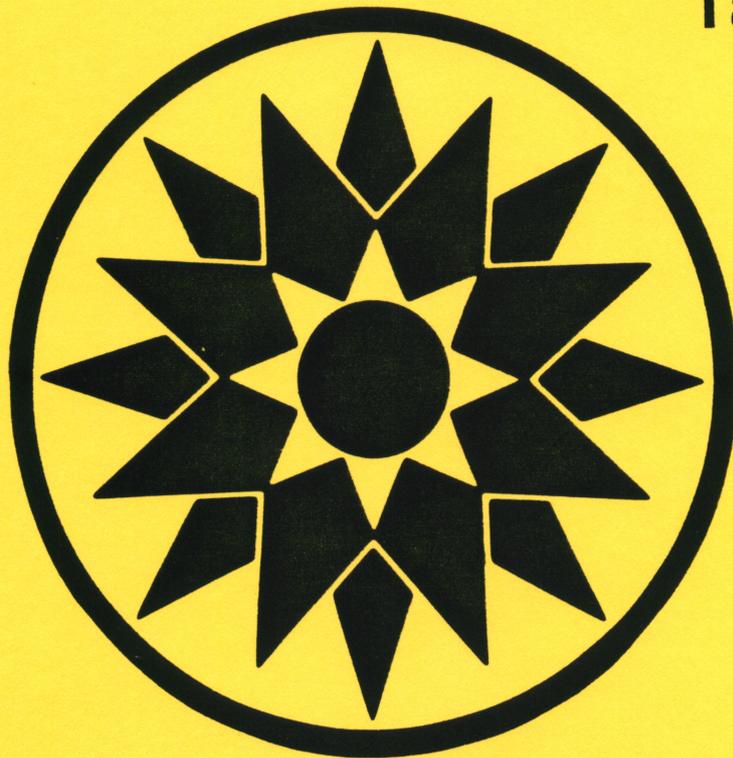


Teacher's Guide

The Right Turn: Strategies in Problem Solving

Apple
Commodore 64
IBM PC/PCjr
Tandy 1000



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If you are using an IBM or Tandy 1000

STOP!

Before you use this program . . .

you must add DOS (IBM/TANDY) to your diskette. It's a simple procedure and need only be done once. After you've finished, throw this page away and enjoy the courseware!

NOTE: With the 64K IBM PC use only DOS 1, or 1.1.
PCjr requires 128K, DOS 2.1 and Cartridge BASIC.
On the Tandy 1000, use DOS 2.11.22 with Tandy BASIC 1.02.00.

ADDING DOS WITH ONLY ONE DISK DRIVE:

1. Put the DOS diskette into the disk drive. Close the door and turn on the computer and monitor.
2. Press ENTER () in response to the "date" and "time" requests given by the computer.
3. When "A >" appears on the screen, remove the DOS diskette and insert the program diskette into the drive (don't forget to remove the write-protection sticker from the edge of the program diskette).
4. Type START-1 and press ENTER ().
5. Follow the disk-switching instructions given by the computer. After you have finished, the program will start automatically.

ADDING DOS WITH TWO DISK DRIVES:

1. Put the DOS diskette into Drive A (Left on IBM/Bottom on Tandy). Close the door and turn on the computer and monitor.
2. Press ENTER () in response to the "date" and "time" requests given by the computer.
3. When "A >" appears, remove the DOS diskette from Drive A and put it into Drive B (Right on IBM/Top on Tandy). Then put the program disk into Drive A (don't forget to remove the write-protection sticker from the edge of the program diskette).
4. Type START-2 and press ENTER (). The program will begin automatically.

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Pembroke Hill is an independent, college preparatory school that emphasizes students' individual needs through a holistic, interdisciplinary approach to learning.

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INTRODUCTION

THE RIGHT TURN is designed to reinforce problem solving skills. Students solve problems by rotating or flipping a pattern in a 3x3 grid. The TEST and CHALLENGE portions of the program include analogy problems. For example: Grid 1 is to Grid 2 as Grid 3 is to ?. As a basis for the development of problem solving material, Sunburst has adopted a Problem Solving Skill Matrix devised by a group of teachers from Rochester, Minnesota. The Matrix (see p. 2) organizes problem solving skills and strategies into four columns:

MEMORY

COGNITIVE SKILLS (Discrimination, Attributes, and Rules)

COGNITIVE CONTROL STRATEGIES

CREATIVITY

THE RIGHT TURN is designed to provide practice in the second and third matrix columns: "Cognitive Skills" and "Cognitive Control Strategies." Two of the most important problem solving skills students practice are:

- * Looking for a pattern or a sequence. They examine 3x3 grids and determine which rotation or flip has caused the pattern to be altered.
- * Information gathering. They PLAY with figures and record results, then apply their knowledge in PREDICT and TEST.

Students also must apply the mathematical skills of:

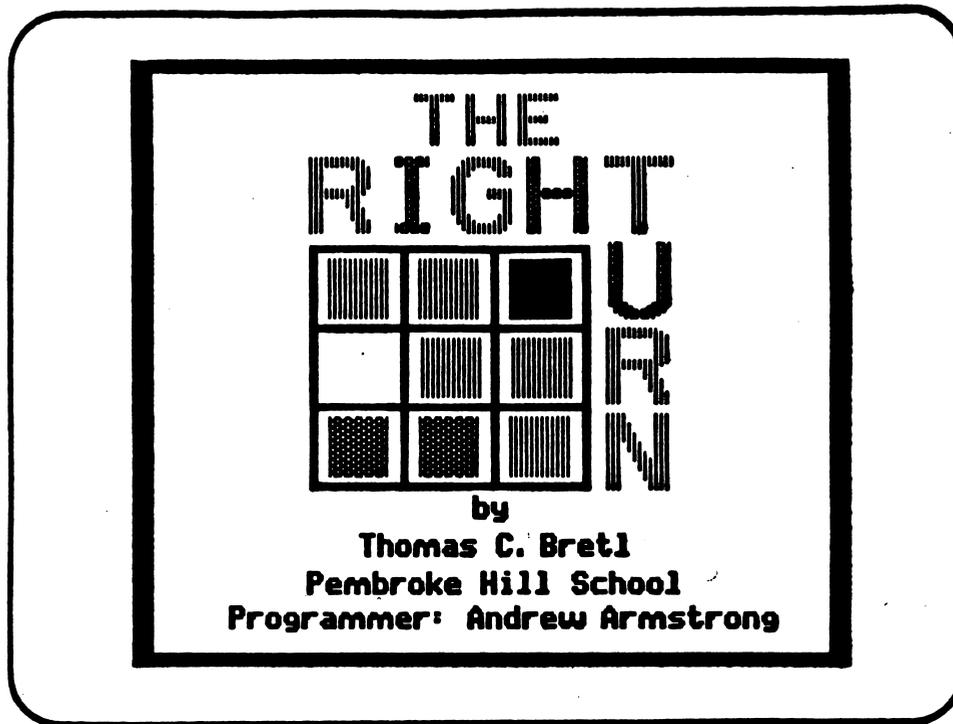
- * Rotation. They turn figures 90, 180, 270, or 360 degrees.
- * Axis of symmetry. They flip a figure across a horizontal, vertical, or right or left diagonal axis.

The program requires students to choose the rotation or flip that will correctly complete an analogy. Worksheets in the guide reinforce the concepts of both verbal and visual analogies.

