



Color Cubes

Radio Shaek

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Introduction

In the last few years puzzle cubes have been baffling millions of people. Color Cubes is a cube that is made up of twenty-seven smaller cubes (called cubies) of six different colors. The goal of Color Cubes is to unscramble the faces of the cube so that each face is made up of a solid color.

If you have tried to unscramble a puzzle similar to Color Cubes, you know how utterly confusing and frustratingly impossible it seems to be.

Your Color Cubes cartridge can help you to solve this seemingly unsolvable puzzle. It can help you change that maddening frustration into blissful satisfaction.

The cartridge has all the features of similar cubes. It displays a three dimensional cube made up of twenty-seven cubies and six colors. As with a similar cube, you can rotate any vertical or horizontal slice or layer of the cube.

The unique features of this cartridge make it a valuable aid in solving the cube. With this cartridge, the computer will record your last 255 moves and will undo and redo them. This allows you to retrace and analyze your moves. Even better, it will let you backtrack to a better position if you were doing well and then lost your train of thought.

Your cartridge has fourteen different colors. This gives you two entirely different cube color schemes to work with (six colors per cube plus one for the background). This is especially useful if you want to mark a certain position in your progress. If you change the cube colors, then change them back to the original set, you can easily pick out a particular spot if you undo moves.

The Color Cubes cartridge offers you the unique option of either letting you enter configurations of particular cubes into the computer, or it will randomly mix a cube for you.

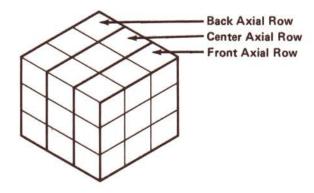
With the configuration feature, both you and a friend can work on the same puzzle, either on two Color Computers, or with one computer and one similar cube (in this instance the person with the computer has the definite advantage). You can also keep track of cube configurations that you enjoy solving, so you can work them again.

The cartridge also lets you compete against time when solving the puzzle. The timer, displayed above the Menu, is automatically reset to zero whenever you select 1 on the Menu. When you use 3 to change the cube, it is also set to zero. The timer is turned off whenever you return to the Menu (where time is shown), and turned on only when you make a move that changes the cube's configuration.

Definitions of Terms

To describe the different ways to manipulate the cube, several specific terms are used. These are:

Axial-Refers to position of a row of cubies. For example:

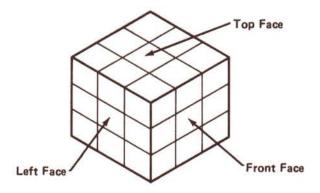


Configuration—The method of describing the arrangement of cubies into a cube.

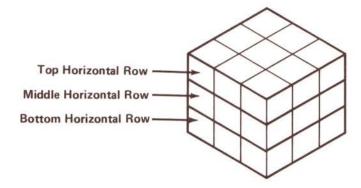
Cube—A solid form having six square faces. Color Cubes is made up of twenty-seven smaller blocks (called cubies).

Cubie—Used to describe one of the twenty-seven small blocks that form the Color Cubes.

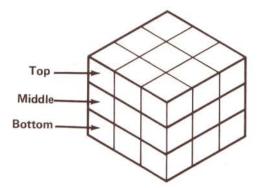
Face—A flat plane of a cube. When viewing the cube from a straight-on angle, the top of the cube is called the top face, the front of the cube the front face, the left side of the cube the left face, etc. The color a face should be is determined by the color of the center cube on the face. For example:



Horizontal—Refers to position of a row of cubies. For example:



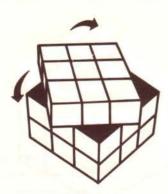
Layer-Used to describe three portions of the cube. The layers are:



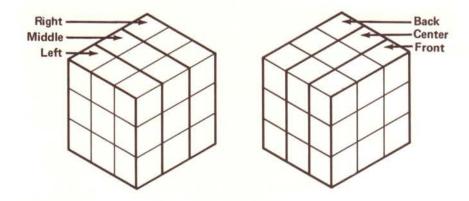
Roll—Refers to vertical and axial movements of rows of cubies, and to positioning of the cube (without changing cubies).



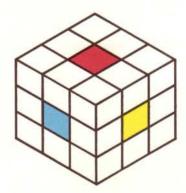
Rotate-Refers to horizontal movements of rows of cubies.



