclosure of COLORFRAMES.)

Matt: "The restroom."

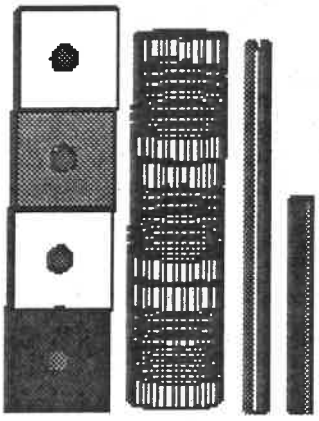
Andrew: "No, that's the place where you buy popcorn and soda and beer."

Features of this observation reveal its educational significance. First one can notice how Matt and Andrew are developing a story, while Tim is more interested in naming his objects. Tim's purpose seems more social than architectural. Andrew really uses the block structure as a visual anchor for a sequence of imagined events (e.g. small stadium, large crowd, enlarge stadium). To Andrew the blocks are seen within a field of movement, not just blocks as a static design. And Matt is a weaver of tales (e.g. "game of the century"). The blocks are a perfect medium for all three cognitive styles.

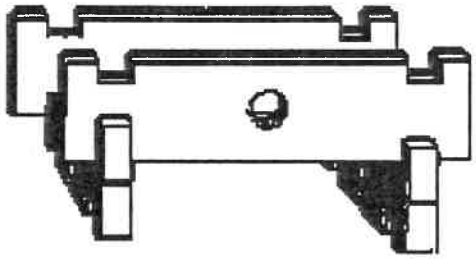
F. Encountering and Solving Problems

The LMW Blocks are unique enough to focus on individual blocks and block combinations that yield interesting problems of construction and design. This discussion is parallel to what one often finds in other books on block building, such as the difficulty children have when trying to build an arch, or why is it that children usually build towers before they build roads. With the LMW Blocks, children have similar discoveries, such as:

Does a stack of BOBBINS (or CUBES) have a dowel inside or not? (An interesting problem of judging distance.)

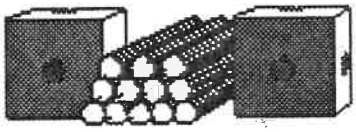


With STACKBUILDER there are no four blocks the same length, so squares are not possible. What other types of enclosures are possible? (An interesting problem of planning wholes from available parts.)



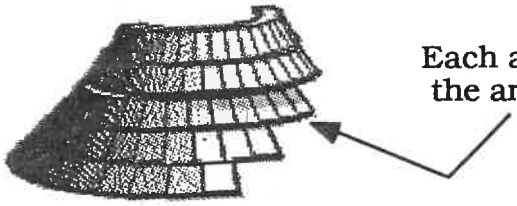
There are several other interesting problems. Look for them as children build with the LMW Blocks. These problems generally deal with some principle of balance, counterforce, distance judgments, and support. The examples include a brief reference to the general problem the child faced. Children are quite inventive in their solutions. Some of the solutions are elegantly simple while others are overkill. In either case, the problems are wonderful learning encounters

Dowels roll outwards.

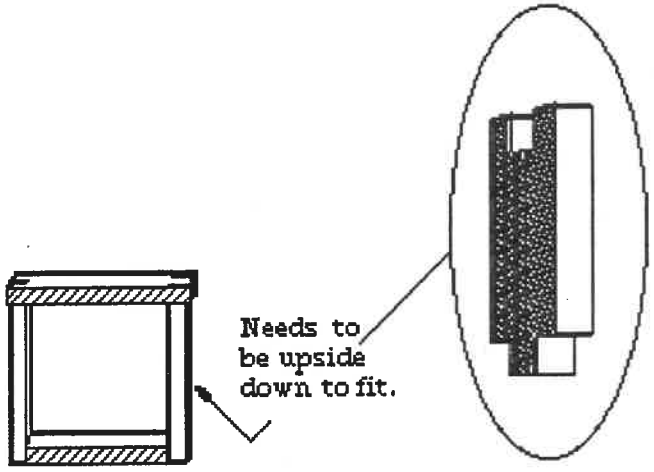


Child solves by inventing "bookends."

"How do I stack a pyramid of dowels. They keep rolling apart?" This problem requires children to think about counter-force. The friction of the flat surface of the cube serves as a counter-force to the rolling surfaces of the DOWELS.

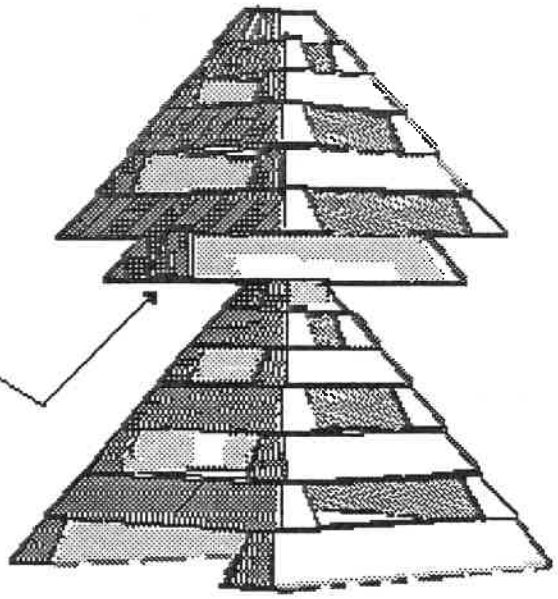


"How did you do that? It looks like it should fall over!"
Sometimes it is useful to make a structure that challenges the child's ideas about what is possible. Here the weight of each arch counterbalances the arch underneath, as long as more than about two thirds of the arch is resting on the one below. It is the cumulative effect of these supporting arches that make it look like it defies gravity. But then this same cantilever principle is involved in the spiral staircases seen in grand homes and buildings. Once the children see this structure, they will try to recreate it, and during their trials and errors they will learn a great deal about cantilevered arches.



"I can't get this block in here to make the window. That little top piece is in the way."
It is surprisingly difficult for children to see that a solution is as simple as rotating a block. The difficulty for this problem comes from the children's assumptions about the orientation of the COLORFRAMES. They invariably think that the COLORFRAMES should rest on the two "feet" with the "head" part at the top. In order to solve the "window" problem, the children must override their initial assumption about orientation and turn the COLORFRAME on its head. This problem is a good example of creative problem-solving, which itself always depends on a certain amount of mental flexibility.

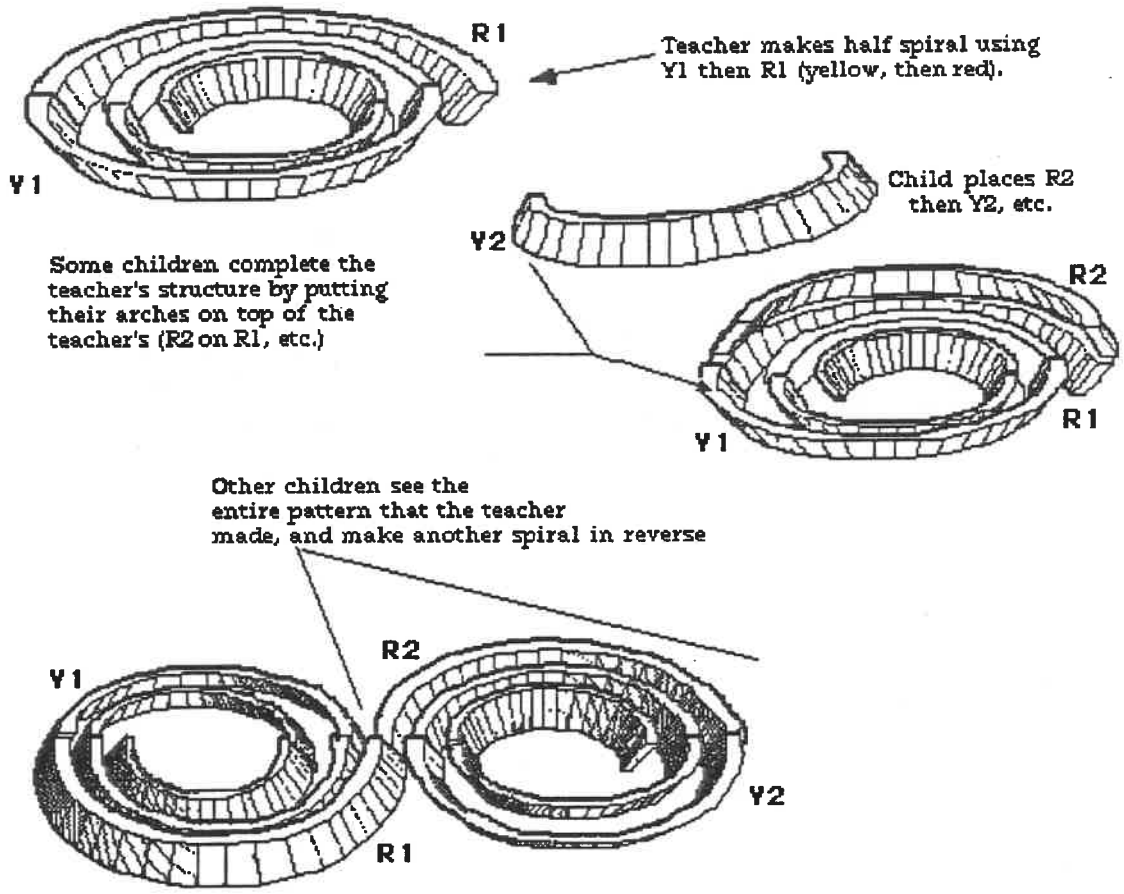
Two pyramid blocks pushed together, balanced on apex of bottom pyramid, and used as beam to support the upper pyramid structure.



Matt and John: Age 7

"We finally figured out how to balance the top pyramid on top of the bottom pyramid."
Look at the incredible solution that these seven year old children invented. The base of the bottom pyramid is a square, the usual base and a shape that is repeated at each higher tier of that pyramid. But how do you get a square base of a new pyramid to rest on top of the small apex of the first pyramid? The solution calls for the recognition that the base of the upper pyramid must be both **small** (to rest on the apex) and **large** (to support the upper pyramid). These children split the difference and made the base of the upper pyramid small in one dimension (pushed the parallel blocks together) yet large in the other dimension, the length of the blocks. This length of the large blocks made it possible for the children to put the next level of blocks far enough apart to continue the pyramid structure using diminishing squares. This problem involves a type of minimum-maximum reconciliation that is definitely pre-mathematical in in its mental structure.

"The teacher asked me to finish what she started. What is it that I am looking at and where should I put the next blocks?"
Asking a child to finish a block structure gives the teacher a "window" to the child's mind. Whenever a child completes something, the child has to interpret the structure as a part of some larger whole. But there are many different "wholes" that can be the completion of a given structure. On the facing page, there are two interpretations of the teacher's structure. This kindergarten teacher has made a half spiral ending with Y1



and then R1. The first child attends mostly to the last action the teacher did, namely, placing R1. So he simply takes an identical block, R2 and places it on top of R1. And so on until the teacher's structure is covered. It would be an overstatement to say that this child has made another spiral. The spiral is an accident of the child's attempt to cover each of the teacher's blocks by matching the edges of individual blocks. The second child, on the other hand, has taken a mental step back, interpreted the teacher's structure as a spiral, and then uses that interpretation as a guide for making another spiral in reverse. Such are the differences in block building, one a more **local**, individual-block approach and the other more **holistic**, block-pattern approach These differences are clues to a child's developmental level.

IV. Teaching Styles: Interacting with Children in a Variety of Ways

If the LMW Blocks are used in more structured situations, it is important to consider various teaching styles. We will discuss three that differ in the type of intervention.

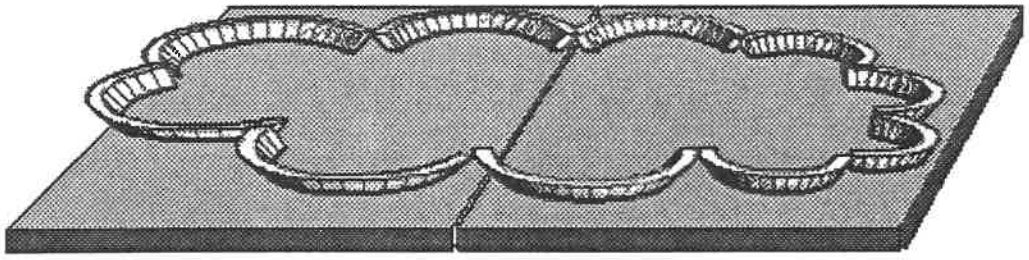
The teacher who assumes a *supporting* role will spend more time observing the child, but the teacher is not completely passive. The teacher will move in occasionally to support the play and to occasionally clarify a challenge that has emerged during the learning encounter. As a second style, teachers may provide the children with a hint or aid to further them toward their self set goals. This *assisting* role offers the child a place to begin, but the goal still emerges from the child's own intentions. Finally, the teacher may decide that the LMW Blocks can be used to work on skills for a particular week. In this situation, the teacher will assume a more *guiding* role and offer the children particular problems to solve or games to play. It is understood that during a single session the teacher will use a combination of some or all of these roles as the need arises.

A. The Supporting Role: Facilitating the Play

The supportive role of teaching is most possible when the teacher or teacher's aide can focus on the spontaneous actions of a small group of children. The teacher observes. She thinks about the goals the children have set for themselves. She thinks about the means for reaching that goal. Some are the means that the children are using, others the children have not yet invented. The teacher anticipates needs. Here is an actual case example.

Observation:

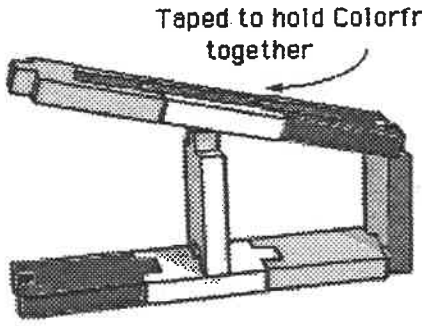
Four girls, age seven, are busily building a swimming pool using ARCOBALENO, COLORFRAMES, and assorted STACKBUILDER blocks. At one point Holly says to Mary Ann, "Let's make the pool bigger." Some of the blocks have fallen to the floor. The teacher notices that these are the remaining ARCOBALENO blocks, so she quietly places them on the table within reach of the two girls. Holly adds these blocks, but feels a need to place them in pairs, red next to red, blue next to blue. The pool grows, and the play continues, but it almost ends in frustration because the structures get too large for the small table. The teacher casually moves a second table to abut the first, thereby making the building area larger and saving the day.



A third girl, Naomi, decides to add a diving board to the swimming pool. She tries and tries to use COLORFRAMES blocks to make this board, but she can not attain the desired angle with the blocks as they are. Jennifer, the fourth girl, suggests that Naomi use a CUBE on the back end of the diving board (as a counterweight).

"But then it won't look like a diving board, " protests Naomi. The teacher then intervenes by saying that Naomi is allowed to use things from the crafts area if she thinks that would help.

"I know, I'll tape the blocks together." She goes to the crafts area to retrieve the masking tape, builds her diving board at the desired angle and is satisfied that it still looks pretty much as she wishes.