Problem Solving Skill Matrix

<ul style="list-style-type: none"> ● Mnemonic Systems ● Visual Association ● Whole to Part ● Self Testing ● Creating a Context ● Personalization ● Regrouping ● Auditory Aids ● Number of Items to Remember ● Sequence 	<div style="border: 1px solid black; padding: 5px; text-align: center; font-weight: bold; font-size: 1.2em;">The Right Turn</div> <ul style="list-style-type: none"> ● Higher Order Rules ● Rules ● Defined Concepts ● Concrete Concepts ● Discrimination 	<ul style="list-style-type: none"> ● Simultaneous Scanning ● Selecting Appropriate Notation ● Identifying Multiple Solutions ● Examining Assumptions ● Working Backward ● Using a Model ● Focus Gambling ● Conservative Focusing ● Estimating, Predicting, Projecting ● Scanning for Clues, Hints ● Restating the Problem ● Analyzing ● Making Organized Lists ● Looking for a Pattern or Sequence ● Brainstorming ● Openness to Insight, Flexibility ● Successive Scanning ● Retrieval Strategies ● Information Gathering ● Problem Finding 	<ul style="list-style-type: none"> ● Fluency ● Flexibility ● Originality ● Elaboration
<p>MEMORY</p>	<p>COGNITIVE SKILLS [DISCRIMINATION, ATTRIBUTES AND RULES]</p>	<p>COGNITIVE CONTROL STRATEGIES</p>	<p>CREATIVITY</p>

THE RIGHT TURN: PROGRAM OBJECTIVES



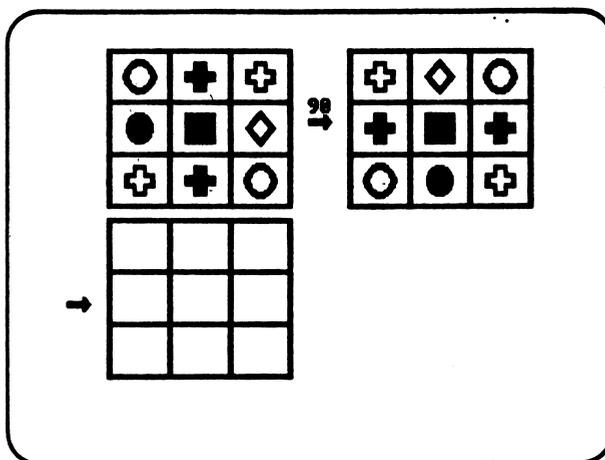
- SKILLS:** Visual discrimination
Scanning for clues or hints
Looking for a pattern or sequence
Information gathering
- GRADE LEVEL:** 4 - adult
- READING LEVEL:** 4th grade (for instructions)
- TIME REQUIRED:** 5 minutes
- OBJECTIVES:**
- * To help students experiment with mathematical transformations -- such as rotation in a plane or flipping a pattern across horizontal, vertical, and diagonal axes.
 - * To help students develop visual thinking skills, including spatial perception and spatial reasoning.
 - * To give students practice analyzing a problem and predicting an outcome.

PROGRAM DESCRIPTION

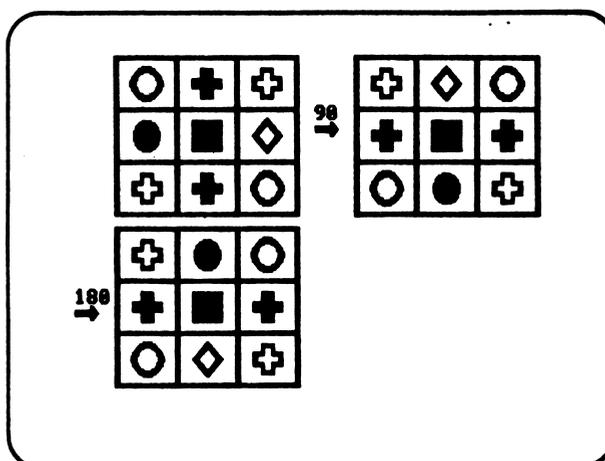
Overview

The object of THE RIGHT TURN is to fill a 3x3 grid with colorful patterns* and then predict how those patterns change when the grid is rotated or flipped.

There are four possible rotations: 90, 180, 270, and 360 degrees. The direction of rotation is always counter-clockwise. The transformation shown below is an example of a 90-degree rotation:

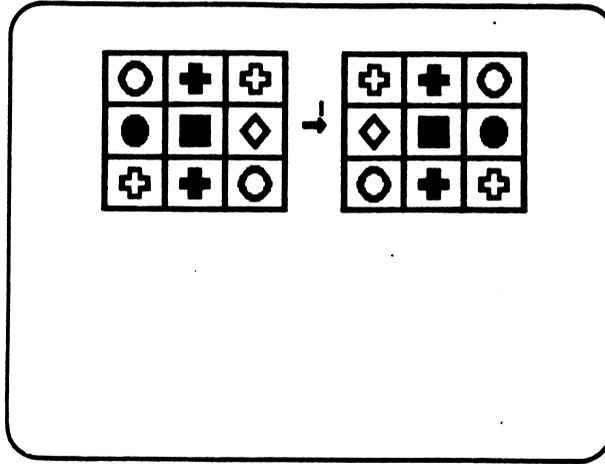


The third grid shows a rotation of 180 degrees:

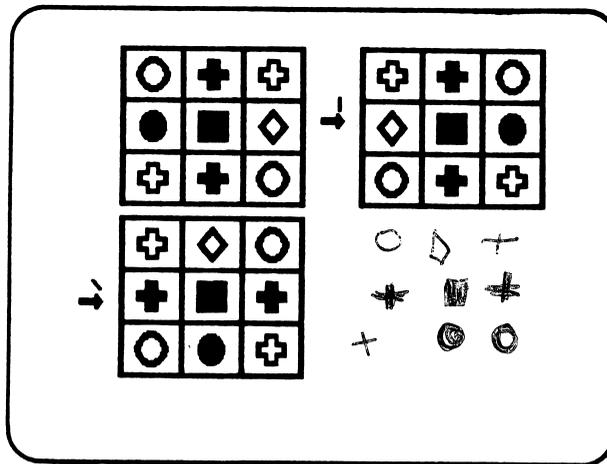


* NOTE: Since the manual is in black and white, all examples use black-and-white shapes in the grid rather than colors.

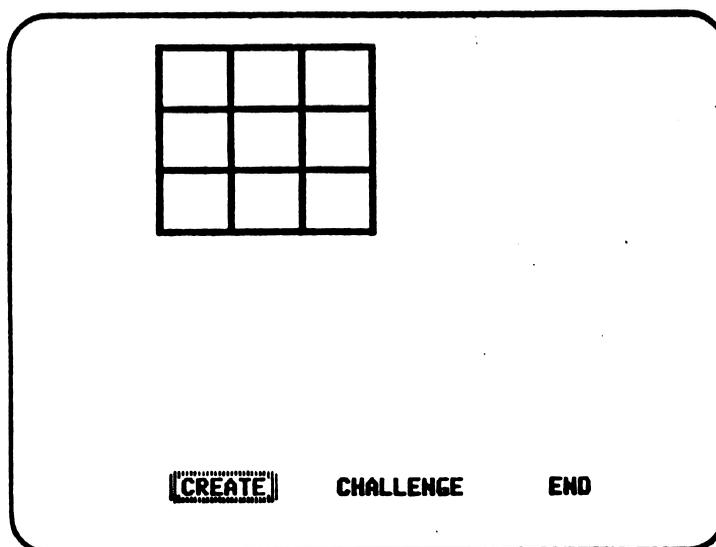
Patterns may also be flipped across an axis: a horizontal (-), vertical (|), or left (\) or right (/) diagonal. For example, the transformation below shows a vertical flip -- that is, a flip across the vertical (|) axis:



The third grid below shows a left diagonal flip of the second grid -- that is, a flip across the left diagonal (\) axis:



The Main Menu



Students first are presented with three main menu choices:

CREATE -- They make their own color or shape pattern -- for use in various challenges.

CHALLENGE -- A colored pattern is randomly generated for use in analogy challenges.

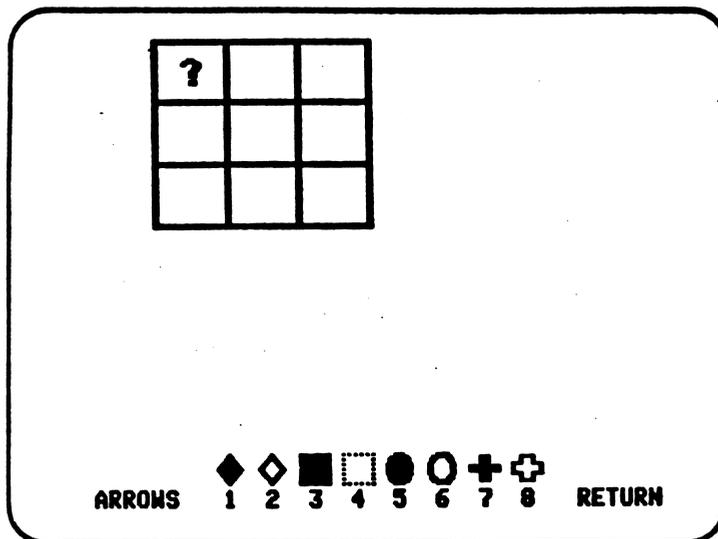
END -- They end the program or restart the game.