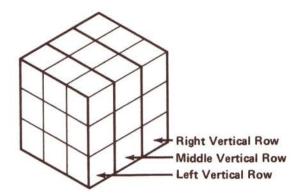
Slice—Used to describe six portions of the cube. The slices are:



Standard position—Describes a position of the cube by referring to the center cubes of each face (the center cube determines the color for a face). In the standard position, the red cube is the top center cube, the yellow cube is the front face center cube, and the blue cube is the left face center cube. Standard position:



Vertical—Refers to the position of a row of cubies. For example:



View—Describes your perspective of the overall cube.

Working the Puzzle

Turn on the TV and adjust the volume to a comfortable level (the computer makes several beeping noises to give you information). Insert the cartridge in the slot on the right side of the computer. Turn the computer on (press the button on the left rear panel of the Color Computer).

Place the Color Cubes template on your keyboard. This helps you to quickly remember the keys to use for particular moves.

The Menu for Color Cubes appears on the screen. To adjust the color on your set, press 2 (the CONTINUE GAME option). Since you initially have no game to continue, a solved cube is now on your screen. Adjust the color on your set so that the colors that you see are red, yellow and blue (colors may vary on your set).

Press \boxed{V} . The cube will shift so you now see the remaining three faces of the cube. These colors should be purple, orange and green. Pressing \boxed{V} again will return you to your first view of the cube. Use \boxed{V} until your colors are adjusted.

Now press BREAK to return to the Menu. You now see:

COLOR

CUBES

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- 1. RANDOMIZE AND START GAME
- 2. CONTINUE GAME
- 3. RESET CUBE
- 4. SAVE STATUS ON TAPE
- 5. LOAD STATUS FROM TAPE

SELECT (1-5)

Any time you wish to return to the Menu, press BREAK .

Randomize and Start Game

When you press 1 at the Menu, the computer will randomly scramble a cube for you to try to solve. You have several commands available to move the cube and the cubies.

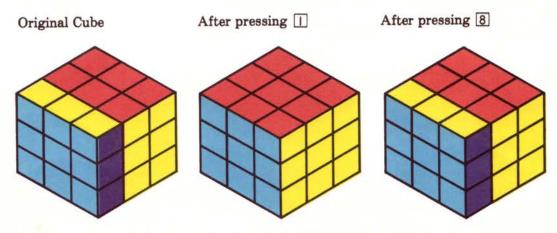
After you press a command key, a short beep will sound when the action is completed. If you press a key that has no command, you will hear a different beep tone. All keys will repeat if held down.

Rolling the Slices

To rotate any of the left, middle and right slices (vertical slices) 90 degrees, you use six commands:

Key	Motion
8	Rolls left vertical slice backwards.
	Rolls left vertical slice forwards.
9	Rolls middle vertical slice backwards.
0	Rolls middle vertical slice forwards.
0	Rolls right vertical slice backwards.
P	Rolls right vertical slice forwards.

Example

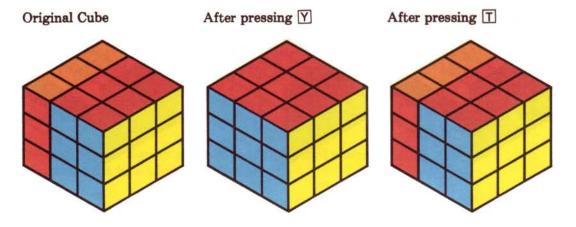


Try moving the left slice of the cube on your screen by pressing \blacksquare . Move it back to its original position by pressing \square .

Above, you saw the computer directly roll the slices (it did not have to make more than one move). To roll the back, center and front slices (axial slices), the computer combines a few moves, but you only press one key. To roll the axial slices 90 degrees:

Key	Motion
T	Rolls the back axial slice left.
Y	Rolls the back axial slice right.
G	Rolls the center axial slice left.
H	Rolls the center axial slice right.
B	Rolls the front axial slice left.
N	Rolls the front axial slice right.