The teacher was supportive by opening opportunities for Naomi to use materials from elsewhere in the classroom. When asked about the tape across the tops of the blocks (its symbolic status), Naomi informs her peers that "Oh, that's so they won't slip when they run (i.e. the diving board mat).

Let's back away from the teacher's role issue for a moment and discuss why this encounter was worth supporting in the first place. What are the children learning? Look again at the figure above that shows the swimming pool made of ARCOBALENO curves. The girls have for some days used these curves only to make perfect circles, or a tunnel of arches. The idea of a swimming pool broke away from the idea of making perfect circles. With this structure, the girls understood by changing the angle of curve to curve, they could make an enclosure that was bigger than any two curves matched together. The structure plays out an important relation, that two "halves" can become smaller fractions in some larger whole. We are not speaking mathematically in the strict sense, but these structures do embody the qualitative relations (more, less, bigger, smaller within larger) that are fundamental to understanding quantitative relations. Look closely at how Holly feels compelled to keep mates together. The two halves are still halves if you consider their qualities (both red, both

semi-circles), even though the overall objective of making the pool treats the individual pieces as less than half of the pool. The possibility that these children are exploring the relative nature of a fraction, like one-half, is reason enough to support the play.

Look at Naomi's diving board. Recall that she could not get her board to maintain her desired angle without the help of masking tape. But the tape was clearly an expedient to the physical requirement of linking the blocks together. The tape had come from outside the pool of items the girls had accepted as miniature objects. When asked about this, she cleverly reframed the tape from tape-as-adhesive to tape-as-safety mat. The symbolic play gave Naomi an opportunity to engage in this type of mental flexibility. *These are the things of which effective problem-solving is made.*

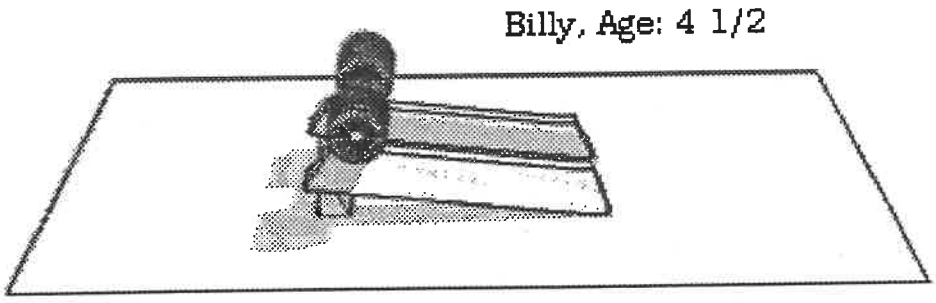
B. The Assisting Role: Offering a Means

Sometimes a child will misjudge her own capabilities. At such a time the child is headed for frustration, particular if the child has a history of task persistence. Teachers should use their clinical judgment, which will sometimes call for teacher intervention. Rather than watch a child get farther and farther from the goal or get so emotional that clear thinking is suppressed, the teacher should offer the child some helpful hints. A helpful hint says several things to the child. First it says, "I am sensitive enough to know that you are having trouble." Second it says, "You do not have to prove anything to me by solving this problem without any help." And third it says, "Let's look at this problem in a different way."

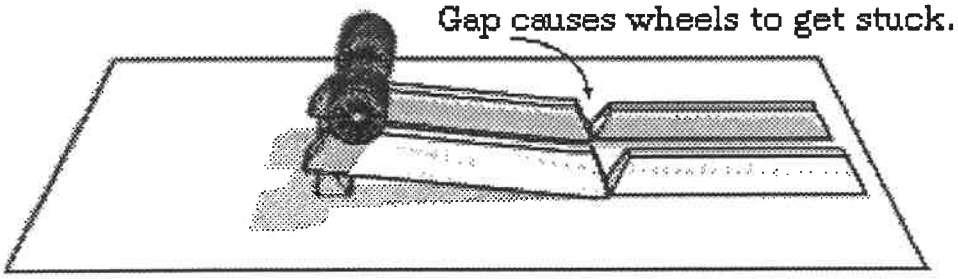
Offering a means that is not also a solution requires all the teacher's intelligence. And offering a means in a manner that the child can accept without feeling criticized or embarrassed, requires all the teacher's wisdom.

Observation:

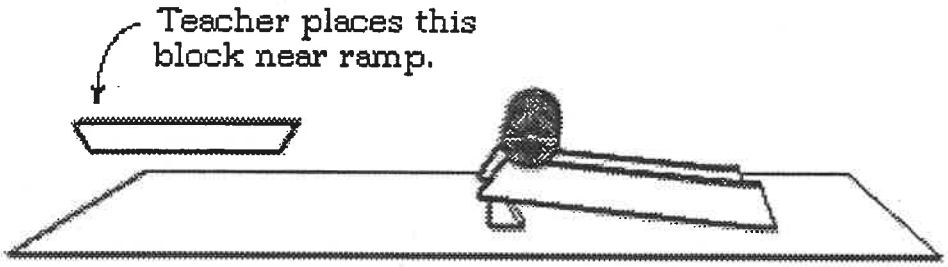
Billy, age 4 1/2, decided to build a ramp for a wheel and axle made from two BOBBINS and a long dowel. He got the idea from watching another child using the wedge from the Units Blocks set in the classroom. But the LMW Blocks do not have a wedge, so he had to prop up one end of two PYRAMID blocks to make an incline, as in the picture on the next page.

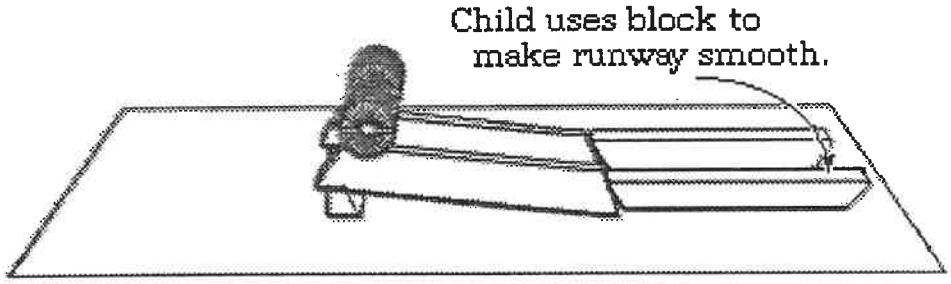


He wanted to roll the wheels a longer distance than the length of one parallel pair of PYRAMID blocks, so he added another pair (orange) to extend the length. But he ran into the problem that the extension created a gap in which the wheels would get stuck. He kept rolling the wheels; he did even try another pair of PYRAMID blocks. Unfortunately he would not think to invert the blocks to create a smooth rail from the ramp.



As the teacher observed this child's frustration she decided simply to place near the ramp a single orange PYRAMID block inverted (see figure below). After one more failed attempt the boy saw the block, read its implications for his problem, and added it to the ramp yielding the smooth railing. (See figure on the following page.)





This example demonstrates the subtle difference between giving the child the solution and giving the child better access to a means. The teacher placed the reoriented block near the ramp, but not joining the ramp. The child could have easily taken that block and oriented it as all his previous attempts, thereby reconstructing the troublesome gap. But this child sensed that the teacher's block was a message of some sort, so he thought about that block enough to understand the implication of the inverted orientation. Since the child could take it or leave it, this method does not carry the criticism implied when a teacher solves the problem for the child.

C. The Guiding Role: Suggesting a Goal

This role is the most controversial, because in it we feel both good and bad. We feel good that we are clearly instructing the children, but we feel uncertain about the quality of the learning by children taught in this manner. The down side of this controversy can be reduced. You should be confident that the goals you choose are developmentally appropriate and that the children have sufficient latitude in how to reach those goals.

Teachers can guide children in several ways:

- Pose a problem
- Parallel play
- Set up structures in advance
- Make a prepared terrain

1. Pose a problem

Example: Ages 4 - 6 years

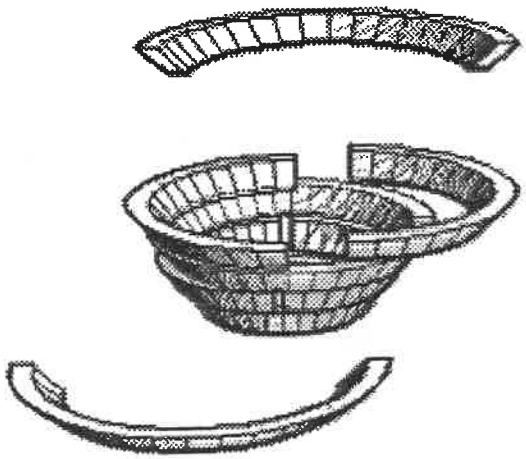
Give the children ten pieces from the COLORFRAME set. Ask them to make the best circle they can with these pieces. Emphasize that a good circle is closed at the joints and is as smooth as possible. Lay the pieces out flat. Most children will begin working on this task with the pieces flat. But this approach creates a problem in that the notch and groove either constrains the angle from block to block, or makes it necessary to

separate adjacent blocks to the point of not looking very smooth. A more flexible structure can be made by placing the COLORFRAME pieces on edge, thereby allowing the notch and grove to pivot freely like a hinge. The task encourages children to overcome the givens of the task, that the blocks are presented flat on the table. Thus, here is a small game in creative thinking.

The alert teacher will be able to embed this task in some on-going play that the children have begun. It could happen that the children are making long flat roads with COLOR-FRAMES for cars.

As a simple request you can ask: "Can you make a circle for the race track? Here, we must use only these (ten) and the cars need to have the track a smooth curve."

If children are working in small groups, all the better. This way, a child who is watching and is less ego-involved in a particular solution, is likely to say, "That isn't very smooth," and may have the psychological distance from that block structure to think of an alternative approach.



Example: 6 - 8 year olds

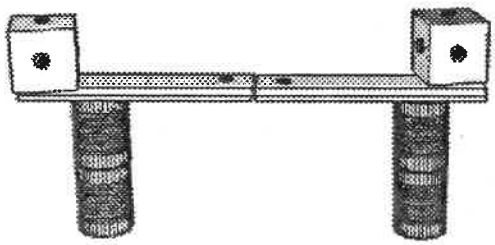
If you have observed primary-grade children trying to build the bowl-like stack with ARCOBALENO, there is no harm in asking a new group of children to solve this rather interesting problem. There are some interesting problems of counterbalance weighting to be discovered. The arches need to alternate, as in the figure to the left.

2. Parallel Play

One of the most natural ways to offer suggestions to a group of children is to become, momentarily, a member of the group. If the child builds the cone-like stack with ARCOBALENO, you could build the bowl-like stack. If the children are working on the nested circles with ARCO-BALENO, the teacher can make the bowl-like spiral. If the children have made the bowl-like spiral, the teacher can make the cone-like spiral. If the children have made a road with the COLORFRAMES, the teacher makes a road with COLORFRAMES, but makes the colors graduate from one hue to the next.

3. Set up Structures in Advance

The guiding role can happen even before the children enter the blocks area of the classroom. The teacher can set up interesting structures in advance. These structures serve as suggestions and catalysts for a greater range of experimentation by the children. The model does not give away the lessons to be learned. The model only establishes the fact that a structure can be done. The analytical thinking that the child must perform, even when trying to duplicate the structure, is an important part of meaningful learning. Rote learning only enters when the model is so piece meal and simple and pre-sequenced that the child can perfectly imitate the model without much thinking. Group recitation of number facts or names of shapes are examples of poor quality instruction.

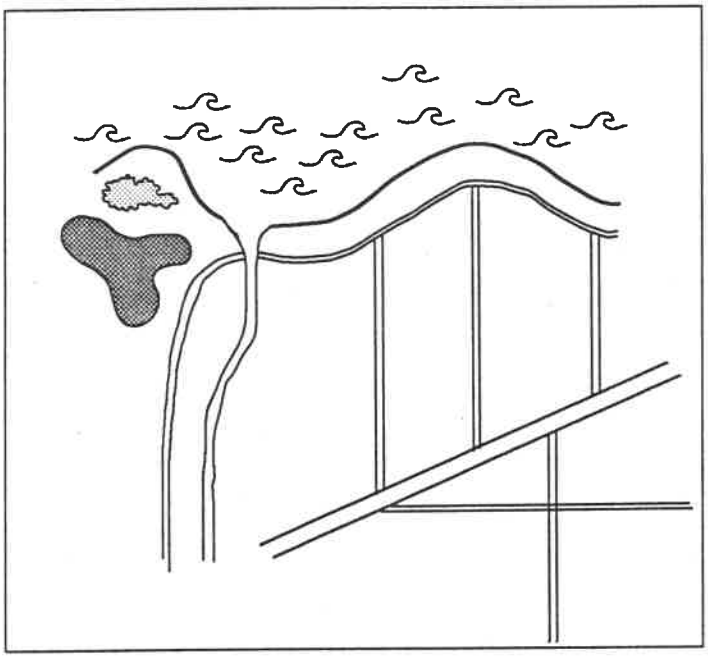


Example:

Ask a child to inspect a cantilevered arch. Most children will be filled with wonder about dynamic principles that beg to be understood. And the child who is intrigued with this unusual structure is half the way home to regulating his/her own learning.

4. Preparing a Terrain

It is often helpful to provide the children with a terrain within to work. In this manner, the children quickly become immersed in problem-solving because the terrain, as a small world, provides the children with reasons to make particular structures.



Example:

The teacher can prepare a terrain, drawn in color on a large bed sheet stretched tightly and tacked to the table. The terrain has brooks, paths, hills, rivers, lakes, trees, scrubs, and other landmarks. The teacher asks about four children to make a village of the future, using the LMW Blocks. As part of the game, they are to construct bridges that span the river in one place and the brook in another. The teacher has deliberately made the river so wide that no single block can span it. Therefore the children will have to engineer a suspension structure. To motivate the problem, the children are told that this is a mighty, raging river that is too deep and too swift to have supporting pillars under the bridge.

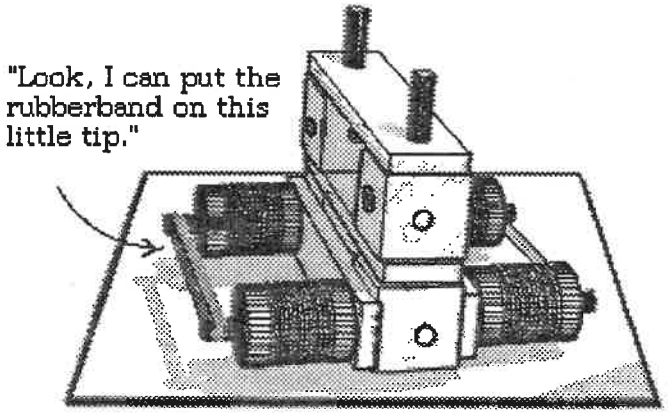
The problem is staged, and the children must figure out how to build a structure that satisfies two requirements: one, that the bridge is self-sustaining, and two, that it has a flat surface suitable for travel. BEAMS, DOWELS, and counterweights all come into play. The theme that this is a city of the future also motivates children to make structures with interesting designs. The children may also recognize the functional value of their structures. A curved roof will make snow slide off instead of accumulate as it does on a flat roof.

V. Learning Objectives: Discussion and Examples

This following section will present encounters that focus on learning objectives. The section will discuss what each objective means and will give a few new examples of focused activities. However, as we have continually advised, these focused activities yield more meaningful learning when they are integrated into some project or game with an over-arching theme of interest to the children. For a more complete listing of examples, refer to Appendix B.