To make selections:

- * On the Apple (keyboard version), students use the left and right arrow keys to move the box over their choice. Then they press the RETURN key.
- * On the Apple (Touch Window version), students touch the menu choice they want. When they lift their finger, they go to that selection.
- * On the Apple (mouse version), students move the pointer to the choice they want and click the button to go there.
- * On the Commodore 64, students use the < and > or the cursor (CRSR) keys to move the box over their choice. Then they press the RETURN key.
- * On the IBM PC and Tandy 1000, students use the left and right arrow keys to move the box over their choice. Then they press the ENTER (↵) key.

CREATE

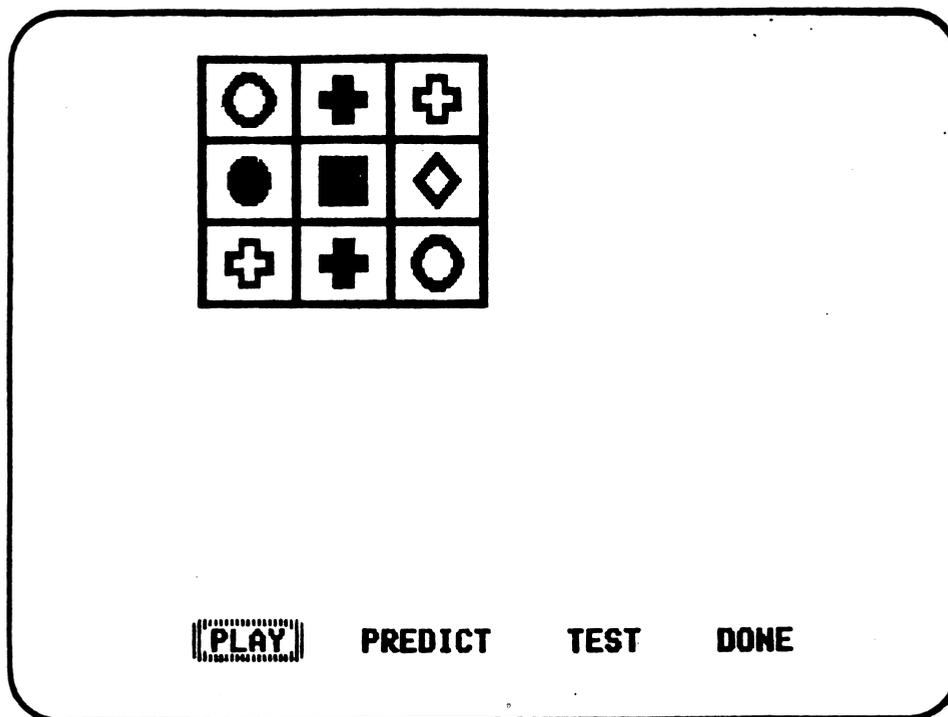
CREATE allows students to enter a pattern in a 3x3 grid. Each time a color/shape is chosen, the question mark moves to the next square in the grid.



Students can change their pattern by moving the question mark to any square in the grid and choosing a different color/shape. To make a pattern:

- * On the Apple (keyboard version), students select a color/shape by pressing keys 1-8. They can also move the question mark by pressing the arrow keys. When the pattern has been completed, they press the RETURN key.
- * On the Apple (Touch Window version), students touch the color/shape they want, and the square with the question mark is filled when they lift their finger. They move the question mark by touching the square they want and lifting their finger. When the pattern has been completed, they touch the word "DONE" and lift their finger.
- * On the Apple (mouse version), students move the pointer to the color/shape they want and click the button. They shift the question mark by moving the pointer to the square they want and clicking the button. When the pattern has been completed, they move the pointer to "DONE" and click the button.
- * On the Commodore 64, students select a color by pressing keys 1-8. They move the question mark by pressing the < and > or CRSR keys. When the pattern has been completed, they press the RETURN key.
- * On the IBM PC and Tandy 1000, students select a color by pressing keys 1-8. They move the question mark by pressing the arrow keys. When the pattern has been completed, they press the ENTER key.

After students create a pattern, they have several other options:



They may:

PLAY with the pattern (by rotating or flipping it);

PREDICT the pattern resulting from a randomly-generated rotation or flip;

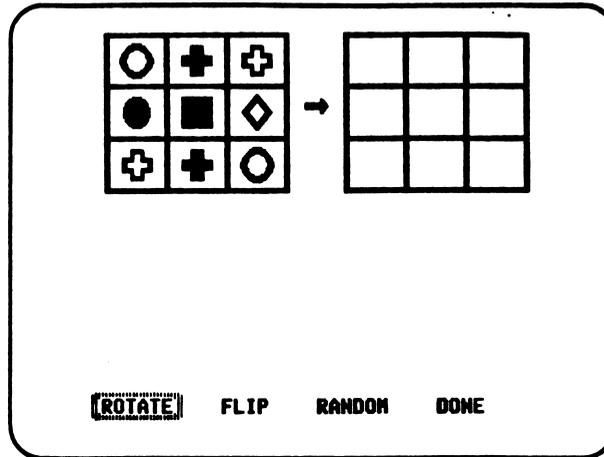
TEST themselves on an analogy;

or choose DONE, which returns students to the main menu.

If students are just beginning to use the program, they should select PLAY or PREDICT rather than TEST.

CREATE - PLAY

PLAY allows students to see how the rotation and flipping options work by trying different transformations of their pattern.



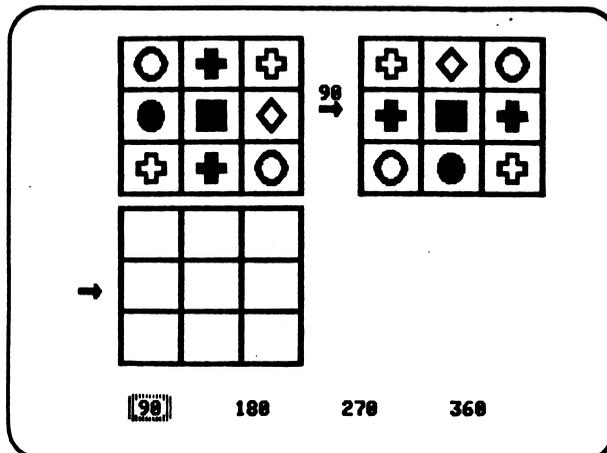
Students can choose to ROTATE or FLIP their pattern, or they can select RANDOM to have the computer choose a transformation.

The computer performs the current transformation and displays the result on another grid. For any given starting pattern, students may create up to three successive transformations using the ROTATE, FLIP, and RANDOM options. They may also select DONE at any time.

PLAY - ROTATE

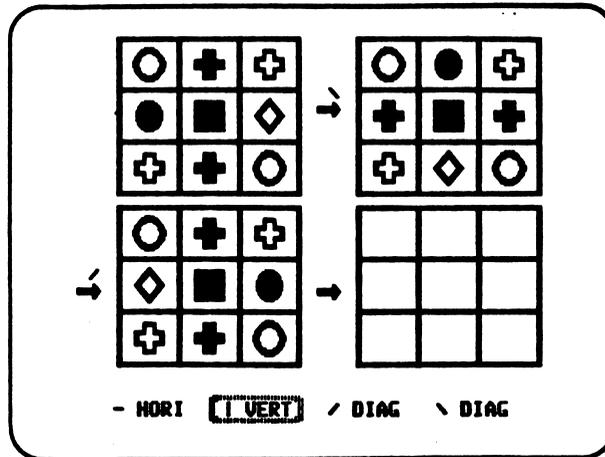
If students choose ROTATE, they are given the following choices:

- 90 - To rotate 90 degrees counter-clockwise.
- 180 - To rotate 180 degrees counter-clockwise.
- 270 - To rotate 270 degrees counter-clockwise.
- 360 - To rotate 360 degrees counter-clockwise.