Example

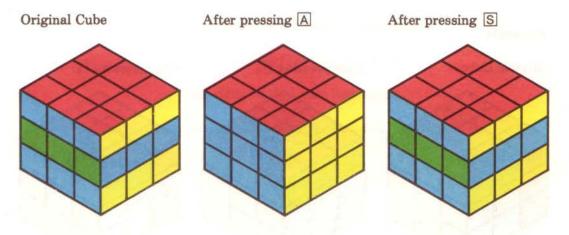


Rotating the Layers

To rotate the three layers 90 degrees, a single keystroke is used. This rotation is direct. The keys are:

Key	Motion
Q	Rotates the top horizontal layer left.
W	Rotates the top horizontal layer right.
A	Rotates the middle horizontal layer left.
S	Rotates the middle horizontal layer right.
Z	Rotates the bottom horizontal layer left.
\boxtimes	Rotates the bottom horizontal layer right.

Example



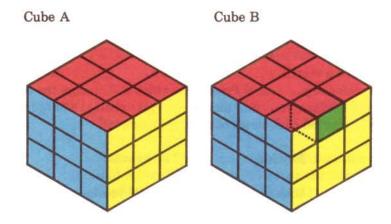
Try rotating the top layer by pressing $\overline{\mathbb{Q}}$. Rotate it back by pressing $\overline{\mathbb{W}}$.

Determining the Positions of the Cubies

The color of the center cubie on each face of the cube determines the color for that face. For example, when the cube is in standard position (red on top, yellow on front face, blue on left face), red cubies belong in the top layer.

You can change the color of the center cubie by rolling either the middle vertical slice or the center axial slice. A key to solving the cube is to try to correctly position a cubie on all of the faces it touches.

In the examples below, cube A has correctly positioned cubies in the top layer. Cube B does not because the cubie in the center of the top layer on the front face only matches the top face of the cube, it does not match the color of the front face.



Moving the Cube

There are several ways to move the cube around so you can change your perspective. These moves do not change the positions of any of the cubies.

To change your total view of the cube (to see the three sides you can not see now), press $\boxed{\lor}$. To change it back, press $\boxed{\lor}$ again.

Pressing F will display the cube in the standard position (red on top face, yellow on front face, blue on right face).

Another way to change the angle of display is to use the arrow keys:

Key	Motion
4	Rolls the cube left 90 degrees.
\rightarrow	Rolls the cube right 90 degrees.
\uparrow	Rolls the cube backwards one face.
	Rolls the cube forwards one face.

Roll the cube around until you are familiar with the arrow keys.

Undo and Redo

The computer remembers the last 255 moves that you have made while working on your cube. If you get lost while in a series of moves, use the undo key to take you back, one move at a time, to the beginning of that sequence. If you retrace your moves and find that you did what you wanted to and want to redo them, use the redo key.

You can not make any changes once you backtrack, if you want to redo the moves. If you do, the computer erases all future moves and starts keeping track of your moves from that point.

If you want to mark a starting point for a series of moves, use the $\boxed{\mathbb{C}}$ key. This key changes the color of your cube. Pressing it twice will change the color and then change it back. When you undo moves, the color change will tell you exactly where you started that series of moves.

Keys	Motion
SHIFT -	Undoes up to 255 moves. (If you have not made 255 moves, it will undo to the starting point.)
SHIFT →	Redoes up to 255 moves.

Make a series of random moves using all of the above commands, then try using the undo and redo keys to familiarize yourself with them.

Continue Game

If you have exited the game to return to the Menu, or if you have just loaded a game from tape, press 2 for CONTINUE GAME at the Menu. You will be returned to the cube you were working on. If you press 2, and you were not working on a game (i.e. you just inserted your cartridge), a solved cube will appear on your screen.

Reset Cube

This function shows you how a particular cube is constructed. It also lets you enter your own cube into the computer by using configuration letters.

There are over 43 quintillion ways the cube can be arranged by twisting and turning the layers and slices. There are even more different ways the cube can be assembled if you place each cubie in the cube in any position you want.

Press 3 from the Menu. You will see a line of letters that exactly describes the way your cube is currently put together. This is called the configuration. After you have selected RESET CUBE, the following keyboard functions are available:

Key	Function
BREAK	Returns the main Menu display.
CLEAR	Changes all the letters in the configuration to "A"'s and moves the pointer (@) under the first letter. (This configuration is for a solved cube.)
ENTER	Makes the cube visible (as if you selected CONTINUE GAME at the Menu). You can now manipulate the cube. Pressing BREAK will return you to the configuration display instead of to the Menu.
→	Advances the "@" pointer to the next letter in the configuration.
⊏	Moves the "@" pointer to the left under the configuration.