A. Increasing Perceptual and Motor Skills

Too often we reduce young children's learning to stimulus-response associations. This color (stimulus) is pink (response). Most of the advice on teaching children to discriminate sounds, shapes, and colors comes from this overly simplified theory of learning. However, it is still important to encourage children to compare and contrast sensory information. But the critical question becomes: what makes sensory stimulation into sensory information? Information tells us something new about the world.

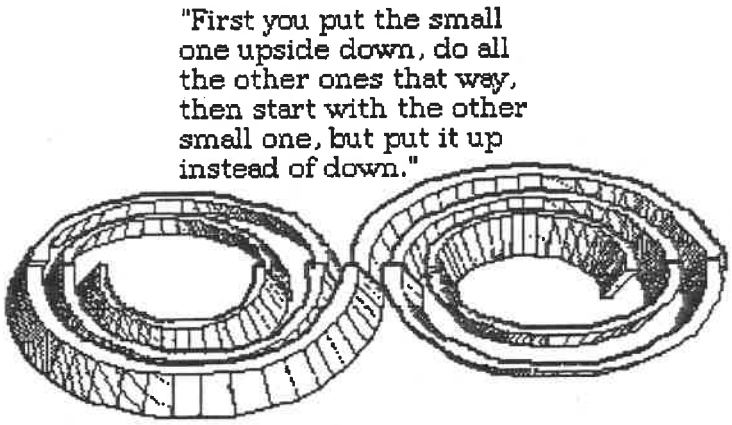


Example:

You can play games with the sounds the LMW Blocks make. But to assure high level thinking, play the game behind a curtain this way. Strike a block with a wooden mallet but shield the block from the children's view. Ask the children if they can figure out from the sound what type of block was struck. Or you can roll a BOBBIN and ask children which block could possibly make that sound. Strike two DOWELS together like a musical instrument. Ask the children if they know how you made that sound.

B. Stimulating Language Development

Language skills for preschool and elementary grade children consist of vocabulary development and the development of communications skills. The LMW Blocks present a platform from which children can work on these skills.



Example:

For *vocabulary development*, the nomenclature of the blocks themselves is a good starting place. Children, when working in small groups, will find it effective to use an agreed upon name for each block. Instead of asking, "I need the blue block!" (referring to the BOBBIN), children will more likely receive the desired block if they ask, "I need the blue BOBBIN!" Children will learn to use shape designators when color is not enough. On the other hand, children will learn to use color designators for the COLORFRAMES, since all of these blocks are the same shape. Note that these colors have subtle variations. The designator "dark green" would not specify a particular COLORFRAME. Granted children may begin by saying things like, "the dark, dark green," but with a little help from the teacher, children can invent names like, "grey-green," or "green like our cactus plant."

Example:

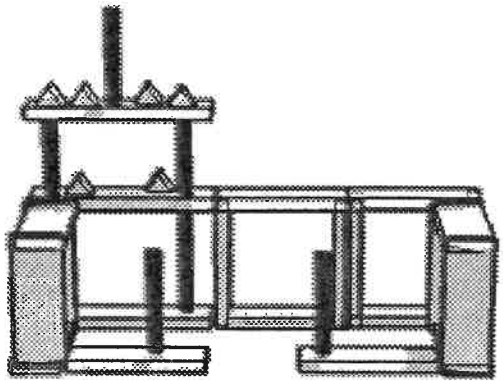
The trick for the teacher is to find situations where it is important for the children to use a color descriptor. One such situation is a game in which two sets of COLORFRAMES are used. Each group of children takes turns using the two sets, but group members cannot see each other's blocks. The two sets are divided by a half-wall partition on the table. Group A has a player on both sides of the partition and so does Group B. A group member picks up a COLORFRAME at random and tries to describe its color sufficiently well so that his/her group member

on the other side can pick out the identical block from his/her set of COLORFRAMES. It is interesting to see how children progress in their vocabulary when naming is essential to effective communication.

Often the communication involves more than naming objects. The children may need to communicate an entire *sequence* of actions, such as telling someone else how to build a complex block structure. Here again the teacher can provide situations wherein children find it necessary to give another child instruction.

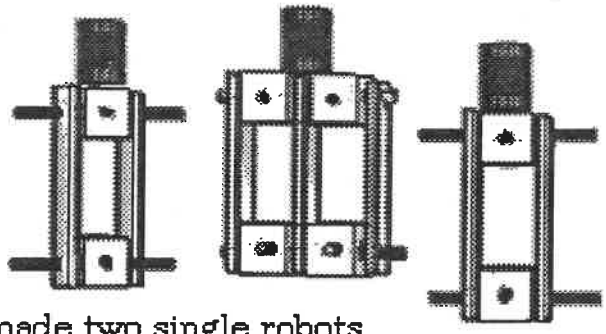
Example:
A child has just solved the problem presented by making ARCOBALENO into a bowl. The arches have to alternate 90 degrees of rotation for the structure to stand. The child who solved this problem could be encouraged to tell a friend how the bowl was made.

Do not assume that children new to the task can just look at the bowl and figure it out. Children see only a little more than they can understand. It will help the children understand what they are looking at if they recount their own thinking. It is important for the teacher to encourage students to discuss what did not work as well as what did work. Understanding is more than knowing how something can be done. Complete understanding rests equally upon knowing how the final product differs from failing structures.



Example:
The communication game mentioned above with COLORFRAMES can be varied and made more relevant for peer instruction about *sequences.* The two groups (6 - 8 years old) split into two subgroups as before, but this time the groups build a complicated structure rather than simply select a single COLORFRAME. The groups win points when one set of

group members builds a structure identical to the hidden structure built earlier by the other set of group members. More points are given for structures that use blocks of many types (ARCOBALENO, COLOR-FRAMES, BEAMS, BOBBINS, etc.). The groups are told that they can not describe the structure as a whole, e.g. "It looks like a house with a tower." They can only refer to individual blocks, to sequence, and to position. Thus a "legal" instruction would be, "First take two orange PYRAMID blocks and place them lined up but not touching." These constraints on communication will encourage the children to think about the process of construction, something that is more demanding and ultimately more useful. For younger children these communication constraints can be loosened so that global descriptions of the whole structure are allowed.

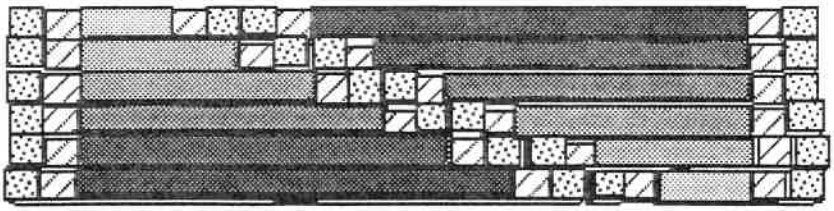


"I made two single robots and one double robot!"

C. Provoking Mathematical Thinking

This objective is carefully worded in order to avoid a misunderstanding. We are not advising the use of LMW Blocks to teach number facts, e.g. accurately counting 6 objects or adding 3 + 4. These skills can be taught with any objects, from rocks to twigs to colored discs. We emphasize mathematical thinking, some of which involves number facts but is more than remembering those number facts. We should distinguish number facts from problems that ask the question: "Do I add or subtract?" And, "Do I add more in this situation than I added in the last situation?" The child has to figure out what rule to use, not simply know a rule. These types of problems require a deeper form of thinking and are more in line with what we mean by mathematical thinking.

What about the LMW Blocks makes them useful to teach mathematical thinking? Such features are not readily apparent since the LMW Blocks do not have the very many duplicate pieces the way that the Cuisenairre Rods™ or the Unit Blocks™ have. Nevertheless we have observed numerous instances where children have confronted authentic problems in mathematical thinking.



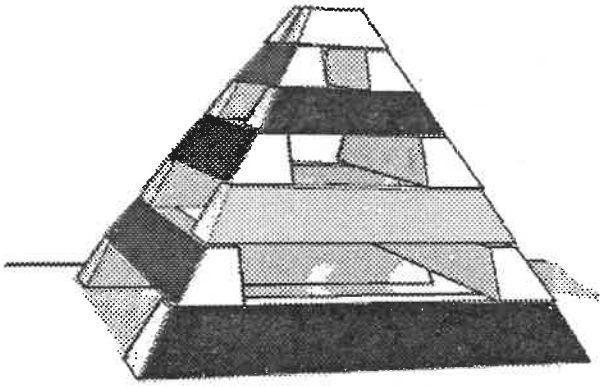
Example:
Take the simple case of putting the blocks away in the PLAYFRAME (or similar container). The Stackbuilders are most efficiently stored as seen in the figure below. This is the most compact arrangement that is possible.

The STACKBUILDER blocks form one ascending series abutting one descending series. Each pair of blocks makes a length equal to every other pair of blocks. Yet visually the rows look very different, since the pair composition is different in each row. Now granted, you do not have to place the rows in the PLAYFRAME as an ascending times descending series. But this approach guarantees success, i.e. it is a rule.

It is interesting to watch children invent this rule and become more and more systematic about placing STACKBUILDER in the PLAYFRAME. The mathematical rule can be stated, choose the smallest from set one and the largest from set two: place in the PLAYFRAME. Choose the smallest from the remaining blocks in set one and the largest from the remaining blocks in set two: place in the PLAYFRAME. Repeat until all blocks have been placed. Indeed, inventing such efficiency is the crux of mathematical thinking.

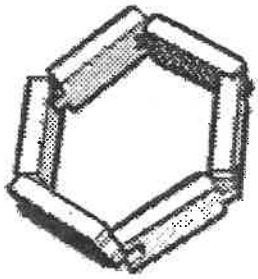
> Mathematics, as a discipline, can be defined as a formalized system of thinking about relations, usually quantitative, but not necessarily quantitative. A quantitative relation would be, how much more is 8 than 6? The answer can be given in units, in this case, "2." But the power of mathematics is as much the logical necessary of the answer. In this case, it is logically necessary that 8 is 2 more than 6, always is, always will be, given the definitions of the numbers 8 and 6.

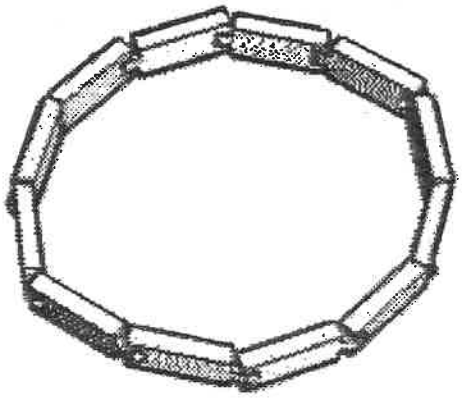
With the LMW Blocks there are types of logical necessity other than purely quantitative relations. These relations should also be treated as authentic cases of mathematical thinking. They are more qualitative in nature, such as "*Must* these two blocks face in *different* directions (to accomplish some goal)?" Or "Will this progression *always* grow *wider* as I use this order of placing the blocks?"



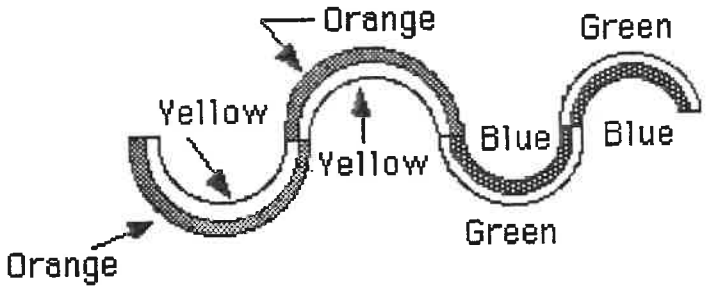
Example:
In building the PYRAMID structure, the child initially will be confused about the orientation of the individual blocks. She places the two red blocks with the red side facing out (o.k.), and then makes the second tier with the two orange blocks facing in (not o.k). This second tier will destroy the taper of the pyramid and needs to conform to the slant of red blocks below. Eventually the child will discover that if she conforms to the slant of the tier below, the structure will necessarily rise with the proper taper bottom to top. Searching for these constraints that determine the final structure is as much a part of *logic* as a part of general *problem-solving.*

Example:
With ARCOBALENO children will discover the rule that generates a spiral versus concentric circles. Placing the next smallest abutting the largest (and repeating this) will generate the spiral. Placing the same size next to the largest (and repeating this) will generate the concentric circles. Here the child will understand how a change from sameness to difference rules effects a progression.



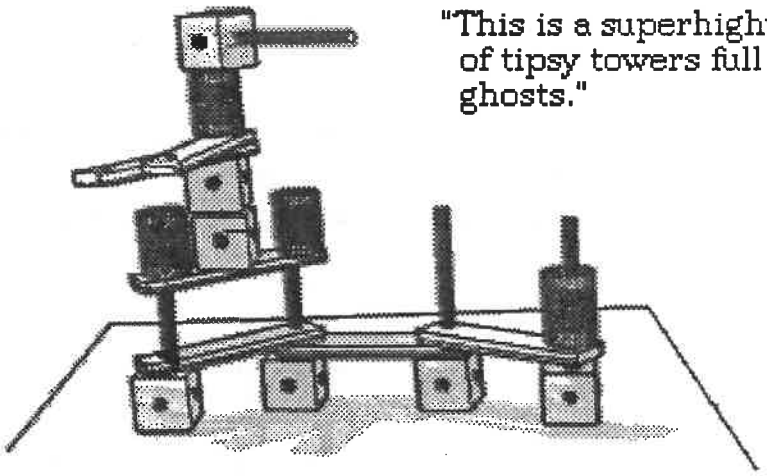


Example:
With COLORFRAMES children can discover that the relation between the number of sides in an enclosure determines the smoothness of the curve. So, a circle made with 6 pieces will look more angular than a circle with 12 pieces. To return to our earlier comments about mathematical thinking, knowing that one must add to make the curve smoother is an authentic example of mathematical thinking.



Example:
Logico-mathematical thinking is thinking that offers the reason for statements such as this: it can only be this way. Look at the design one child made with ARCOBALENO. Notice that the orange block alternates position with the yellow block, first in the lower position, then in the upper position. Likewise the green block alternates position with the blue block, first in the lower, then in the upper.

Julie initially tried to make this design with the orange block in the lower position for both curves. She did this by matching the end of one orange block with the end of the other orange block. (Search for sameness). Even though the orange ends matched, she could not make her double curve road using this rule of matching orange to orange. At this point she could have used trial and error to construct the double curve road. There is no particular reason for the child to reflect about the "logic" of this pattern, but she does. "Oh, the orange *has to* go on the outside (of the curve) each time, it's larger! " Note well the child's phrase "has to." This phrase indicates she understands the necessity of this alternation pattern. Cognitive development occurs when children take a more reflective attitude towards their successes, even though that reflective attitude is not essential for the success. Teachers should stand ready to help the children understand their successes rather than merely to help children be successful.



"This is a superhighway of tipsy towers full of ghosts."