PLAY - FLIP

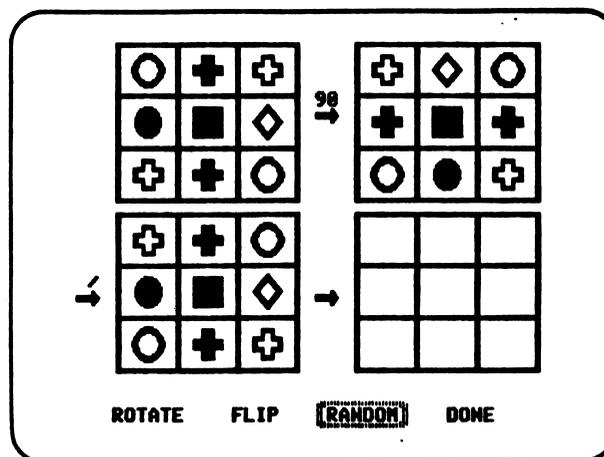
If students choose FLIP, they are given the following choices:



- HORI -- To flip across the horizontal axis; top and bottom rows switch.
- | VERT -- To flip across the vertical axis; left and right columns switch.
- / DIAG -- To flip across the right diagonal; each row becomes the corresponding column.
- \ DIAG -- To flip across the left diagonal; each row becomes the corresponding column.

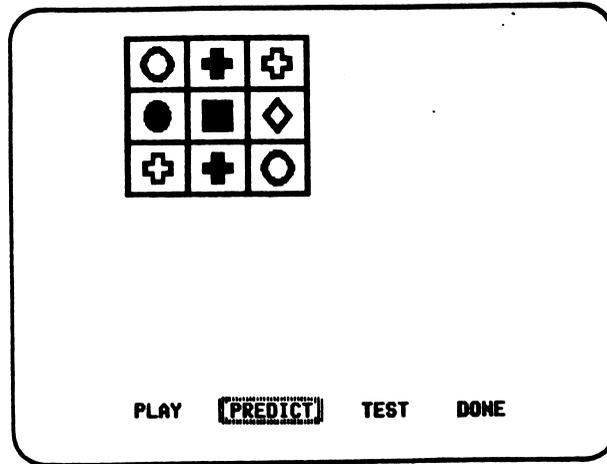
PLAY - RANDOM

If students choose the RANDOM option in PLAY, the computer selects a transformation -- any of the rotations and flips -- and performs it.

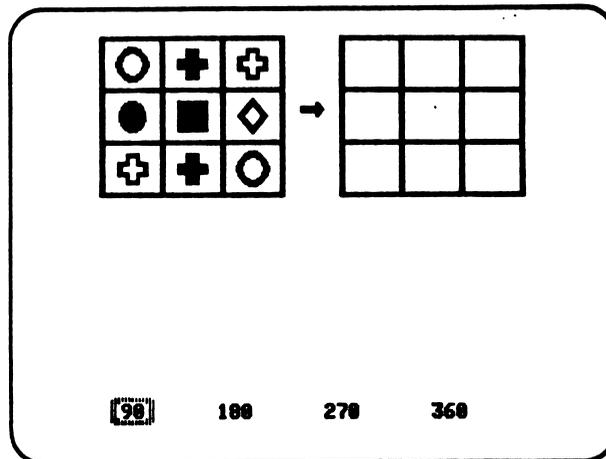


CREATE - PREDICT

The second option available after students have created a pattern is PREDICT.



This choice works just like PLAY, except that after a transformation is chosen, students must predict the outcome of the transformation rather than having the computer fill in the transformed grid.



Using the example on the bottom of page 11, suppose students choose to ROTATE the pattern 90 degrees:

○	+	+	?		
●	■	◇			
+	+	○			

90
→

ARROWS
1
2
3
4
5
6
7
8
RETURN

They must predict a 90-degree turn by choosing the appropriate pattern of colors/shapes in the second grid.

○	+	+	+	◇	○
●	■	◇	+	■	+
+	+	○	○	●	+

90
→

Good Prediction!
Press RETURN to continue.

If students are correct, the message "Good Prediction!" is printed. After they press the RETURN (ENTER) key, a blank grid is displayed for the next transformation. With a Touch Window, students touch the spot or the word "HERE" on the screen to get the next blank grid. With a mouse, students move the pointer to the spot or the word "HERE" and click the button.

If students do not predict correctly, their prediction is erased, and they're allowed to try again or to see the correct transformation. For example:

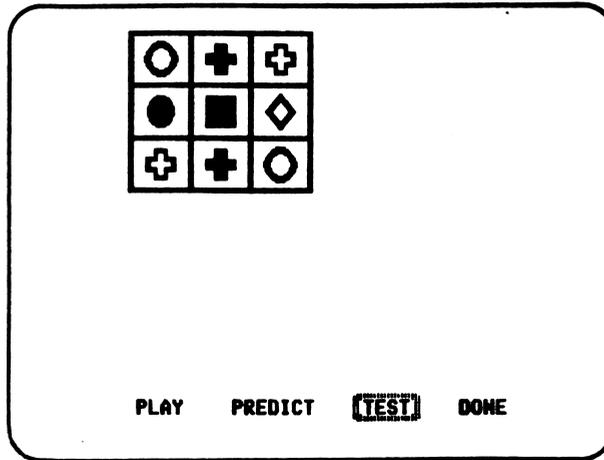
Incorrect prediction.

Do you want to try again?
 YES NO

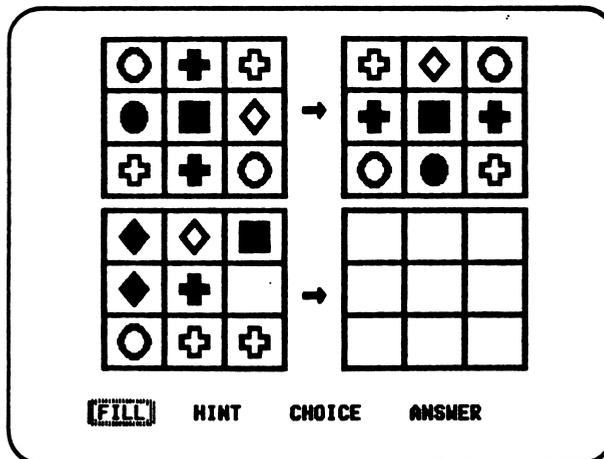
Good Prediction!
 Press RETURN to continue.

CREATE - TEST

Besides PLAY and PREDICT, the CREATE section of the program has a TEST choice that challenges students to solve an analogy problem.



After students create a grid, they may choose TEST. The pattern is then rotated or flipped. Next, a new grid is produced to test their ability to carry out a similar transformation.



In the above example, the analogy problem represented is:

Grid #1 is to Grid #2
AS
Grid #3 is to Grid #4

The transformation on the first line is displayed for the student. He or she completes the analogy on the second line.

TEST offers students four choices in solving the analogy:

FILL -- They predict the effect of a transformation by filling in all the squares of a grid.

HINT -- They're given a hint about which transformation is being used.

CHOICE -- The squares are filled in for them, illustrating different possible solutions. Students respond "YES" or "NO" to each possible outcome until the correct one comes up.

ANSWER -- The correct pattern is shown.

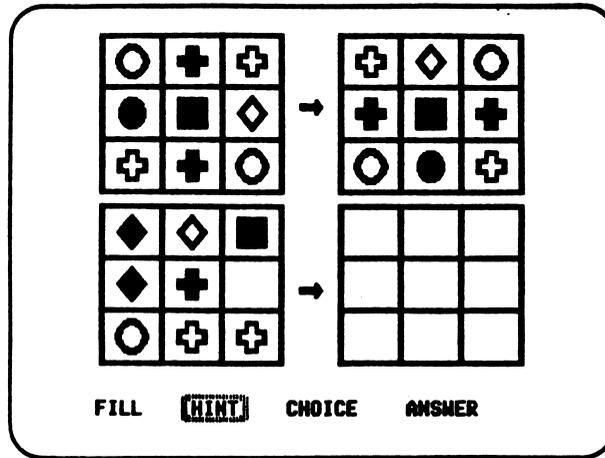
TEST - FILL

If students know the answer or want to try a prediction, they choose FILL and then fill in the lower right grid to complete the analogy.