Uses of the Reset Cube Function

This function can be used in three ways. The ways are:

- 1. If you do not want to try to understand what all the configuration letters mean, then use this function to remember how the cube is put together at a particular moment. To use it this way, write down the 21 letters in the order they appear in the configuration. Later, you can reset the cube in that order by selecting 3 on the Menu, typing in those letters, pressing BREAK to return to the Menu, and pressing 2 for CONTINUE GAME.
- 2. If you want to reset the cube to its solved position, press CLEAR. All letters will be changed to "A"'s. Press BREAK and 2 to CONTINUE GAME (or press ENTER).
- If you are a genuine Color Cubes fan, or if you want to study spatial relationships, then read the section, More About Configurations (on page 17). Otherwise, skip that section.

Save Status on Tape

If you want to stop playing the game, but you don't want to lose the current status of your cube, save the game on tape. This option will save the current configuration of the cube, the history of your moves (up to 255), and the elapsed time. Press 4 at the Menu. You will see:

PREPARE RECORDER TO RECORD

PUSH "ENTER" WHEN READY

(OR "BREAK" TO GO BACK TO MENU)

Connect your tape recorder to the computer according to the Color Computer Manual. Wind the tape to the position on the tape that you want the game recorded (make sure the tape is beyond the leader). Write down the tape counter number so you can later reload the game.

Press "Play" and "Record" on the recorder. Press ENTER on your keyboard.

"RECORDING" will flash at the bottom of your screen. When the recording is completed, you will return to the Menu.

Load Status from Tape

To load a game status that you have saved on tape, press 5 at the Menu. You will see:

PREPARE RECORDER TO PLAY

PUSH "ENTER" WHEN READY

(OR "BREAK" TO GO BACK TO MENU)

Rewind your tape to the position that the game is saved on the tape (use tape recorder counter number). Press "Play" on the recorder, and ENTER on the keyboard.

"LOADING" will flash at the bottom of your screen. When the game has been loaded, you will return to the Menu. Press 2 to continue your game.

More About Configurations

This section shows you the spatial relationships of Color Cubes. Studying how a cube is constructed by analyzing the relationships of its cubies deepens your understanding of the puzzle. Once you understand these relationships, you can enter a particular cube you want to solve into the computer. This is done using a configuration.

The configuration (the row of letters shown after you have pressed 3 for RESET CUBE) provides a means of exactly describing how a cube has been constructed. It is a simple way of describing what your cube looks like to a friend (simple, considering the fact that the program can display 24 to the 20th power different cubes!).

To understand the rest of the section, put together the "Cubie Orientation Illustrator."

Your assembled illustrator looks like a cubie. When you set it on the table in front of you, any one of its six faces can be turned to face you. With any given face towards you, the cubie can be rolled from side to side so that any one of four faces can be the top face. This shows you that there are 24 different ways you can orient the cubie (six faces times four positions per face).

To describe the twenty-four different ways you can orient the cubie, twenty-four letters are used—"A" to "X." The arrangement of these letters makes up the configuration.

Notice that there are four letters on each of the six faces of the illustrator. They are printed so that as you roll the cube from side to side, only one letter is right side up at the top edge on the front face of the cubie. By referring to these letters, a particular orientation can be described.

Instead of saying, "the cubie is turned so that it is yellow on top, blue in front, and red on the left," you can say the cubie is in position "R." Turn your illustrator to this position and notice that "R" is at the top edge of the front face of the cubie.

Color Cubes is made up of twenty-seven separate and identical cubies. However, the configuration only describes the orientation of twenty-one cubies. This is because there are seven cubies that act almost like they are a single, unchangeable structure.

These seven cubies are: the cubie that you never see in the core of the cube (the buried cubie) and the cubies that are visible in the middle of each of the six faces (only one surface of each of these cubies is visible).

More About Configurations (continued)

Each one of these middle cubies reflects the color of a different side of the buried cubie. If the cube is in standard position, the buried cubie would be in position "A" (red on top face, yellow on front face, blue on side face).

The configuration is twenty-one digits long. Each digit represents the orientation of one cubie, except for the first digit. It represents the orientation of the buried cubie and, as described above, represents the orientation of the cubies in the center of each of the six faces.