D. Enhancing Imaginative Play

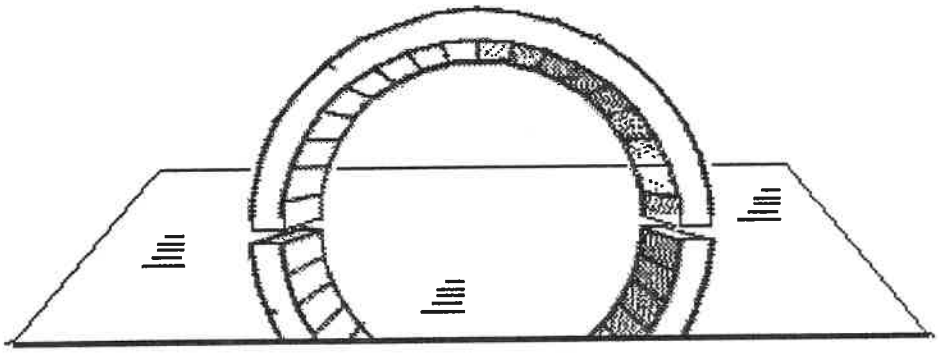
The very fact that the LMW Blocks are so unusual itself enhances imaginative play and creative thinking. On their first encounter, the children do not quite know what to make with an arch from ARCOBALENO or the columns from PYRAMID. Usually they try to make something familiar, like a doorway with an ARCOBALENO arch, but they find that it does not come out as expected. This accident turns out to be a plus because the surprise elements are catalysts for new ideas. A doorway made from a conventional half circle would have no "direction" since such a block has no bias, no slant to its curving surface. But in ARCOBALENO the upright arch does have direction and children begin to discover that one side of the arch looks like the entrance and the other looks like the way out.

The children will gradually incorporate these unique features of the LMW Blocks into their constructions and they will do so intentionally rather than by accident. For example the arches will generate a great deal of symbolization about movement in and out, and about topological relations of bounded and open spaces.

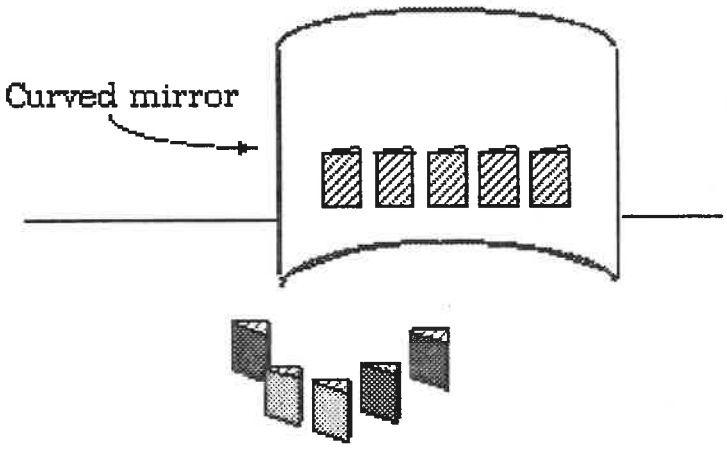
Archway in

Archway out

Example:
You can enhance imaginative play by adding specific supporting material. A large mirror placed flat on the table enhances the design effects that children make. They will begin to include the mirrored image as part of what they intended. Instead of just doing anything and seeing how the reflection appears, children will begin to treat the mirror image as a "completion" of the real structure. For example, an arch from ARCOBALENO placed upright on a horizontal mirror makes a completed circle.



The mirror also provokes children to build imaginative structures with vertical definition, rather than single layered structures that present only minimal reflection. Mirrors at right angles also provoke children to explore the kaleidoscopic effects of placing the colorful LMW Blocks within the angle of two mirrors. A curved mirror creates even more surprise. Curved mirrors can be made from poster board mylar.



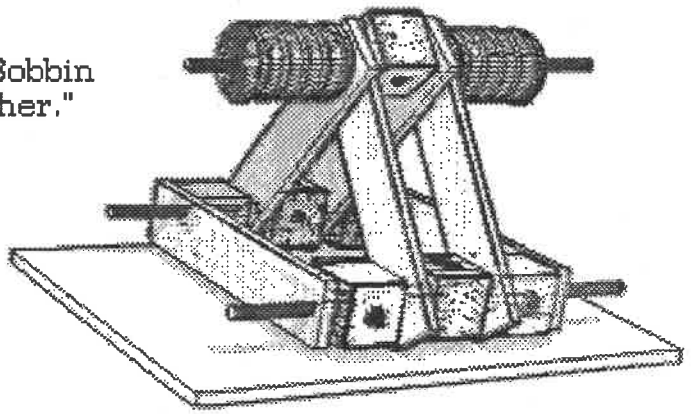
Example:
Children can also build structures on half-inch Plexiglas™ placed horizontally to create a clear table top. Children will learn about the underneath layout of the LMW Blocks by looking up from below.

Example:
Children can use graph paper to draw the layout of their block structures, and then use these "blueprints" to make modifications in the block structure. The blueprint will represent what they have built and will help them make improvements.

> Note that the objective here is to enhance creative thinking, which is a form of problem-solving. It would not be enough simply to create surprise, say with the curved mirror. The preferred encounter creates *conflict* rather than surprise. Surprise can be dismissed as mildly interesting and may not lead to any further exploration. Conflict, on the other hand, causes the children to rethink an event or a concept. For example, what if the reflection from a curved mirror looks more familiar than the objects being reflected. The teacher can do this by making an irregular row of blocks look straight in the reflected surface of a concave mirror. This event will make children rethink what a reflecting surface does. The curved mirror does not always "distort" the subject matter, even though it does always change it.

Imaginative play and creative thinking can also be enhanced by giving children silhouettes of the LMW Blocks made from black construction paper. The children can try to make "shadows" of their block structures using the construction paper cut-outs. Two children can try to make two different shadows from the same block structure. These type of activities enhance the "imaging" part of imagination, because the shadow must be imagined since there is no real shadow to serve as a reference.

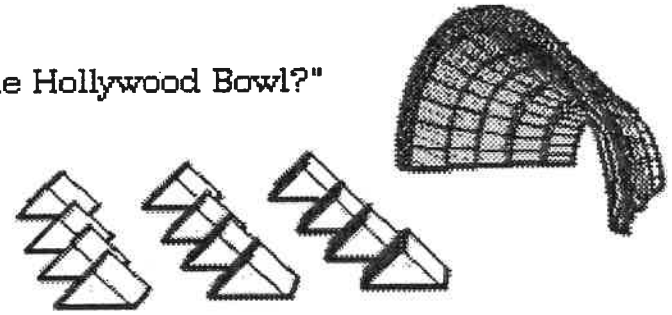
"We made this Bobbin machine together."



E. Encouraging Cooperative Problem-Solving

Like so many of the preceding suggestions, the teacher stages a problem that will encourage children to work on a learning objective. There are several considerations to stage cooperative problem-solving effectively. First the teacher needs to design some system whereby a dominant child

does not do all the work and whereby a reluctant child is easily involved. Second the activity should be an authentic problem, not busy work like putting the blocks away or assembling the support material. The problem should have sufficient complexity that several bright minds are required to solve it. Games with rules have these prerequisites for cooperative problem-solving. The rules assure that personal dominance has little bearing on group participation. And the objective of games can be as complex as the teacher desires. Here are several suggestions for games with rules that will encourage cooperative problem-solving in children from six to eight years.

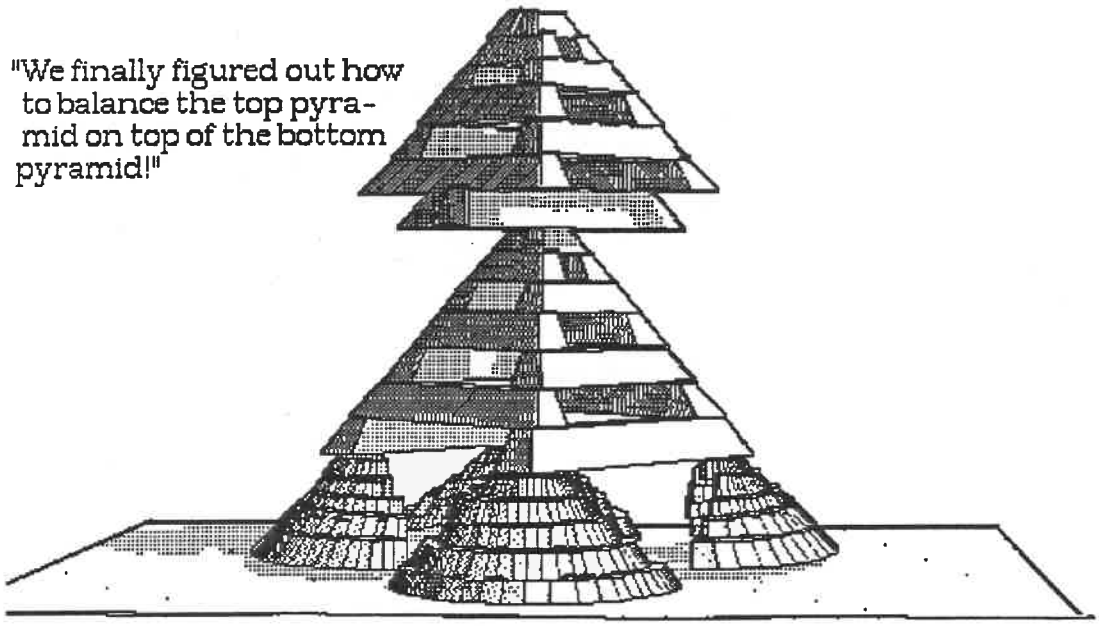


Example:
Six children are in Group Red and six are in Group Black. Group Red is divided into the Red A and Red B, three each; likewise for Group Black. The A's from both Red and Black meet to decide what famous structure they are going to build with the LMW Blocks. The teacher can provide them with magazine photographs of famous structures like the Eiffel Tower, the Hollywood Bowl, the Taj Mahal, the Guggenheim Art Museum, an Aztec pyramid, the Apollo Lunar Vehicle, or any other famous structure that the children know.

Once the Red A and Black A subgroups select the same structure, they set about building it with the LMW Blocks. Each subgroup takes turns so that both subgroups have access to the entire set of LMW Blocks. When the Red A's finish, the Red B's try to recognize what the LMW Blocks represent. To prevent one group learning from another group's effort, the teacher can involve the Black B's elsewhere while the Red B's are trying to identify a structure. The game continues in rounds, and points are given to each group based on the time it takes to identify the name of a block structure.

The cooperative problem-solving comes in primarily during the building of the structure. The small size of the group makes it possible for the teacher to sense the dynamics of the group. The teacher can help the trio divide labor if one child becomes too caught up with his own ideas. The fact that children play both author and reader of block structures also assures that individual children will find a way to participate in the group effort.

Example:
Other games can be played that ask groups to work cooperatively to make the most _(fill in the blank)_ structure that they can imagine: the funniest structure, the scariest, the most daring, the most futuristic, and the least likeable. This last category, in particular, causes children to think about how something is *not* exemplified. Thinking about negative instances of a category improves the child's understanding of what something is.

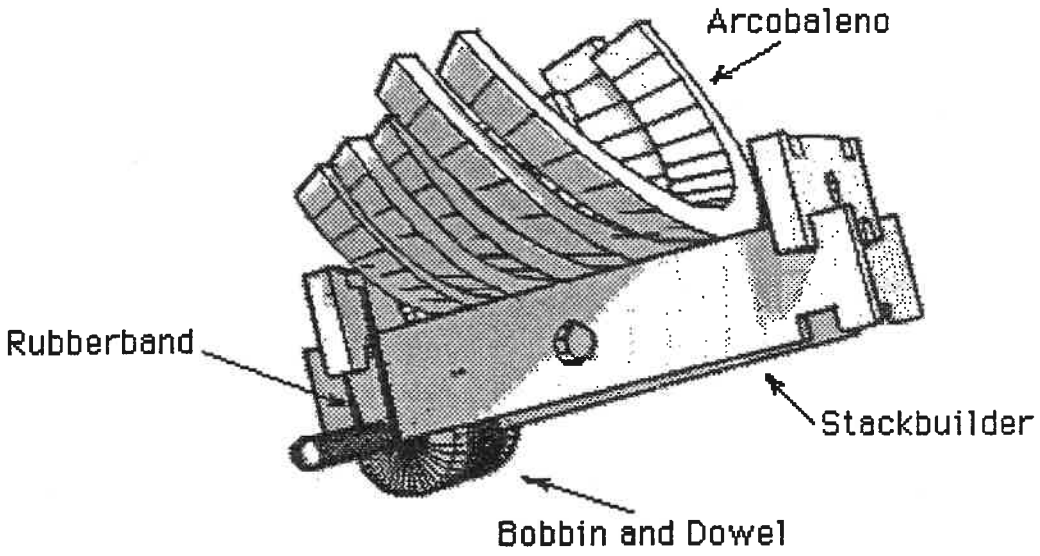


F. Developing Physical Knowledge

The term "physical knowledge" is used here instead of the more abstract term "physics." Physics usually means not only the mechanics of levers and gears but also the quantified representation of momentum, inertia, and energy. The term "physical knowledge" is more appropriate to describe young children learning about balance, leverage, stability and other dynamic aspects of block construction.

Several examples of physical knowledge have already been mentioned, such as the boys who balance an entire pyramid on the apex of another pyramid, or the child who solved the problem of the gap in the ramp rail. Physical knowledge encounters occur more often when the trappings of research are scattered around the LMW Blocks. Pencils, graph paper, string, rubber bands, small pulley, pan balance-scales, bare copper wire, flashlights, all tune the children to think about the regularities of the physical world.

Perhaps the best way to stage physical knowledge activities is to use the third teaching technique: Suggesting Goals. The teacher can ask the children how they might do something. The "something" is not arbitrary, but involves at least one of the physical knowledge concepts mentioned above. Here are a few examples.



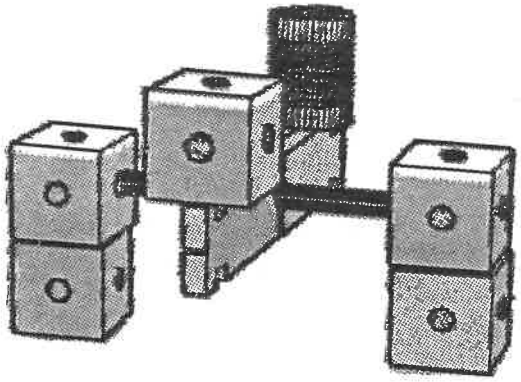
> How can you make a wheelbarrow using the LMW Blocks?

> How can you make a rocking chair or a wheel chair using the LMW Blocks?

> Using this flashlight how many square shadows can you make with the LMW Blocks?

> What sort of mobile can you make using the copper wire and the LMW Blocks?

> Who can make the tallest structure using the STACKBUILDERS that I cannot blow down?



> Can you use the LMW Blocks to decide if a BOBBIN weighs the same as a CUBE? (See picture above.)