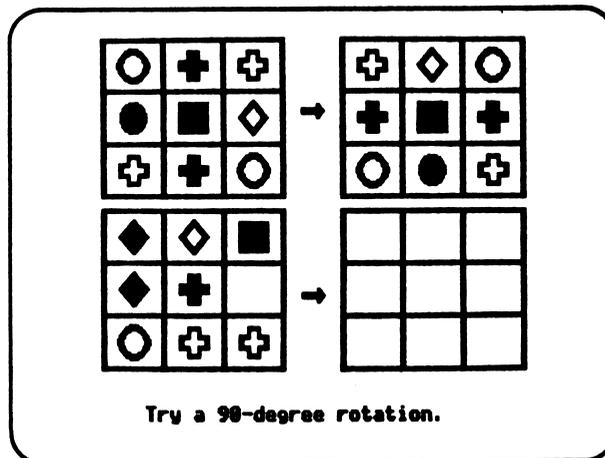
FILL HINT CHOICE ANSWER

If students fail to complete the analogy correctly, the program prints an appropriate message and erases the predicted solution. Students are allowed to continue working on the problem and may select any of the menu options in TEST.

TEST - HINT



Students may ask for a HINT to help them solve an analogy problem. A hint -- a description of the analogy being used -- is shown at the bottom of the screen for several seconds. Then students may choose an option (FILL, HINT, CHOICE, or ANSWER) again.



TEST - CHOICE

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◇	◇	■																		
◇	+																			
○	+	+																		
FILL	HINT	CHOICE	ANSWER																	

In this option, a possible solution is presented in the lower right grid. Students respond:

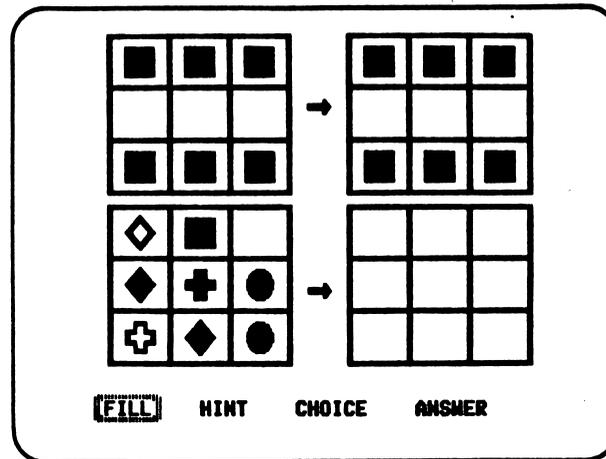
- YES -- The solution is correct.
- NO -- The solution is not correct.

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◇	+																			
○	+	+																		
■		+																		
◇	+	+																		
◇	◇	○																		
YES	NO																			

If an incorrect solution is shown and students answer NO (correctly), another solution is presented. They continue to examine randomly-generated solutions, deciding each time whether the choice correctly completes the analogy.

Possible Ambiguity

When students create a pattern in the upper-left grid and then choose TEST, there is a possibility that the solution to the analogy will be ambiguous. For example, in the analogy problem below, it is impossible to know exactly which transformation occurred between Grid #1 and Grid #2.

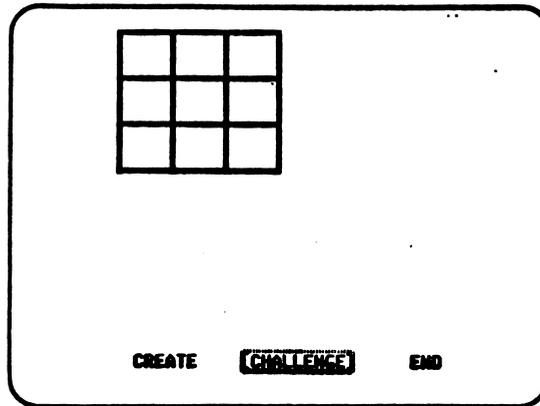


In this case, a 180- or 360-degree rotation, a horizontal flip, and a vertical flip all yield the same pattern in Grid #2.

If students complete such an ambiguous analogy correctly but do not use the same transformation that was randomly generated by THE RIGHT TURN, they are acknowledged for finding a "reasonable" solution. Then they're prompted to try again. This process continues until students find the exact transformation that was randomly generated.

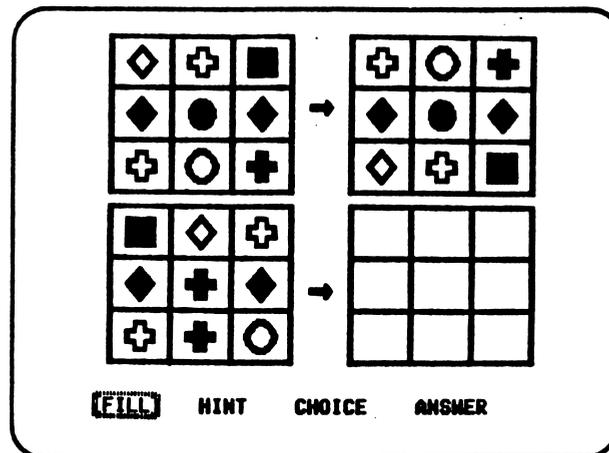
CHALLENGE

If students choose CHALLENGE, the second option on the main menu, a pattern is created and transformed for them. They are then challenged to do an analogous transformation. CHALLENGE works like the TEST portion of CREATE. It is available from the main menu to allow faster entry for experienced players. Also, unlike TEST, in which students provide the starting patterns, here the starting patterns are provided for them, so ambiguity does not arise.

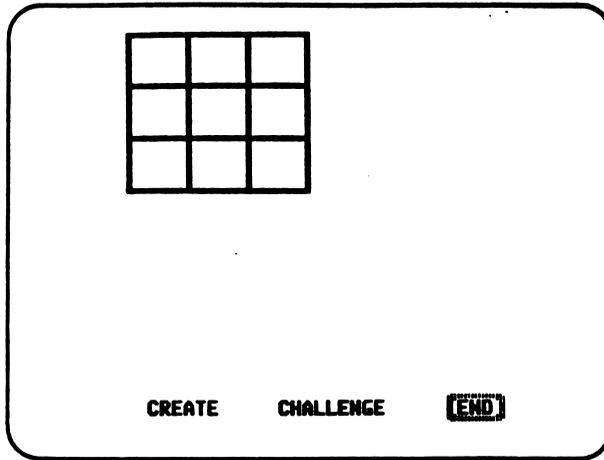


After students choose CHALLENGE, the upper-left grid is filled with a pattern. That pattern is then rotated or flipped and printed in the second grid; students aren't told what kind of transformation was performed. Another pattern is then printed in the third grid. Students solve the analogy problem by duplicating the transformation that was done in the second grid; they use the fourth grid for their answer.

As in TEST, CHALLENGE offers students four choices in solving the analogy: FILL, HINT, CHOICE, and ANSWER. See pp. 15-18 for a detailed description of how these choices work. After the correct solution to the analogy problem is found, students return to the main menu.



END



END, the final option on the main menu, allows students to restart the program (reread the instructions) or end the program.

CHANGE OPTIONS

THE RIGHT TURN provides several special options for teachers: turning the sound on or off (all machines), changing the colors or shapes used in the grids for different monitors (Apple, IBM, and Tandy 1000), and choosing between the keyboard, mouse, or Touch Window (Apple only). These changes can be made from only one place in the program -- when players are asked at the beginning "Do you want instructions?" At this point, teachers hold down the Control (CTRL) key and press the T key to use the Change Options.

Before entering Change Options, teachers should remove the write-protect sticker on the diskette.

Sound

THE RIGHT TURN is initially set to use sound. However, teachers can turn off sound for classroom use. After pressing Control-T, the following question appears: "Do you want sound?"

Choosing "NO" turns off the sound. Choosing "YES" turns the sound on again. Sound remains on or off -- as it is set -- even if the program is removed and restarted later. NOTE: If sound is turned on, students may also press Control-S to turn it off while they're playing THE RIGHT TURN.

Monitor (Apple, IBM, and Tandy 1000)

THE RIGHT TURN is initially set for use with a color monitor or TV. However, teachers with black-and-white or other types of displays can change this setting so the program uses patterns or colors more fitting to their monitor. After the sound question, teachers are asked which of two sets of colors/patterns looks better on the screen.