Each digit represents a specific cubie. With the cube in standard position (looking down at the top face), the ordering of these cubies is:

Top Layer		iyer	Middle Layer		Bottom Layer			
7	8	9	12 -	13		19	20	21
5		6		1		17		18
2	3	4	10 -	11		14	15	16

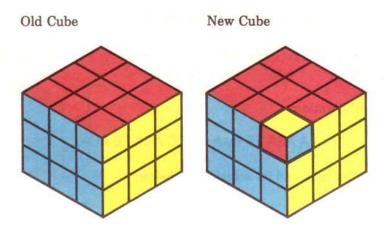
Now that you know which digit represents which cubie, it is simple for you to enter a configuration. Notice that the configuration arranges letters into groups of twos and threes.

These groups tell you how many cubies are in a row (some rows only have two cubies listed because the center cubes are all described by the first digit). Just hold the illustrator so that the cubie you wish to describe is oriented so you could slide it into its position in the cube.

To help you visualize this better, let's do a simple example. Press CLEAR to change the configuration to all "A"'s. The cube is now solved. (If you want to see the solved cube, press ENTER. Pressing BREAK will return you to the configuration.)

Let's change the orientation of cubie #2 to make it yellow on top, red on the left face, and blue on the front face. When you position your illustrator, you will see that this orientation is position "R."

Press $\overline{}$ to move the "@" cursor under the second slot in the configuration (the one to be changed). Press $\overline{\mathbb{R}}$. Now the second cubic is changed. Press $\overline{\mathbb{E}}$ and you will see the new cube.



It is possible, and extremely probable, that you can enter unsolvable configurations. An unsolvable cube will have more than nine cubic faces of one or more colors. If you have a cube that has 17 blue cubic faces showing, it cannot be solved, as there are only positions for nine blue cubic faces.

Enter this configuration:

A ADD AP APP AD AA ADD AA AAA

Press ENTER. Notice the 17 blue faces. No matter how you twist and turn this cube, it can never be solved.

If you just type letters at random, you will probably end up with an unsolvable configuration. It is also possible to have more than one configuration for the same cube.

Consider these configurations:

A HAA AA AAA AA AA AAA AA AAA B BBB BB EBB BB BB BBB BB BBB

and

If you type these in, you will see that they are the same configuration, but the cube has been rotated or tipped from the first configuration. To keep your configurations simple, always place the cube in standard position—then your first configuration digit will always be "A," and you will avoid any duplication.

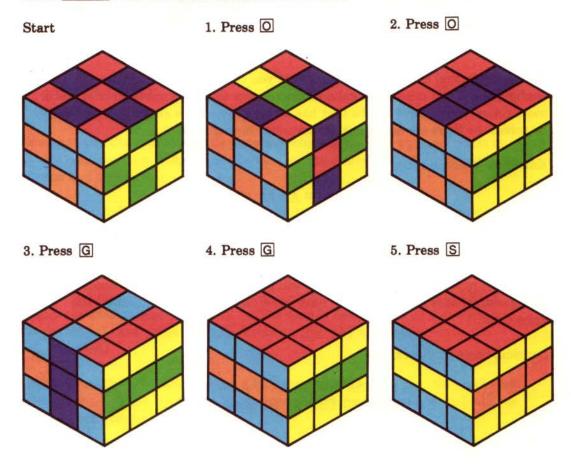
Two Easy Configurations to Solve

If you have never played a puzzle cube, you may want to start out with a simple cube to solve. Here are two to get you started:

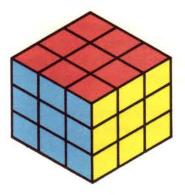
1. Enter the configuration:

A AGA EE AGA CC CC AGA EE AGA

Press ENTER. The cube and its solution are below:



6. Press S



2. Enter the configuration:

A LLL LL LLL LL LL LLL LL LLL

Try solving this cube. Use the arrow keys, \boxed{V} and \boxed{F} to change your view of the cube. Hint: It can be solved with six 90 degree moves.

Solution: In this order, press: G, S, H, O, A, 9.

Key Sequences

There are several key sequences that are used repeatedly in solving Color Cubes. Some of these are listed below. Above the starting position of each cube is the configuration for that particular cube. If you want to follow the moves on your computer, enter the configuration and then follow the steps.