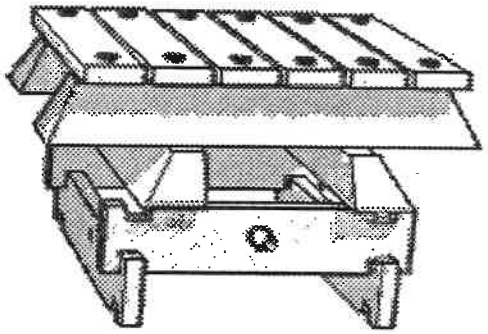
G. Nurturing Aesthetic Ideas

Of all the many purposes of the LMW Blocks, nurturing aesthetic ideas rises to the top, given the beauty of their design, color, and texture. These are not simply blocks. These are blocks that say to the viewer, "Block-building is valued in our culture." The children respond to the beauty of these blocks: they work with them more gently and they are not satisfied to call them just blocks. The children we observed often call them "The Art Blocks."

What might you see in the actual block play that you would accept as aesthetic rather than the child's intent to make a representation or a structure that does not fall over?

Example:

We observed one child putting together the COLORFRAMES in pairs, each time saying "These two colors look good together." She would occasionally remove one member of the pair to search for a better mate. Her criteria was somewhat personal, but it seemed like she was trying to create a contrast within a narrow spectrum. She would prefer pink and rose over pink and red. It was a pleasure to see a child express these subtle contrasts, rather than a child still in the stage of making diametric opposites like black and white or blue and red. The aesthetics of her play can be described as follows: "These colors are different, but they are different in interesting ways." Her play was nurturing a *reframing* of the concept "difference"; she was making a *comment* on what we call "difference." In describing aesthetics in this manner, you can also recognize the similarity among aesthetics, mathematics and logic.



Megan: Age 7

Example:
Megan, age 7, combined pieces from STACKBUILDER, BEAMS,and PYRAMID to make a house. The blocks from PYRAMID were used to add an interesting detail to the eaves of the house. "This is a China house," she explained. The angles on the corners were to her similar to the upward curves she had noticed in photos of China. She too was making a comment on the type of house, in this case, a house from a far away place. The aesthetic detail added an entirely new valance to an otherwise ordinary house.

These accents of angles, curves, and color go beyond the purely functional purposes of design. They remind us of experiences, they make a statement about form itself, and they speak of the creator's attitude toward his/her work. Children will cap an abstract structure with a colored PRISM, just to say, "This is the top. This is definitely the end." Or the child may place the colored DOWELS among a layout just to say, "These are special places. These are places to notice." Again, their intent is not always to represent some object they have seen, but rather to add order and structure to the design they have made. By expressing these aesthetic ideas with the LMW Blocks, children come to appreciate the power of aesthetics to communicate one's stance toward a work and to make more readable the elements of design that are appealing to the creator.

We encourage you to extend these objectives in many ways. First observe children work and then provide a bit of structure. In this manner learning should proceed in step with the children's interest.

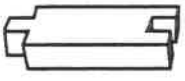
VI. Appendix A: Expanded Activities

In this appendix we will describe ways to expand the educational value of the LMW Blocks by adding new materials and by structuring a set of problems for the children. It is our intention to use these structured activities as a window for teachers to witness children's thinking and as a door for children to enter for new explorations. However, the instruction as a whole should spiral through all three teaching styles that we described in the previous section. It is felt that spontaneous, self-directed explorations of the LMW Blocks will always be a valuable time for the children. It is during these self-directed explorations that children consolidate new learning to make it their own.

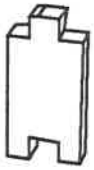
A. Reading a Map Made from the LMW Blocks

Blocks are easily rearranged. This makes them a wonderful medium for representing spatial layouts. The map is a representation of spatial layout with one added feature — the symbols in the map have a convention, an agreed upon meaning, that helps one read the map and to know its relation to some larger space. The LMW Blocks can serve as a guide, a map, of familiar spaces, such as the classroom, the school building, the center city, the park or playground. The fact that the LMW Blocks are not clearly replica objects makes them all the more useful for teaching children the functions of a symbol system. The curves of ARCOBALENO can stand for a bridge, a tunnel, a hill. The COLORFRAMES can stand for a boat, a person, or even as a logo for the public restroom or telephone booth.

The learning objective centers on the child's growth in understanding that symbols need not look like their referent. The symbol can be related conceptually to their referent. The young child will probably use the COLORFRAME to be a person (because it looks like a person when stood on end). But a more advanced symbol for COLORFRAME would be to represent a place where people go, instead of the people themselves. So, using the COLORFRAME as a logo for the men's rest room uses the symbol more conceptually than literally or concretely.



Boat or boat dock



Person or person's place

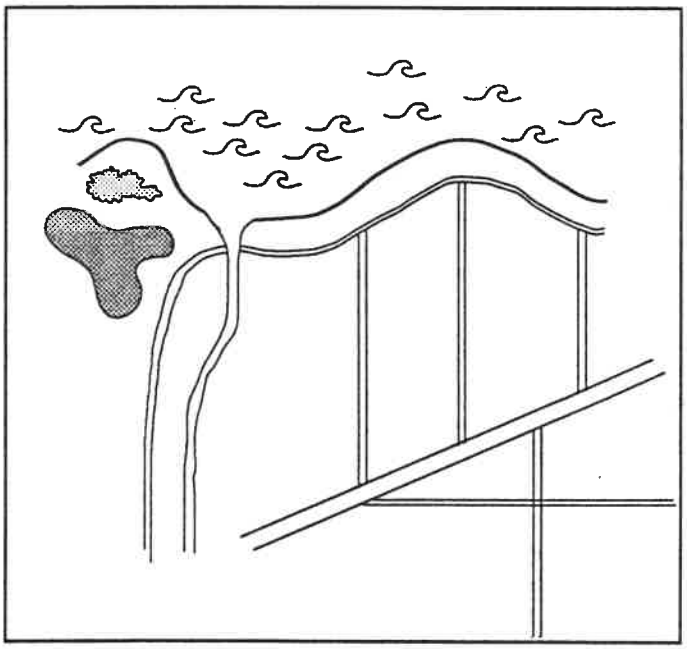
Let's reconsider the use of the COLORFRAME, flat on the table, as a symbol for a boat. It looks somewhat like a boat, with its point as bow and its notch as stern. But, if the children agree to use the COLOR-

FRAME to represent the boat dock at the end of Harbor Street, now the block is more symbolic of a complex of relations (a place where boats go) instead of more simply "the boat itself." These conventions are the essence of map symbols. The symbol for a campsite is a schematic looking teepee. This symbol does not mean that one would find a teepee upon arrival to the real site. The teepee icon (abbreviated picture) is a reminder for the word "campsite."

What other conventions might the children invent, conventions that are more conceptual than pictorial? A piece from STACKBUILDER could represent a construction site (block looks like steel I- beam). The BOB-BIN on end with a DOWEL inside could be a factory site (dowel as smoke stack). A row of PRISMS could be a residential neighborhood; a small piece from PYRAMID could be a church; a combination of STACK-BUILDER and DOWELS make a readable symbol for a playground (such as a jungle gym). A good map symbol has just enough resemblance to the thing it represents as to be readable, but also has an "economy" of scale and design so it can be easily produced and easily repeated. The map symbol should also be compact, because good maps will carry a lot of information per square inch.

These objectives need to be immersed in a game that causes the children to think about symbols. You can use the same terrain from the activity briefly described in the previous section, the white sheet with landmarks drawn on it and stretched tightly over a large area.

Example: Map of river, roads, hills, lake, streets
The landmarks show a few roads, a river that flows to a seaport harbor, a major highway that cuts diagonally through the city, a forested area on the west side of the river and a lake near hills just below the forest. The



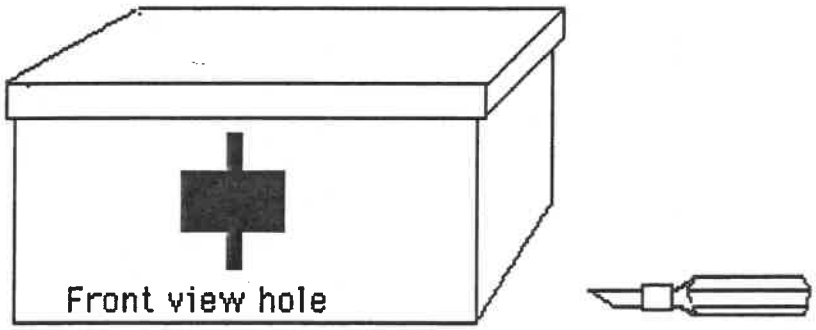
whole layout is about five feet by five feet. Children are asked to make a pretend city using the LMW Blocks. Their task is to make their map readable to another group of children. They can do this by choosing blocks that look like the objects they represent, but they are encouraged to make a legend. It is explained to the children that a legend is a list of the symbols in the map and

what they represent. Some discussion about symbols (as above) should precede the game. The relation between the LMW Block and its referent should not be arbitrary, but clever. A curve from ARCO-BALENO as a bridge would be rather literal, but using a CUBE as a church, "because it is holely," is clever. More verbal children, who have reached the level of enjoying puns, can make these symbols.

You will probably find it necessary to begin the children, age 5 to 7, with a short list of items that should be included in the map. Such items can include: a boat dock, a bridge, a school, a playground, a police station, a church, a factory, a campsite. Not only does this list utilize the potential for the LMW Blocks to be symbols that we have already identified, it also will give the children a reason to think about where in the landscape these items are most likely to be. For example, the campsite is more reasonably located on the west side of the river; the police station more in the center of the city. The children should discuss the reasons why things are located at particular places.

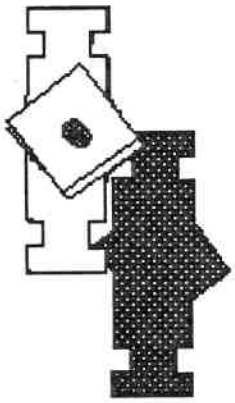
B. Identifying a Spatial Perspective

It is not obvious to children that an object's shape is dependent upon one's own perspective to that object. In other words, a house built into the side of a hill may look tall to you if you are standing in the front, but short to your friend who is thinking about seeing the house from the backyard. It is important to help children understand that "facts" are relative to the perspective of the viewer. Even though we will discuss this objective in reference to spatial relations, you can easily imagine its implications for social relations as well, e.g. two children's attitude toward one of them.

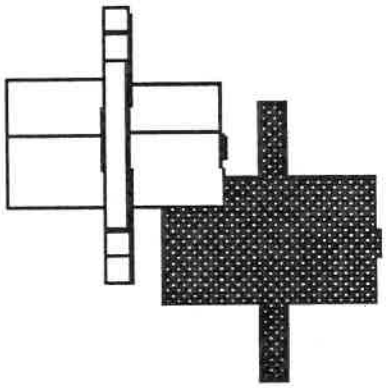


These games in spatial perspective can be played with flashlights or with pasteboard boxes. Let's describe the pasteboard box version first. Take one of the blocks from the LMW Blocks set and trace an outline of that block on the side of a square pasteboard box. Using an X-acto knife, cut the outline to make a hole the exact shape of that block. Now

rotate the block to another orientation and repeat this process on the other side of the box. If you are fortunate enough have a pasteboard box that has a lid (such as the box that contains reams of ditto paper), cut out a third perspective on the lid. Make the lid hole be the "top" view of the block, and the holes on the vertical sides of the box the "side" view and the "front" view.



Side view
hole



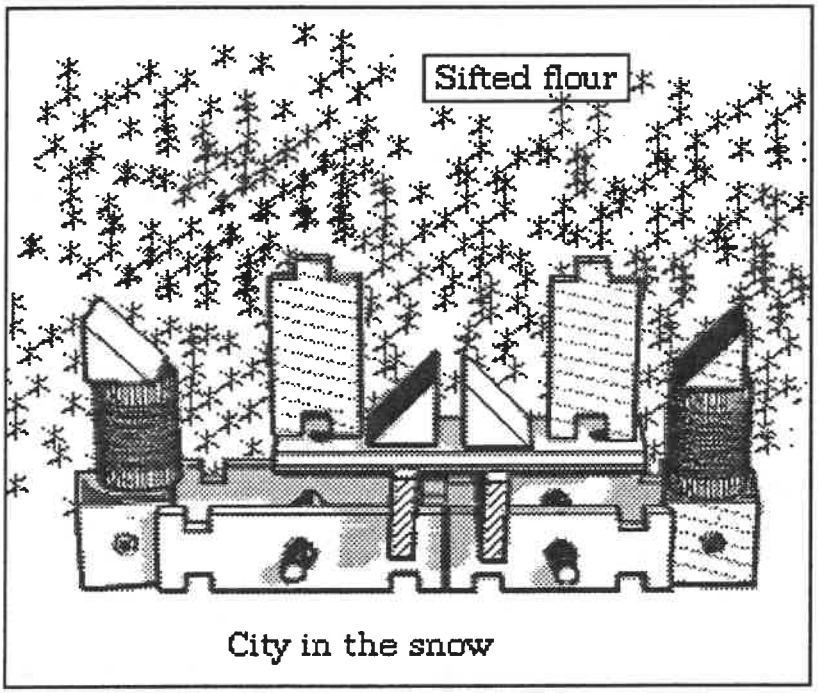
Front view
hole

In the flashlight version, children look at the shadows of blocks and try to figure out which block, or arrangement of blocks, cast the shadow. It takes only a few minutes to make a box with two tissue paper screens. Cut a window in the right side of the box and in the front of the box. From the inside of the box, tape several sheets of tightly stretched tissue paper, thick enough so that when the flashlight shines on the LMW Block the child on the other side can see only the shadow, but not its color or interior features (e.g. holes, corners). On the two walls opposite the windows, cut a circular hole the same size as the end of the flashlight. This box has now become two rear projection screens.

Place the box on the table and make some sort of short platform inside the box (e.g. a large book), so children can place block structures on the platform and see the entire shadow of the block structure. Ask two children to build a block structure in private and place this structure inside the box. Then invite two other children to join the game. The children who built the structure in the box now hold the flashlights and turn them on or off as needed. The two new children are to build blocks structures identical to the one in the box that casts the shadows. One child builds while studying the shadow on the *side* screen, the other builds while studying the shadow on the *front* screen. Place a partition between these two children so that neither can study the other's structure while building. The fun comes when the two children discover that they have built different structures in spite of their knowledge that the shadows come from only one structure.

C. Simulation Games

Simulation games take the child into a pretend world that behaves similar to the real world. In high schools a course in economics may simulate the economy via a board game with paper money, banks, rules (laws), playing pieces for natural resources, etc. In fact, one could consider the popular Parker Bros. game Monopoly™ a simulation game. The physical world is another popular pretend-world for simulations. On computers especially, children can construct their own pinball boards and then watch an image of a pinball bounce, ricochet, and fall through holes as if it were in the real world. Children learn from these games because they give the children more control over the relevant variables that change the pretend world and more frequent access to these cause and effect relations.



City in the snow

The LMW Blocks can also be used for certain types of simulations. Here is one idea that comes from Marks Meadow Elementary School in Amherst, Massachusetts. It is called "The City in the Snow." The children had been anticipating the first snow fall for weeks. The teachers decided that snow fall is a good theme for many learning encounters, including the study of architecture. The teachers decided to ask the children to build a miniature village using blocks. The teachers explained that snow (sifted flour) would fall on this village. Could they predict where the snow would fall? Where it would not reach? Where it would fall but slide away?