- * On the Apple, teachers choose the first set (1) to use colors in the program. They choose the second set (2) to use patterns (specifically designed for a monochrome monitor or black-and-white TV).
- * On the IBM and Tandy 1000, teachers choose the first set of colors (1) for use with an RGB color monitor. They choose the second set (2) for use with a composite color monitor.

Keyboard, Mouse, or Touch Window (Apple)

THE RIGHT TURN is initially set for use with a keyboard. However, it can also be played with a mouse or the Touch Window. After the monitor question, teachers are asked which device they want to use. As in the other Change Options, once teachers choose a setting it remains in place until they change it again. (See p. 35 for instructions on installing the Touch Window.)

CLASSROOM USE

Before Using the Program

Before actually using THE RIGHT TURN with students, teachers may wish to describe to them the eight possible transformations of a 3x3 grid:

Four possible rotations -- 90, 180, 270, and zero (0) or 360 degrees.
(Note: A zero-degree or 360-degree rotation leaves the pattern unchanged.)

Four possible flips -- horizontal, vertical, and left or right diagonal.
Each of these flips moves across one of the axes on the grid plane.

A horizontal flip interchanges the top and bottom rows of the grid across the horizontal axis. The center row remains unchanged. Likewise, a vertical flip interchanges the left and right columns, while the center column remains unchanged.

The effect of a diagonal flip is more difficult to describe. A left-diagonal flip moves across the diagonal axis running from upper left to lower right (\). The top row and left column exchange places as well as the bottom row and right column. Likewise, a right-diagonal flip moves across the diagonal axis running from upper right to lower left (/). This time the top row and right column exchange places as well as the bottom row and left column.

In all cases, the center square remains unchanged.

NOTE: Rotations and flips are visual transformations; for students who have a visual orientation to problem solving, talking in words about the effect of a transformation may be less effective than seeing what happens on the model grid.

Drawing a grid on the blackboard is another alternative. However, this method is not as effective as having a physical model that can actually be rotated and flipped by the teacher and students. Some suggestions for constructing such a model are provided on the next page.

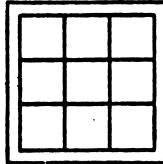
Suggestions for Constructing a Model Grid

Materials:

- * A square piece of cardboard, or two square pieces of illustration board glued back-to-back.
- * A package of colored construction paper with the following colors: white or black, red, light blue, purple, green, blue, yellow.
- * A roll of tape or velcro
- * A black marking pen
- * A ruler
- * Scissors

Instructions:

1. Mark off both sides of the cardboard in a 3x3 grid using a thick marking pen. It is best to leave a small border around the outside edge.



2. Measure the side length of the resulting grid squares.
3. Using the measured side length, mark off squares on the construction paper, and cut 18 grid squares of each color.
4. Use the tape or velcro to fasten the colored paper squares to the grid. Use only a loop of tape turned sticky-side-out to fasten each color square, so that you can easily change the pattern.
5. When creating patterns, be sure that the front side and back side correspond identically back-to-back -- as if the color were being applied to a piece of glass.

Using the Program

1. Have students start by choosing CREATE to make simple patterns such as stripes. Using PLAY, they can see various transformations of their pattern.

2. After observing a number of transformations on these simple patterns, have students select PREDICT instead of PLAY. They can see how well they predict the outcomes of the transformations they choose.

3. Encourage students to use more colors in creating a pattern. Next, suggest PLAY for experimenting, then PREDICT as a challenge. As students begin to use more colors, it'll be harder for them to predict the outcomes of various transformations. At this point, they may want to recreate their pattern on the model, in order to physically manipulate the pattern.

4. Before students use TEST, the teacher should discuss the concept of an analogy and give students practice in solving different kinds of analogy problems -- both verbal and visual.

Worksheets #1 and #2 present sample analogy problems.

5. Both the HINT and CHOICE options in the TEST and CHALLENGE modes will help students solve analogies. The teacher should encourage students to use these aids. Also, the model should be helpful to students when they are trying to solve a problem on the computer.

6. When beginning to use TEST, students first create a pattern in the upper left grid. In this way, students can start the analogy with a simple pattern, such as a single colored stripe that the computer will rotate or flip. This is easier than if students chose CHALLENGE from the main menu, where the computer generates both patterns for the analogy. The computer always generates its patterns randomly.

As noted earlier in the manual, if students create a highly symmetrical pattern as the first part of an analogy problem, they may set up an ambiguous situation in which more than one transformation yields the same result. THE RIGHT TURN checks for such situations and prints the message "Reasonable...but not correct" whenever a student's answer correctly completes the analogy but is different from the actual transformation that was generated by THE RIGHT TURN. The program always persists until students choose exactly the same transformation that it originally generated.

Some Interesting Topics for Classroom Discussion*

As students begin to explore the world of transformations, a number of interesting mathematical ideas can be discussed.

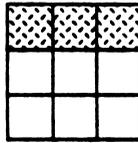
Symmetry. Symmetry is one of the main concepts inherent in THE RIGHT TURN. A flat figure, such as a 3x3 grid from THE RIGHT TURN, can have two kinds of symmetry: line symmetry and rotational symmetry.

A figure has line symmetry if a line can be drawn through it so that, when the figure is folded along that line, both sides of the figure come together and match identically. Thus, an empty 3x3 grid has four lines or axes of symmetry -- horizontal, vertical, and left and right diagonals.

A figure has rotational symmetry if a flat figure can be rotated less than 360 degrees and still retain its original appearance. Therefore, an empty 3x3 grid looks exactly the same after being rotated 90, 180, or 270 degrees.

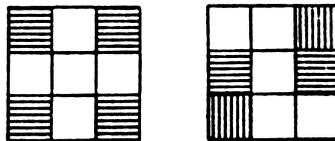
Explore symmetry with your students by examining colored patterns created on the grids in THE RIGHT TURN. Examine the effects that symmetrical patterns have on transformations.

Present students with a figure from THE RIGHT TURN that has line symmetry. The figure should be symmetrical across the vertical axis but not across the horizontal axis; nor should it have symmetry across either diagonal axis. For example:



Thus a vertical flip will leave the above pattern unchanged, whereas a horizontal flip will move the stripe to the bottom row, and a diagonal flip will move it to the left or right column depending on the diagonal used.

Discuss with students a pattern that has rotational symmetry. Due to the nature of the 3x3 grid, colored patterns in THE RIGHT TURN will either be symmetrical under any rotation (90, 180, or 270) or only under 180-degree rotations. For example, the pattern on the left below remains unchanged under any rotation; the pattern on the right only remains unchanged under 180-degree rotation.



* Teachers with black-and-white monitors should read all references to "color" in this section as referring to "shape."

Symmetry in the grid patterns of THE RIGHT TURN is dependent on the placement of colors on the grid and also on the number of colors in the patterns. As the number of colors decreases, the opportunity for symmetrical patterns increases. A grid with all nine squares the same color is clearly symmetrical across all axes and under all rotations. A grid having 8 different colors cannot be symmetrical across any axis.

Worksheet #3 presents questions about symmetry and some problems.

Ambiguity and Multiple Solutions. Certain patterns, particularly symmetrical patterns, create a situation where more than one transformation can produce the same result. For example, in the transformation shown below, due to the horizontal symmetry of the pattern, either a 90-degree rotation or a right-diagonal flip can give the result shown.



Or, in the highly symmetrical pattern below, it is impossible to tell what transformation, if any, was actually performed.

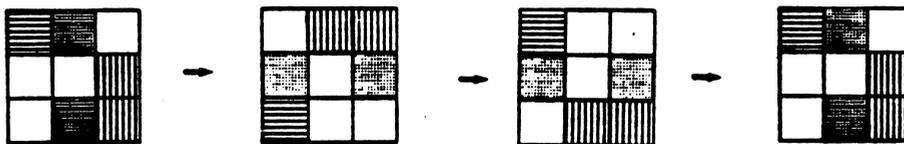


Since students can create their own starting patterns in the TEST portion of the program, situations such as these are very likely to occur. The program has been designed to deal with these situations. Explore the idea of ambiguity and multiple solutions with students. Here are a few ideas:

1. What kinds of patterns are completely ambiguous? That is, what kinds of patterns completely hide any clues as to what transformation was performed on them? Create some of these patterns on the model or on the computer.
2. Create some patterns using only two colors in which more than one transformation will give the same result. What is common to these patterns?