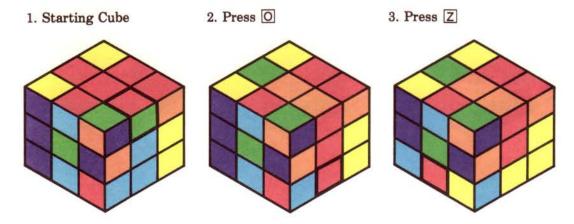
Each sequence moves one cubic into its proper position in the cube. The cubic is highlighted in each of the diagrams below—unless it is on one of the three faces hidden from view.

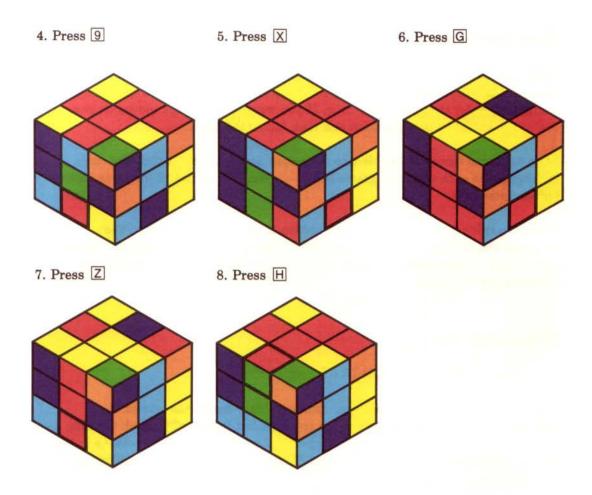
When the cubie is on one of the three hidden faces, you can interrupt the sequence and use the arrow keys to change your view of the cube so you can see the position of the cubie. If you do so, reposition the cube, and then continue following the sequence.

Sequence #1

Configuration: D WCB AD TDR TA KF RRE AL TAP

In this cube the front face, top layer, center cubie is not in the correct position—the cubie matches red on the top face, but it does not match the blue on the front face. If you look carefully, you will see that this cubie belongs in the left face, top layer, center cubie position. To move this cubie, do the following:

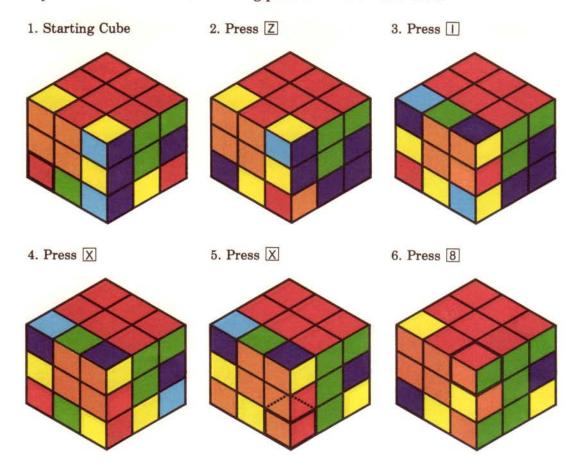




Sequence #2

Configuration: C SCC CC QCC JJ EU SIU LI ROR

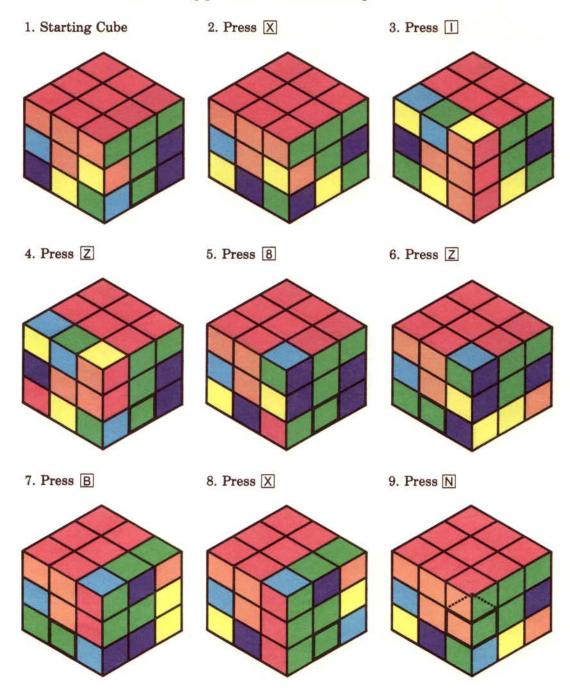
After entering this configuration into your computer, use the right arrow key to turn the cube one position. Notice that the front face, bottom layer left cubie belongs in the front face, top layer, right cubie position. Now use the left arrow key to return the cube to the starting position. To move this cubie:



Sequence #3

Configuration: C CCC CC CCC BJ AU DOP BL MLC

In this sequence the cubic on the front face bottom layer, middle position needs to be moved to the front face middle layer, left cubic position. Use the arrow keys to rotate the cube to familiarize yourself with the exact move needed. Put the cube back in its starting position to follow this sequence.