The children busied themselves making structures that would present some interesting effects, given the coming snowfall. They were particularly interest in rounded surfaces and peaks, asking themselves, "Will the snow stay there?" Some children were able to predict that the snow would not fall under arches, unless, as one child put it, "The wind blows the snow in sideways." This simulation of the snow fall leads to some interesting predictions and surprises. In one case, the snow remained on one side of a triangular block and not the other. The difference was in the texture of the wood. This activity can be done with Units Blocks and/or the LMW Blocks. The LMW Blocks do present some intriguing challenges, particularly with complex structures like the completed PYRAMID structure. Try it. You will be surprised where the snow falls and does not fall.

D. Making Metaphoric Designs

Teachers often can help children think more deeply by asking them to do something out of the ordinary. Asking children "What musical instrument are you?" is an example that stretches children's thinking. One is not literally a musical instrument, but one may still consider one's self more "drum-like" than "flute-like." The quality of the musical instrument is abstracted and transferred to some similar quality of the person. You can play these metaphoric games with the LMW Blocks.

Example:

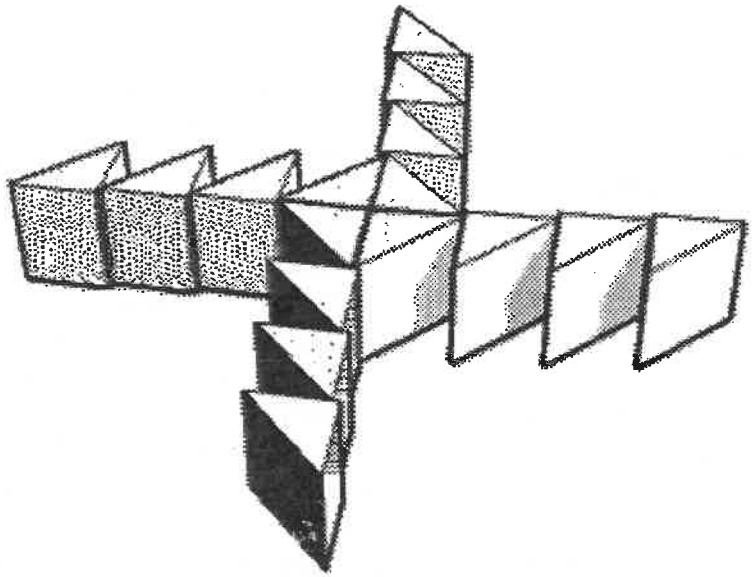
Ask the children to make an "angry design." Some children will find the request itself hard to understand. In the beginning you may have to do a few yourself just to get the children started. But it has been our experience that children are open to these non-literal games after a bit of directed guidance.

Look for two very different response types. Some children, to make an angry design, will simply take a block, say a dowel, and use it as a sword as they growl. While anger is expressed, the child has not made a symbol that remains independent of the action itself. That is, the child has made what is called an "enactive" symbol, but has not left a record of anger for others to study when he is not present. The symbol has no "author independence," that is, the symbol depends on the presence of its author.

More advanced children will make a design that, via its shape and color, captures the emotion in question. But within this category of design making you will find several types. Some children will make a regular design, say three rows with the PYRAMID pieces.

When the teacher asks, how is it that this shows anger, the child blithely answers, "I was angry when I made it because it was hard to make." In this case, the design does leave a record of the emotion, but

the record is idiosyncratic. It is so personal to this child that no one else can "read" the design. This child has moved beyond the enactive symbol, but he is still rather egocentric. Because of this egocentricity, the symbol still lacks author independence. The three rows of the PYRAMID blocks are a personal reminder to the child, rather than a readable symbol to others.



The most advanced level will be those children who make designs that can be read by others. Say a child is asked to make an angry design, and responds with a cluster of PRISMS that radiate outward like a pointed wheel. The sharp angles, at the metaphoric level, say "danger." This quality of *danger, don't touch* is similar to how one feels when angry.

E. Scripting with Invented Worlds

When children work in small groups with the LMW Blocks, they often invent a small world filled with actors and events. You saw one such example with the three girls making a swimming pool from ARCOBALENO and COLORFRAMES . The scene not only had a diving board, a pool, but also a verbal script. The script lays out the sequence of events that portrays the story. In the swimming pool example, the children scripted the events of getting into the water: making a pool side entrance, diving into the pool, putting an island in the center of the pool in case someone wanted to swim there and rest. The blocks facilitated this story-telling activity because the blocks serve as anchor points in time and space.

Since we know that children invent these symbolic worlds, can we use this play to enhance their representational skills? A few realistic looking props added to the LMW Blocks may be just the ticket. But remember,

our objective here is expand the narrative of the story-telling activity, rather than some other objective, such as map-making or making metaphoric designs. Thus we have to choose our props carefully. The best advice we can give is to add props that represent elements in some memorable event just passed.

Example:
The children have just witnessed the school circus put on by the kindergarten children. The circus included feats (or the illusion thereof) of balancing, juggling, lions jumping through hoops, clowns slipping on banana peels, a human pyramid, a strong man lifting a barbell, and so on.

Here is an opportunity to use the LMW Blocks as an invented circus world. The teacher places among the LMW Blocks small figures, some that look like strong men, some that look like clowns, some that look like men and women in tights. Small animal figures would also be useful. To motivate and somewhat direct the scripting with the materials, the teacher explains that she would like the children to plan a number of circus acts. (Actually, the teacher may decide to put on the actual circus, time and resources allowing). The replica objects and LMW Blocks are used, in essence, to *story board* these circus acts.

You can expect to see the children using ARCOBALENO to make the circus rings, the BEAMS and DOWELS to make a trapeze, balance beam, or tight rope, the STACKBUILDER as cages, the CUBES and BOBBINS as pedestals for animal tricks, ARCOBALENO for the grandstand, COLORFRAMES as the crowd, pieces from PYRAMID for ramps, BEAMS and PYRAMID for the human catapult, and BOBBINS for clown barrels or elephant steps.

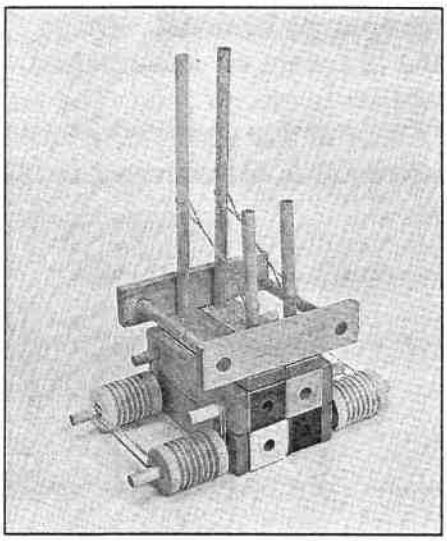
The teacher continues to focus the children to the task of making a representation of the event itself. In other words, the children are asked to do more than portray where an act will happen (e.g. in the center ring), or the order of the acts (e.g. the lion tamer will come on stage after the human pyramid). The children are encouraged to move the figures through the act itself (e.g. the clown will slip on the banana peel just as he is saying hello to the beautiful tightrope walker). Thus the replica figures and the LMW Blocks become a medium to work out the details of the act and to communicate that sequence to someone else. In addition, children with drawing skills could be assigned to making a drawn record of the story board sequence. Then the LMW Blocks can be used to invent and debug the details of the sequence, and the drawings could be the record for others to read.

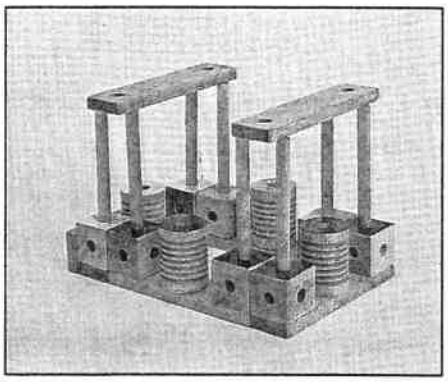
What concepts are the children learning from scripting these invented worlds? Here are some possibilities. As children script the tumblers performing on the catapult, they will most likely think about the relation between height of jump down and height of being hurled up. As children script the clown's fall on the banana peel, they will most likely

think about the timing that makes it funny. As children script the lion-tamer's performance, they will most likely think about how to make it look dangerous. As children script the tightrope act, they might think about the margin between safety and daring. The common element here is children dealing with the relation between a performer and the audience. The performer, to merit the attention center stage, needs to do something interesting, beautiful, dangerous, or unusual. These invented worlds can give children a means to reflect on this relation, which is fundamental to all narrative, not just to circus acts. The narrator, to merit the attention of the reader, needs to say something interesting, well formed, or clever. And to do this requires the narrator to take the perspective of the reader.

VII. Appendix B: Suggestions for Individual Sets

Cubes, Bobbins, Beams





Stimulating Language Skills and Concepts:

Name the pieces while you are building - Cube, Bobbin, Beam, Dowel.

Name the kind of building you are making - Boat, rocket, house, skyscraper, etc.

Invent a new name for your building (a fantasy word) - "This is a ripply, rollery-wheel jet car."

Describe the building or design - Is it tall/short, high/low, fat/thin?

Describe the relative position or location - Is it inside/outside, in front of/behind, over/under?

Symbols - Tell me the name of your building, and I will write it down.

Inventing stories - What is your building used for? Who lives in it? What do they do? Do they have a door? Can you make a row of these blocks and then me a story about that row as you point to each block in turn?

Encouraging Logical/Mathematical Thinking:

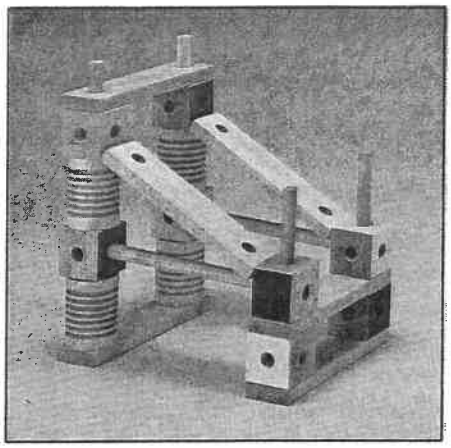
Seriation - Use the Beams to make a staircase for your house. How would you get the Dowels to stay in a stack?

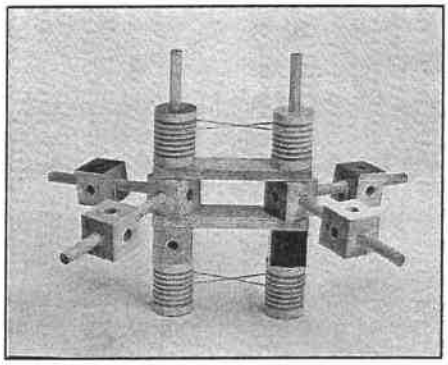
Classification - Are there more wooden blocks or more round blocks? Are there more blocks with holes than wooden blocks?

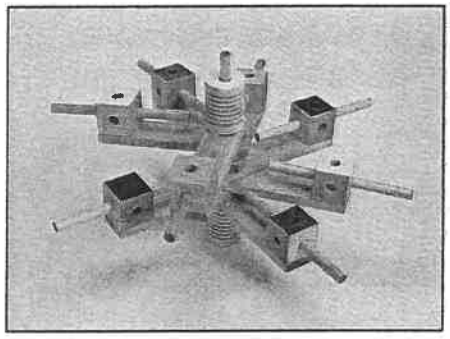
Shapes - What would you call a circle made of Bobbins? What would you call a square made from rectangles (Beams)?

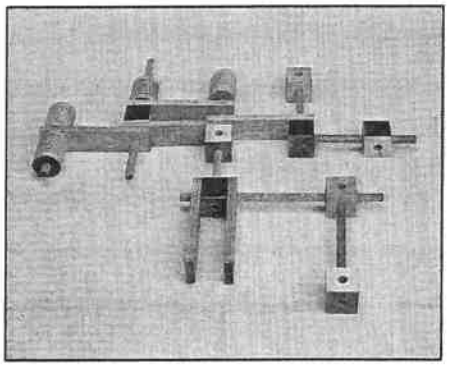
Spatial relations - Can you make the Bobbin shadow look like a square? The Beam shadow look like a square?

Counting - Can you guess quickly whether you have more Beams or more Dowels? Can you predict (estimate) how many Beams we will need to make a fence around these (x number) Bobbins? Do we have enough Dowels to go into every Bobbin?









Developing Physical Knowledge:

Can you make a slide (incline plane)? - Can you make it with one cube and a beam? Two cubes and a beam? Three cubes and a beam? Roll a Bobbin down each of the slides. How fast does the Bobbin go down each slide?

Can you make the see-saw balance? - What if you move the Bobbin closer to the center? What if you use two Bobbins and one Cube?

Enhancing Imaginative Play:

Can you build a house like the one you live in? - Where is the sidewalk? The street? Your friend's house? The bridge?

Can you make a house for an imaginary friend who has wings and lives in a tall tree?

Can you make a tower that is so strong that even a tremendous dinosaur could not get it?

Nurturing Aesthetic Ideas:

Can you make a house with your favorite colors?

Can you make a floor with your favorite grains of wood?

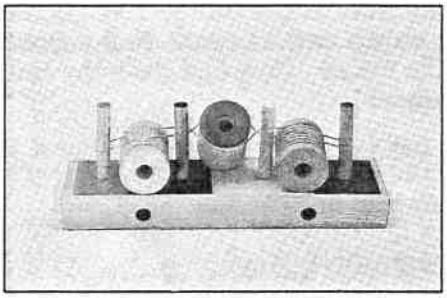
Which house do you like better? - The round dome or the tall tower? Why?

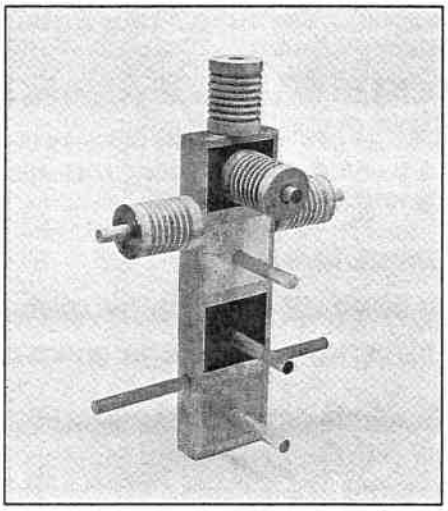
Encouraging Cooperative Play:

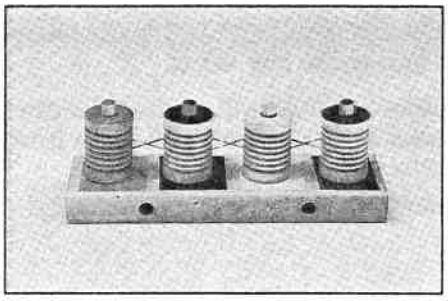
Can we build a house together? - I'll make this end of the road and you make the other.

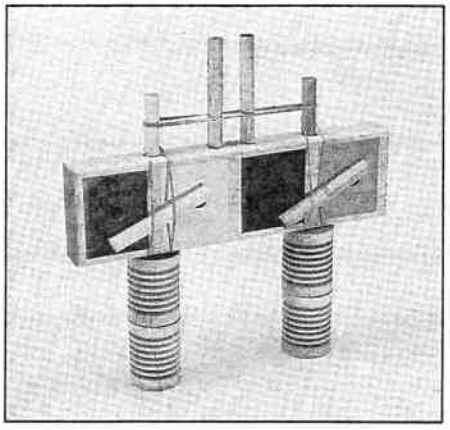
Can you make a bridge that will go over the river? - Then we can make a car go back and forth from your house to mine.