3. Create some patterns using 3 colors in which more than one transformation will give the same result. Are these patterns similar or different from the patterns having only 2 colors?
4. Is it possible to create patterns with 4 or 5 colors that will also give the same result with 2 or more different transformations?

Successive Transformations. Advanced students may be interested in the concept of successive transformations. Given the starting pattern shown below, ask the question: "What sequence of three different transformations will return this pattern to its starting position?"



One solution to this question might be the following sequence:

1. a 90-degree rotation
2. a horizontal flip
3. a left-diagonal flip

In fact, the above sequence of transformations will return the pattern to its starting position regardless of what the starting pattern looks like.

Ask questions such as:

1. What series of 3 transformations starting with a horizontal flip will return a pattern to its starting position?
2. Do you get the same result if you perform a horizontal flip and then a 270-degree rotation as you do if you reverse the order and first perform a 270-degree rotation and then the horizontal flip?
3. Which pairs of transformations are commutative? That is, for which pairs of transformations does the order in which they are performed make no difference?

There are many interesting mathematical concepts that can be explored in this way. Teachers who are interested may wish to consult a textbook on modern or abstract algebra or books on mathematical symmetry.

WORKSHEET 1

VERBAL ANALOGIES

In each of the problems below, circle the word that will correctly complete the analogy.

Example: yellow : lemon
 green :

 sky
 spinach
 fire engine
 cow

1. legs : walk
 wings :

airplane
run
bird
fly

6. 12:00 : 6:30
 3:15 :

9:45
3:45
6:15
11:45

2. taste : food
 hear :

snow
blue
music
love

7. cat : kitten
 frog :

lily pad
fly
tadpole
croak

3. tepee : Indian
 igloo :

polar bear
grass hut
Eskimo
snow blocks

8. letter : word
 classroom :

city
school
street
world

4. stripes : zebra
 spots :

elephant
giraffe
lion
monkey

9. board : tree
 leather :

belt
rope
skin
cow

5. apple : pear
 lettuce :

banana
watermelon
celery
pineapple

10. yellow : squash
 green :

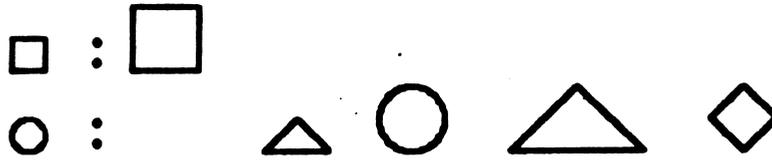
grass
cucumber
spinach
lettuce

WORKSHEET 2

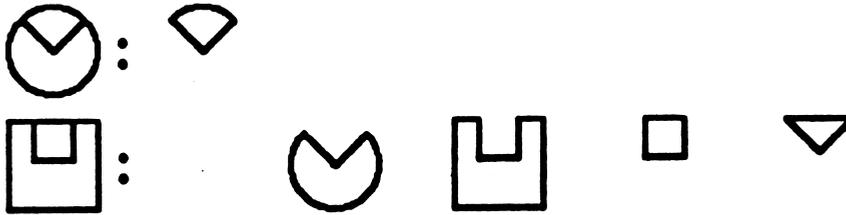
VISUAL ANALOGIES

In each of the problems below, circle the drawing that will correctly complete the analogy.

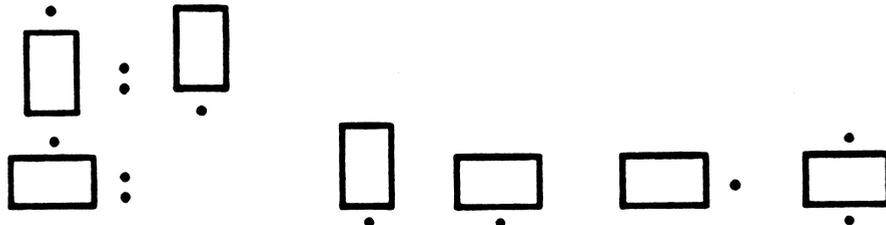
Example:



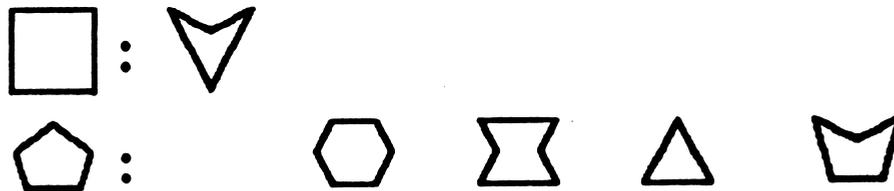
1.



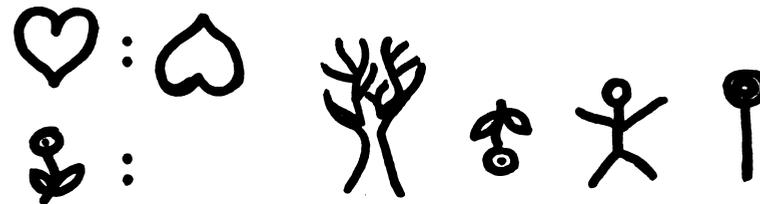
2.



3.

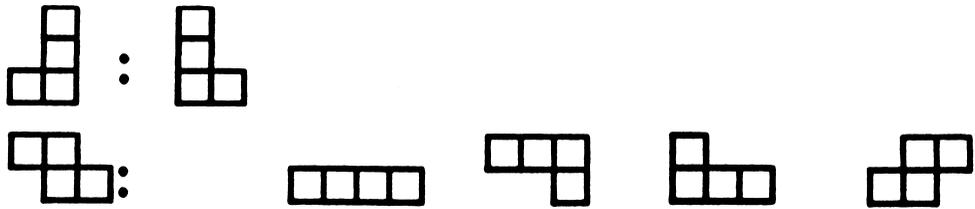


4.

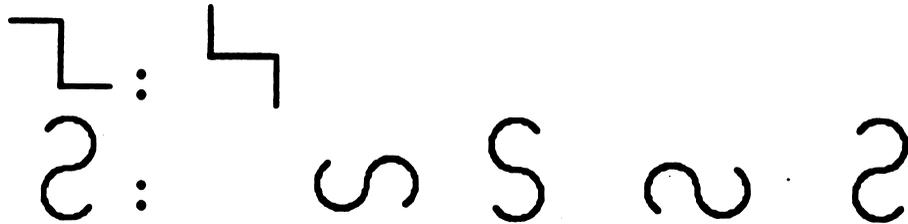


WORKSHEET 2 (cont.)

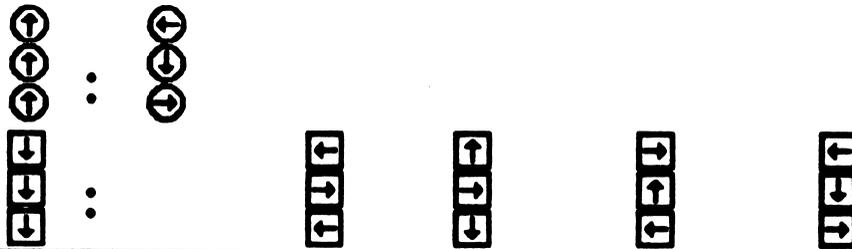
5.



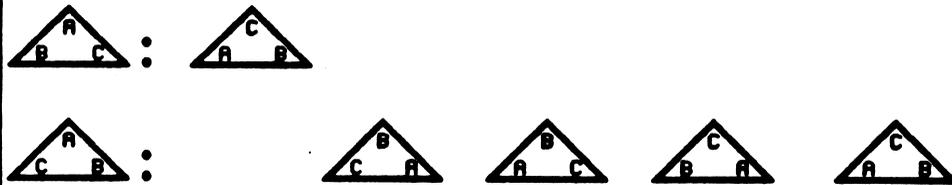
6.



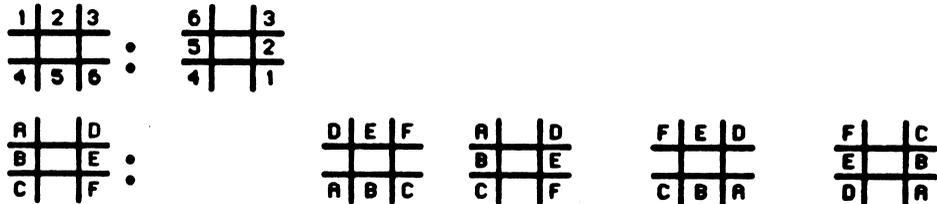
7.