Sequence #4

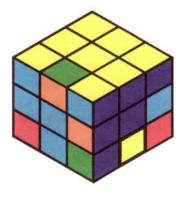
Configuration: S SSS WT SRS WR AX PIN GF IQI

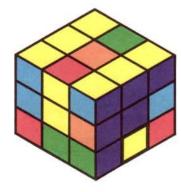
This sequence shows you how to move the last yellow cubic up onto the top face.

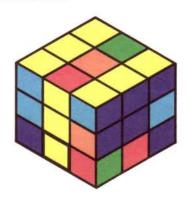
1. Starting Cube

2. Press G

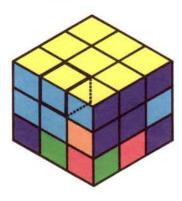
3. Press Z







4. Press H

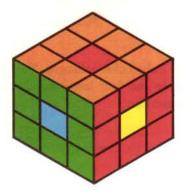


Variations to Color Cubes

There are several other color patterns you can try to form with your Color Cubes. Some of these are shown below, with their solved configurations (so you can enter them into your computer). Most of these patterns are just several steps away from a solved cube. See if you can make these patterns. Then, you can try to change these into a solved cube.

Variation #1

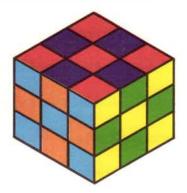
This cube has a box on each of the six faces:



Variation #2

Configuration: A AGA EE AGA CC CC AGA EE AGA

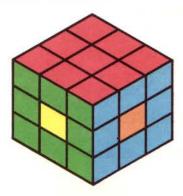
This cube has a solid-colored X on each of the faces.



Variation #3

Configuration: B DDD DD DDD DD DD DDD DDD DDD

This cube has four boxes and two solid faces.



You can make countless other cube color schemes. You might try spelling out letters of the alphabet and three and four letter words (the letters being of one color per face). Use your imagination!

Summary of Key Commands

Menu Keys

Key Function

1 Randomize and start game.

2 Continue game.

3 Reset cube.

Save status on tape.

5 Load status from tape.

Game Keys

Key Function

8 Rolls left slice (vertical) backwards.

9 Rolls middle slice (vertical) backwards.

Rolls right slice (vertical) backwards.

BREAK Takes you to the Menu. If you use RESET CUBE

function, pressing BREAK will return you directly to

the configuration.

Rolls the cube backwards (front face becomes top face).

Rotates top layer (horizontal) left.

W Rotates top layer (horizontal) right.

T Rolls back slice (axial) left.

Y Rolls back slice (axial) right.

Rolls left slice (vertical) forwards.

Rolls middle slice (vertical) forwards.

Summary of Key Commands (continued)

P	Rolls right slice (vertical) forwards.		
←	Rolls the cube to the left (front face becomes left face).		
→	Rolls the cube to the right (left face becomes front face).		
1	Rolls the cube forwards (top face becomes front face).		
A	Rotates middle layer (horizontal) left.		
S	Rotates middle layer (horizontal) right.		
F	Displays the cube in standard position.		
G	Rolls the center slice (axial) left.		
H	Rolls the center slice (axial) right.		
[ENTER]	Takes you from the configuration to the cube. Also initiates save status and load status proceedings.		
CLEAR	In the Reset Cube Mode, changes all letters in the configuration to "A"'s. Also cancels Menu options 4 and 5, and returns you to the Menu.		
SHIFT ←	Undoes up to your last 255 moves.		
SHIFT →	Redoes up to your last 255 moves.		
Z	Rotates bottom layer (horizontal) left.		
X	Rotates bottom layer (horizontal) right.		
C	Changes the color of your cube and the background. Good for marking position.		
V	Rolls the cube to view the three hidden faces.		
В	Rolls the front slice (axial) left.		
N	Rolls the front slice (axial) right.		

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NOTE: Good data processing procedure dictates that the user test the program, run and test sample sets of data, and run the system in parallel with the system previously in use for a period of time

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