Thingamabobbin









Memory Games:

Mix up the Bobbins and the Dowels - Look carefully at the Bobbins and the Dowels. Close your eyes. *[Remove one color Bobbin or Dowel.]* Open your eyes. What piece is missing? What color is it? *[Remove two pieces, three pieces, etc.]* Which ones are missing?

Turn the Bobbins upside down so only the wood side shows - Can you guess what color is on the other side? *[Turn it right side up if they guess the correct color.]* Keep doing it until all the colors are right side up.

Perceptual Games:

Close your eyes - *[Rub two Bobbins together, snap the rubberband, drop one Bobbin from the top of the long Dowel on the base, etc.]* What pieces are making this sound? Can you make the same sound with pieces from your THINGAMABOBBIN?

Stimulating Language Development:

Can you tell me what you made with the Bobbins? - Where does the "Robot" live? What does she eat? What are her favorite clothes? How does she travel to school? Does she need a motor to walk?

What is that interesting round piece on the base? - What does it do? Does it help the machine go faster?

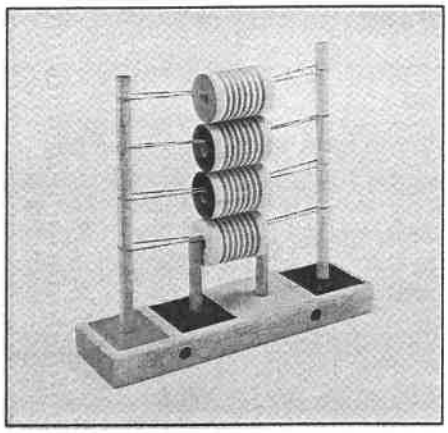
Tell me about the red square on your "boat." - What happens if you push the red square? The green square? What would happen if you removed that part from your machine?

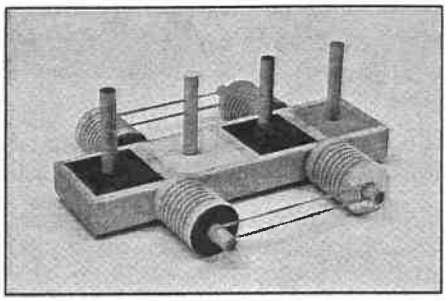
Developing Physical Knowledge:

How can I make the wheels roll on my car?

How can I make one Bobbin turn the other Bobbins?

What will happen if I put a Dowel in between the rubberband when I turn the Bobbin?





Enhancing Imaginative Play:

Can you make a car that goes on land and on water? - What is the name of your car? Where do you like to drive it? Do you go with a friend or by yourself? Can you drive it in the dark?

Can you make up an animal that only lives where it is very, very hot? - Why does it have a red head? Why does it have green feet?

Can you make a machine that makes big logs move? - What is the name of your machine? How does it work?

Encouraging Cooperative Problem Solving:

I want to find a way to make a car that I can push and pull. - Can you help me?

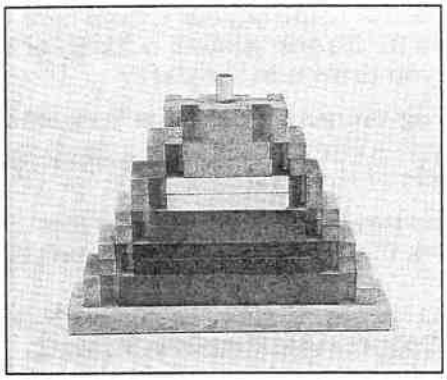
How can we make the four Bobbins stay up in the air without putting a Dowel in the hole?

Nurturing Aesthetic Ideas:

I am lining all the reds and blues on one side and the greens and yellows on the other side. - I like the way it looks.

Can you find a picture of a car that you like as much as your THINGAMABOBBIN car? - Why do you like the car in the picture?

Stackbuilder



Memory Games:

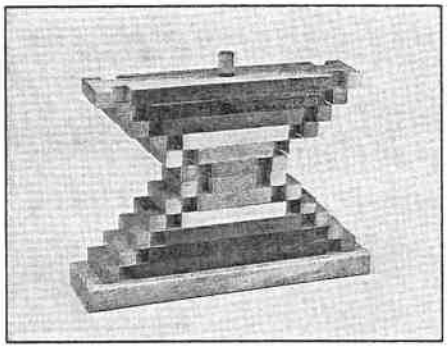
Put out two red, two blue, two green stacking blocks. - Close your eyes, and I will take away one stacking block. Open your eyes. What color is missing? *[Keep increasing the number of colors until all the colors are used together.]* Ask the children to play the game with each other.

Place some of the stacking blocks on their edge so that all the color is on the middle except for one where the color is on the ends - Which block has the color on a different place? *[Keep increasing the number of stacking blocks until the whole set is included].*

Stimulating Language Skills:

Close your eyes - Describe how the stacking piece feels. Is it smooth? Bumpy? Soft? Hard? Fat? Thin?

Name the building you are making - Is it a boat? A space ship? A robot? Invent a new name for your building. Would your friend know what your building looks like just from hearing its name? What is your building used for? Who lives in it? Is it warm inside? What do the people (or animals) do inside the building? Tell me the story about your building, and I will write it down on paper.

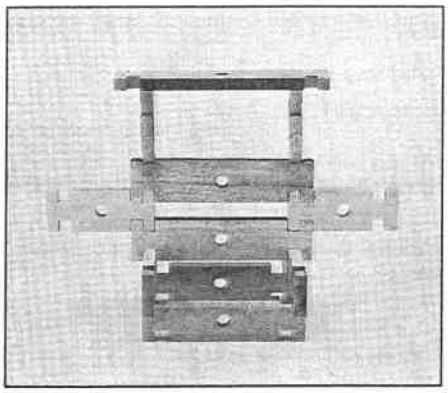


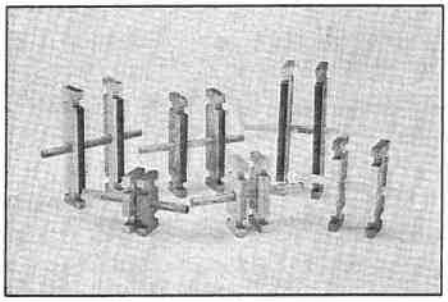
Encouraging Logical/Mathematical Thinking:

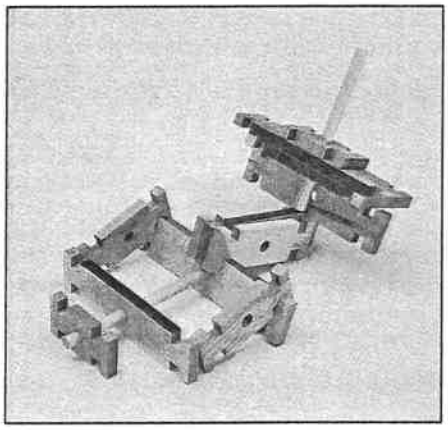
Seriation - Can you make the same pattern as this one? (Pattern shows blocks arranged in graduated increase in lengths.) What piece would come next? Why do you think these blocks have to get shorter and shorter (in some structure where support is better with longer blocks on bottom). What if we inverted the pyramid stack? Why is your stack getting smaller and smaller at the top?

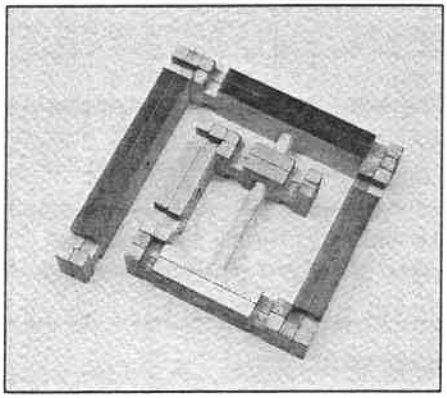
Shapes - How many size rectangles can you make with this set? Can you make a circle with these blocks? Can you put one rectangle inside another?

Classification - How would you describe these blocks as a set? Can you make two of anything? Are there more short blocks or more long blocks? (Provokes children to think about the relative value of short and long.)









Developing Physical Knowledge:

Can you make two stacking pieces lean on each other without falling?

Can you make a see-saw (balance beam) using the stacking pieces? - (Use narrow edge of one piece as fulcrum.) Are there different ways to balance the stacking pieces?

How many different ways can you attach the stacking pieces together to keep them together? - Which way is the strongest?

Enhancing Imaginative Play:

Can you make a house? - I made one with different shaped windows.

Can you make a fenced-in yard? - I made one for my dog and cat. Can you make a cage for some wild, ferocious animals? I made a strong cage so the animals can't escape.

Can you make a pair of space goggles? - I made one for a creature with six eyes.

Can you make a striped animal that lives in the jungle? - I made one with green and yellow stripes so that he can hide behind the trees.

Can you make a helicopter with a twirling propeller? - I made one that can fly in a hurricane.

Can you make a family that lives in a cave? - I made the Belly Button family. This is Mr. and Mrs. Belly Button and their six children.

Encouraging Cooperative Problem-Solving:

I can make the red and orange house; you can make the blue and green house. - Can you make a road so we can get to each other's houses?

How high can I stack these pieces together? - Can you hold on to the bottom of my building while I keep attaching the other stacking pieces?

Can you help me make a swing with the stacking pieces? - I need someone to hold the pieces together while I put the Dowel in the hole.

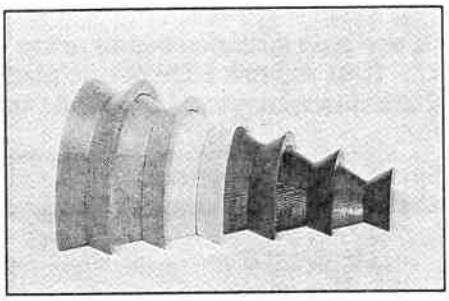
Nurturing Aesthetic Ideas:

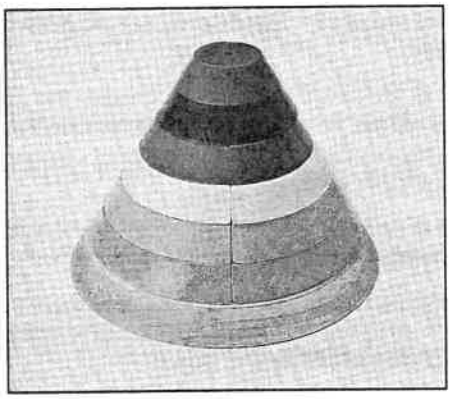
Can you make a colored wall on your house? - I am making a beautiful wall for the outside of my house? All the colors will touch each other.

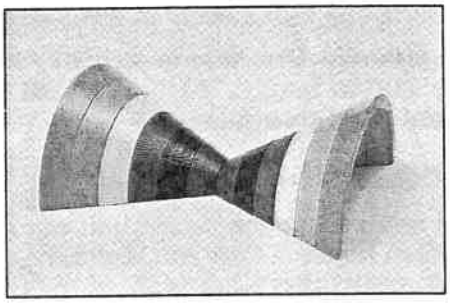
Can you make soft shadows on the inside of your house? - If I shine the flashlight into the round windows of my house, it makes beautiful shapes.

Can you make a special floor for your house? - I like the floor that is all wood. I like the light and dark lines on the wood better than the colored pieces.

Arcobaleno







Increasing Perceptual Skills:

Arcobaleno means "rainbow" in Italian - Can you put the colors back so they look like the rainbow? Can you find other rainbows in the room? Other color sequences like a rainbow? In any books? On someone's clothes?

Can you see all the pieces when you make a bowl, a tunnel? - What pieces can you not see?

Stimulating Language Development:

Tell me about your round house - Who lives it it? Why is it round? What kind of furniture would you put in your round house? What kind of people live in a round house? What kind of pets would they keep? How do people get in and out?

Tell me about your tunnel - What kind of car or truck would go through your tunnel? What kind of tunnel would you need for a large elephant? For a mosquito?

Can you make a concave house? - A convex house? Who or what would live in each of those houses?

What do you call your design? - What does it look like?

Encouraging Logical/Mathematical Thinking:

The design of the ARCOBALENO set lends itself to a variety of serial patterns - Observe the patterns that the children construct and make drawings of them on cards. Other children may want to reconstruct them or draw their own variations. See page 15 for observations of Christine.

Make a design with half of the ARCOBALENO - [Place a mirror standing next to the design]. Can you make the design that is showing in the mirror?

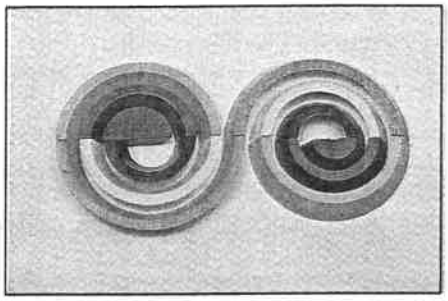
What is the longest snake you can make with the ARCOBALENO? - Mark on a piece of paper where the snake begins and where it ends. How many different ways can you make snakes that are the same size?

Can you make a building that is symmetrical (the same on both sides)? - Can you divide your building in half?

Enhancing Imaginative Play:

Tell me a story about your slithering snake - What is her name? Where does she live? Who are her friends? Is she happy or sad? How would someone know by looking at her how she is feeling?

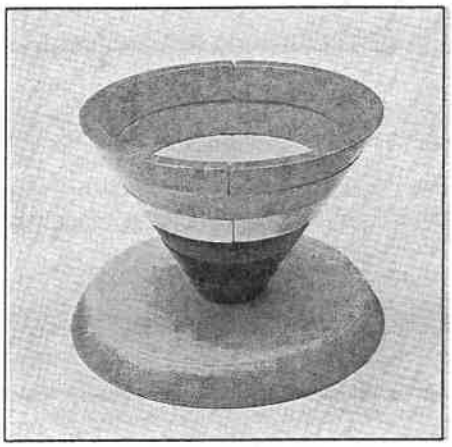
Tell me a story about your volcano - Will it explode? How can the people and animals climb to the top? What do we need for their safety? Will they fall in? *[You can add miniature figures and animals to enrich the imaginative play.]*



Encouraging Cooperative Problem-Solving:

I made a rainbow worm, and you made a rainbow worm - How can we join them together to make one big worm that will still fit in my small worm house?

I need a circle for all of my six circus animals - If you give me some of your pieces we could put them together.



Developing Physical Knowledge:

Can you make a bowl without the pieces falling down? - Tell me how you did it. Why did the pieces fall down before? Can you make a bowl so the pieces *will* fall down?

Can you make a spiral building that will stand up? - What makes it stay up?

Can you make your circle stand up? - What do you need to support it?

Have you ever seen a real rainbow? - How can you make a rainbow of light yourself? Could you show me how with this glass prism?

Let's look at this book on shellfish - Can you find a shell that has a spiral? How is it similar to the spiral you made? How is it different? Where are the individual pieces (the breaks) that make the shell spiral?