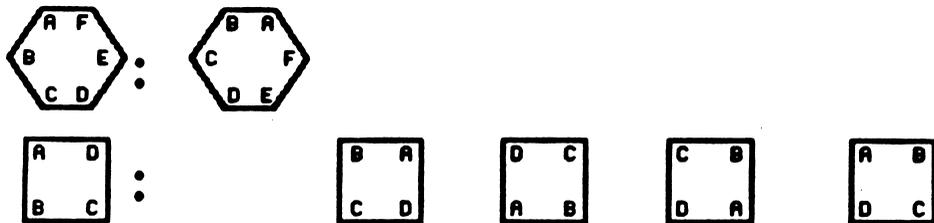
8.



9.



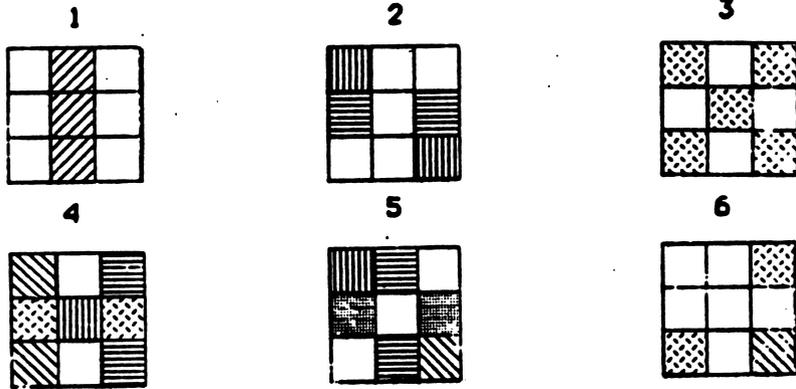
10.



WORKSHEET 3

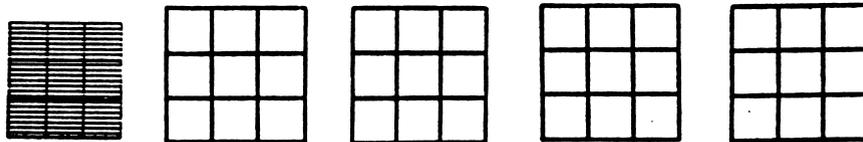
SYMMETRY

I. Here are some grid patterns from THE RIGHT TURN:



- A. Which patterns have symmetry across the vertical axis?
- B. Which patterns have symmetry across the horizontal axis?
- C. Which patterns have symmetry across the left diagonal (\)?
- D. Which patterns have symmetry across the right diagonal (/)?
- E. Which patterns don't change under a 90-degree rotation?
- F. Which patterns don't change under a 180-degree rotation?
- G. Which patterns have no symmetry?
- H. Which patterns remain the same after any transformations -- rotations or flips?
- I. Which patterns are symmetrical across more than one axis (horizontal, vertical, left diagonal, right diagonal)?
- J. Which patterns have both line symmetry and rotational symmetry?

II. Using only 2 colors, (one color plus the background) fill in all the other patterns that never change after any transformation -- rotations or flips.

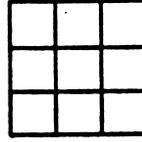
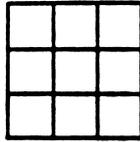


III. Using at least 3 colors (2 colors plus the background) fill in two different patterns that would not change when flipped vertically.

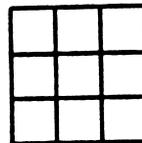
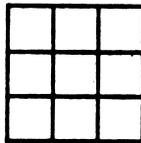


WORKSHEET 3 (cont.)

IV. Using at least 3 colors (2 colors plus the background), fill in two different patterns that would not change when flipped horizontally.



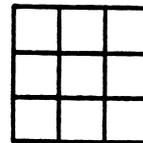
V. Using at least 2 colors (1 color plus the background), fill in two different patterns that would not change when flipped across one diagonal.



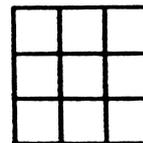
VI. A. Is it possible to create a pattern that has at least one axis of symmetry using 5 different colors (including the background)?

If not, why not? _____

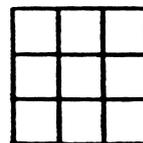
If so, fill in such a pattern:



B. Can you create a symmetrical pattern using 6 different colors?



C. Can you create a symmetrical pattern using 7 different colors?



APPLE: WORKING WITH YOUR TOUCH WINDOW

Installing the Touch Window

- (1) Plug the Touch Window into the joystick port on the back of the Apple IIe or IIc. If you have an Apple II+, you'll need an adapter. Plug the adapter into the joystick socket inside the computer, then plug the Touch Window into the adapter.
- (2) Use the materials provided to attach the Touch Window to your monitor or television screen.
- (3) Follow the steps on p. 34 to turn on your Apple and start the program.
- (4) When the main menu appears, hold the Control key and press the T key to enter Change Options. At the third question, choose the Touch Window. You'll be asked to calibrate it by touching two points on the screen. From then on, you may use the Touch Window.

Operating the Touch Window

- (1) Just place your finger on the screen. When you lift your finger off, you've selected that option. If you change your mind, slide your finger over to another option without losing contact with the screen (or slide it to part of the screen where there isn't an option).
- (2) If you want to stop at any time, press one of the buttons on the lower edge of the window (the equivalent of pressing Control-E on the keyboard).

APPLE: WORKING WITH YOUR COMPUTER

- (1) Turn on the television or monitor.
- (2) Insert the diskette into the disk drive with the label facing up and on the right.
- (3) Close the door to the disk drive.
- (4) Turn on the Apple II. (The on-off switch is on the back left side of the computer.)
- (5) You will see a red light on the disk drive turn on. If the disk drive light does not turn off in about 10 seconds, turn the Apple off and make sure your diskette is placed correctly in the disk drive.
- (6) The SUNBURST logo will appear on the screen, followed by the title sequence for the program.
- (7) If you want to stop, hold the CONTROL key and press the E key.

Shutting off the System

- (1) Remove the diskette from the disk drive.
- (2) Turn off the Apple.
- (3) Turn off the television or monitor.

COMMODORE 64: WORKING WITH YOUR COMPUTER

- (1) Turn on the television or monitor.
- (2) The disk drive must be turned on before the computer. Turn on the disk drive (the switch is located at the back right side of the drive).
- (3) Open the door of the drive by pressing in on the door. Insert the diskette with the exposed oval window inserted first and label up.
- (4) Close the door on the disk drive.
- (5) Turn on the computer. You will see the words--

```
**** COMMODORE 64 BASIC V2 ****
64K RAM SYSTEM 3891 BASIC BYTES FREE
READY.
```

- (6) Type LOAD "0:*",8 and press the RETURN key. The red light on the disk drive will come on. The computer will print --

```
SEARCHING FOR 0:*
LOADING.
READY.
```

- (7) Type RUN. The SUNBURST logo will soon appear on the screen, followed by the title sequence for the program.
- (8) If you want to stop, hold the CTRL (Control) key and press the E key.

Shutting off the System

- (1) Remove the diskette from the disk drive.
- (2) Turn off the disk drive, computer, and television.

IBM PC/PCjr: WORKING WITH YOUR COMPUTER

- (1) Place the diskette in the computer's disk drive with the label facing up and on the right. (If your PC has two disk drives, place the diskette in the one on the left.) Close the door of the disk drive.
- (2) Turn on the graphics monitor.
- (3) Turn on the computer using the bright red switch on the right side toward the back. In several seconds, you'll see the red light on the disk drive light up, and you'll hear the disk drive spinning.
- (4) The SUNBURST logo will appear on the screen, followed by the title sequence for the program.
- (5) Follow the instructions in the program.
- (6) If at any time during the program you want to stop, hold the Ctrl key and press the E key.

Shutting Off the System

- (1) Remove the diskette from the drive and put it in a safe place.
- (2) Turn off the computer.
- (3) Turn off the graphics monitor.