Nurturing Aesthetic Ideas:

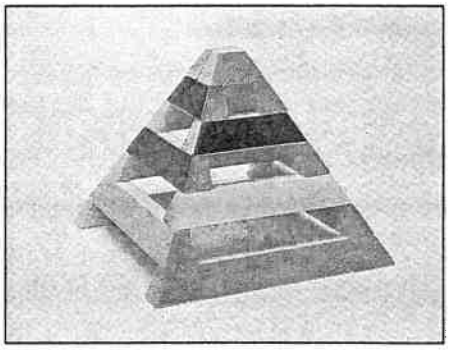
I like my building better when all the colors of the rainbow are in line - It is so smooth and shiny.

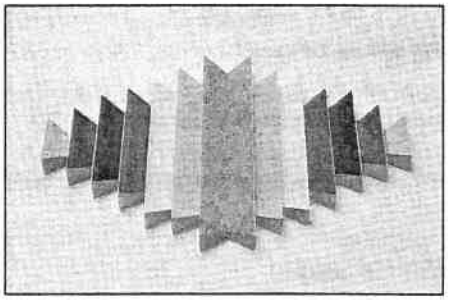
Do you like round houses better than square ones? - I like round houses better because the inside is all curved around.

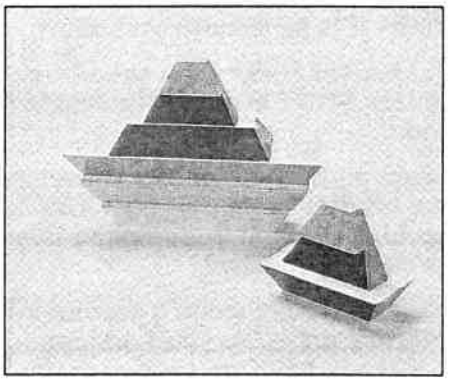
Bring in some books on the history of architecture - Can you find some buildings in this book that are like the ones you built? Which buildings in this book do you like the most? Why?

Bring in some books on contemporary geometric art, Islamic art and Tantric art - Can you find some shapes in these pictures that are similar to the ones you made? Which pictures do you like? Do you like the colors or the shapes or both?

Pyramid







Increasing Perceptual Skills:

Can you find any grains on the natural wood that are the same? - How would you describe their similarity? Wavy? Splash-like? Striped?

Close your eyes - Can you feel the parts that have been painted?

Let your finger take a walk around the yellow piece with your eyes closed. How does it feel as you "walk" along? Smooth ...smooth ...smooth ...sharp ...slippery ...smooth ...etc.

Stimulating Language Development:

Is your PYRAMID a new building or very, very old?

Bring in some books with pictures of pyramids - Does your PYRAMID look like the one in the book? How is it different?

Tell me about the airplane you made? - Where does it fly on long trips? Who is riding in it? Does it go fast or slow? Can it land in the water?

Encouraging Logical/Mathematical Thinking:

The design of PYRAMID, like ARCOBALENO, lends itself to a great variety of serial patterns - The serial patterns can be varied by alternating the wood surface with the painted surface.

Can you make some symmetrical patterns?

How many different ways can you fit the PYRAMID back into the box?

What forms can you make when the angles fit together? - Can you make a shape that is closed on all sides?

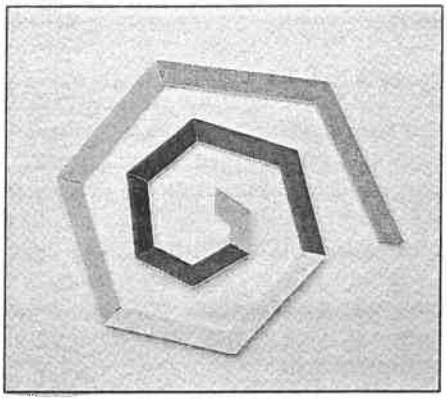
Can you find two colors when put side by side that will equal the same as the red piece? - [The widest sides of each piece will be touching.] Can you find two colors when put side by side that will equal the length of the orange piece ?

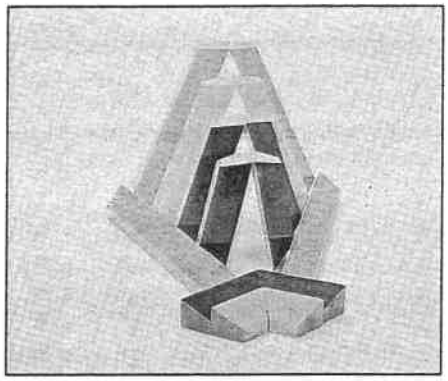
Enhancing Imaginative Play:

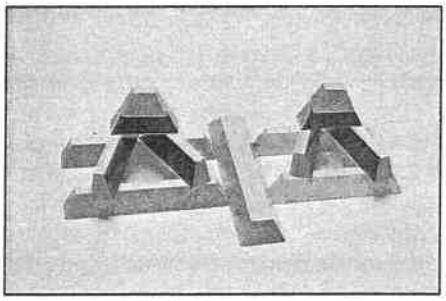
I made a butterfly family - The baby has red-purple wings.

This is my house and this is my friend's house - We live very close together next to a lake where a scary fish lives deep down in the water. This is my boat to use when I try to catch the fish.

This monster is lying down - Watch out! He is getting up!







Encouraging Cooperative Problem-Solving:

I made a spiral design going in - How can we make one going out?

How can we make a tunnel tall enough for our train to pass under?

Developing Physical Knowledge:

Can you make two orange pieces lean on each other without falling down? - What kind of support will help it to stay?

Can I do the same thing with two red pieces? - Two blue pieces? Which ones will work? What is the difference?

Nurturing Aesthetic Ideas:

This building looks like a beautiful church with points reaching up to the sky - I like the way the points push up from the building.

I like my sculpture when the light makes shadows in between the shapes - I can see so many different shapes if I walk around my sculpture.

Bring in a variety of books on architecture and on non-representational sculpture - Can you find some sculptures (or buildings) that look like the one you made? Which one do you like better? Why? Can you make a sculpture (or building) like one in the book? What material did the artist use?

Colorframes

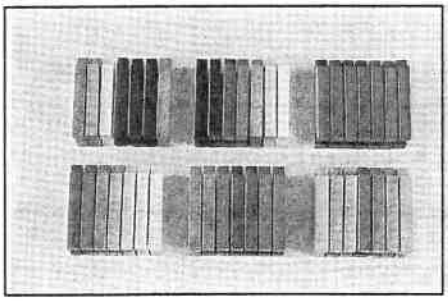
COLORFRAMES is a basic tool for understanding and appreciating the attributes of color. Children as young as three will enjoy building with and talking about the richly colored blocks. Teachers can begin to use clear terminology from the beginning. Concepts of hue, value and intensity can be understood by young children if they are able to "play" with a rich variety of colors. Young children are particularly sensitive to color and delight in noticing small differences.

Color has three basic attributes:

Hue: This concept is used to describe the total color experience. "It's red, blue, etc." This is the historic color name. It is also one of the most basic perceptual distinctions that we make - naming colors. Hues differ as they move from red, to blue, to green.

Value: The most obvious order is to structure hues from light to dark. Value is a word that is used by most color theorists to identify the perception of varying quantities of light. It usually refers to the estimated reflected light from a surface. Values differ as they move within a hue and cast more or less light.

Intensity: This perceptual attribute is most often confused with value. It is, however, a clearly different experience. Chroma or saturation are other words that are used to denote this aspect of color. It can be understood intuitively as the amount of "dullness" or gray (of same value) that is added to a pure hue. Thus red and dull red differ in intensity but could have the same value (amount of reflected light). The undiluted red is more intense, more saturated, less dull. Intensities differ as the color gets more or less gray.



The COLORFRAMES can be grouped into six basic orders utilizing all forty-two colored surfaces. These orders and differences can be seen and named by everyone - from the three-year-old to the mature adult.

1. Try ordering the blocks in a spectrum from red to red-purple (ROYGBIV). (VALUE and HUE change; no INTENSITY change.)

2. Try ordering the blocks from light to dark. (VALUE changes; Black to White.)

3. Try ordering the blocks from the most INTENSE to the least INTENSE with no change in HUE and VALUE. (INTENSITY changes; no HUE or VALUE change.)

4. Try ordering the blocks so the HUE is the same, but the VALUE and INTENSITY change. (VALUE and INTENSITY change; no HUE change.)

5. Try ordering the blocks so the HUE changes but the INTENSITY and VALUE remain the same. (HUE changes; no VALUE and INTENSITY change.)

6. Try ordering the blocks so the value is the same but the HUE and INTENSITY change. (HUE and INTENSITY change; no VALUE change.)

The first three orders are easier; the last three are more complex. There are many other orders that can be created. Try arranging the blocks in any order and talk about the ways each block differs from the others.

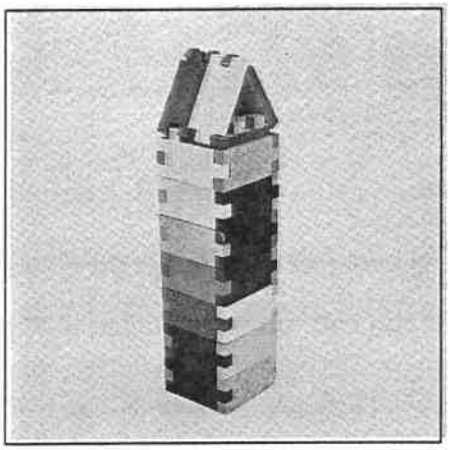
A chart is included in the COLORFRAMES set. Children will enjoy mixing their own colors with paints, trying to match the colors on the blocks or making up new combinations.

COLORFRAMES can also be used in similar ways to other LMW Block sets.

Increasing Perceptual Skills:

Find all the greens - How are they different? Can you find other greens in the room that match the greens on the blocks. Can you paint a different color green? How many greens are there in this room?

Can you build a house with only red walls and a green floor?



Stimulating Language Development:

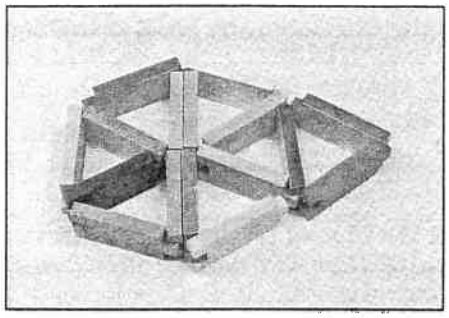
I am decorating my castle with pearly purples on the top and greasy greens on the bottom - I hope no one will slip.

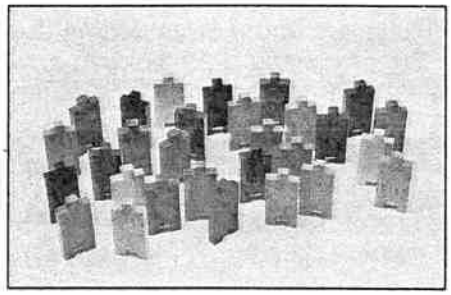
Can you make the walls of your house curve in and out like a snake?

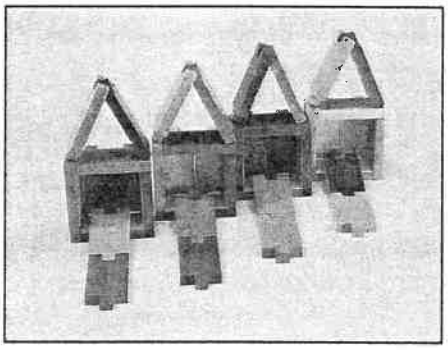
What is the name of this color? - Does it have other names? Can you give it a new name that would help someone else know how it looks.

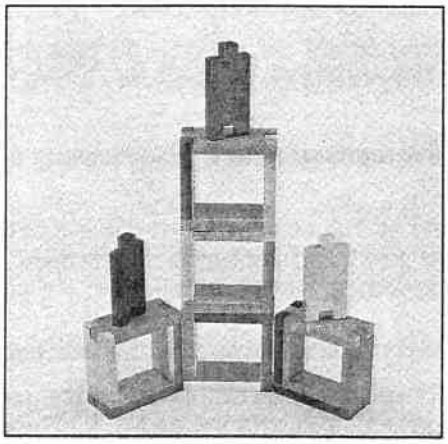
Encouraging Logical/Mathematical Thinking:

Measurement - (Tape off different areas that surround different groups of COLORFRAMES.) How many blocks do you need to fill this "room"? What if the blocks are on their side? What if they are standing up? How many blocks do you need to surround your chair if you put the blocks on their edge? How many blocks high is your chair? My person is tall. Can you make a person twice as tall? Three times as tall?









Shapes - Can you make a three-sided house where all the sides are the same size? Can you make a three-sided house where two sides are the same and one side is longer? Can you make a square house? A rectangular house? A square house with a triangular shape on top?

Enhancing Imaginative Play:

How does this color make you feel?

I made a tower with a magic purple door - If you push on the door, an ugly purple monster will come roaring out and scare you.

This is rainbow country - Everybody is a different color and eats at rainbow tables and has rainbow ice cream.

Encouraging Cooperative Problem-Solving:

Let's build a road from your house to mine - Let's make it start out very light and get really dark when it gets to your house.

Can you design a structure that has only the wood showing on the outside?

Developing Physical Knowledge:

Which is the strongest way to build a very tall, three-sided tower? - Why is one way stronger than the other?

Can you make a door that swings open?

How far apart can you space the bottom row of "people" in your "human pyramid?"

Will your circle of blocks ever be smooth?

Nurturing Aesthetic Ideas:

This is my special picture - I put all the purplish colors in the middle and the reds on the outside. I like the way it looks.

I made a building with three red roofs that sit on curvy walls - It looks beautiful when the sun shines on it and you can see all the different shadows.

Can you find some paintings in this book that use the same colors as the COLORFRAMES? - Which colors do you like best? Why?

Make an angry looking color pattern - A peaceful color pattern, a loud looking color pattern.

VIII. Suggested Readings: Children's Books on Building and Architecture

Although many of the books on this list are written for children in the upper elementary grades, the illustrations and information are very useful in early childhood classrooms.

Barton, Byron. *Building a House.* Puffin Books, 1981.

Cesorani, Glan Paolo. *Grand Constructions.* Putnam Publishing Group, 1983.

D'Aleilio, J. *Know That Building: Discovering Architecture with Activities and Games.* Preservation Press, 1989.

Edom, Helen. *How Things Are Built.* Usborne Publishing Company, 1989.

Forrest, Wilson. *What It Feels Like to be a Building.* Preservation Press, 1988.

Isaacson, Phillip M. *Round Buildings, Square Buildings, Buildings That Wiggle Like a Fish.* Alfred Knopf, 1988.

Macauley, David. *Castle.* Houghton Miflin Co., 1982.

Macauley, David. *Cathedral.* Houghton Miflin Co., 1973.

Macauley, David. *City: A Story of Roman Planning and Construction.* Houghton Miflin Co., 1983.

Macauley, David. *Pyramid.* Houghton Miflin Co., 1975

Macauley, David. *Unbuilding.* Houghton Miflin Co., 1980

Maddex, Diane and Munro, Roxy (illustrator). *Architects Make Zig Zags: Looking at Architecture from A to Z.* Preservation Press, 1986.

Maxon, Dianne and Patton, Sally J. *Architexture: A Shelter Word - A Source Guide for Self-Directed Units.* Revised edition, Zephyr Press, 1989.

Winters, Nathan. *Architecture is Elementary.* Gibbs Smith, 1986.