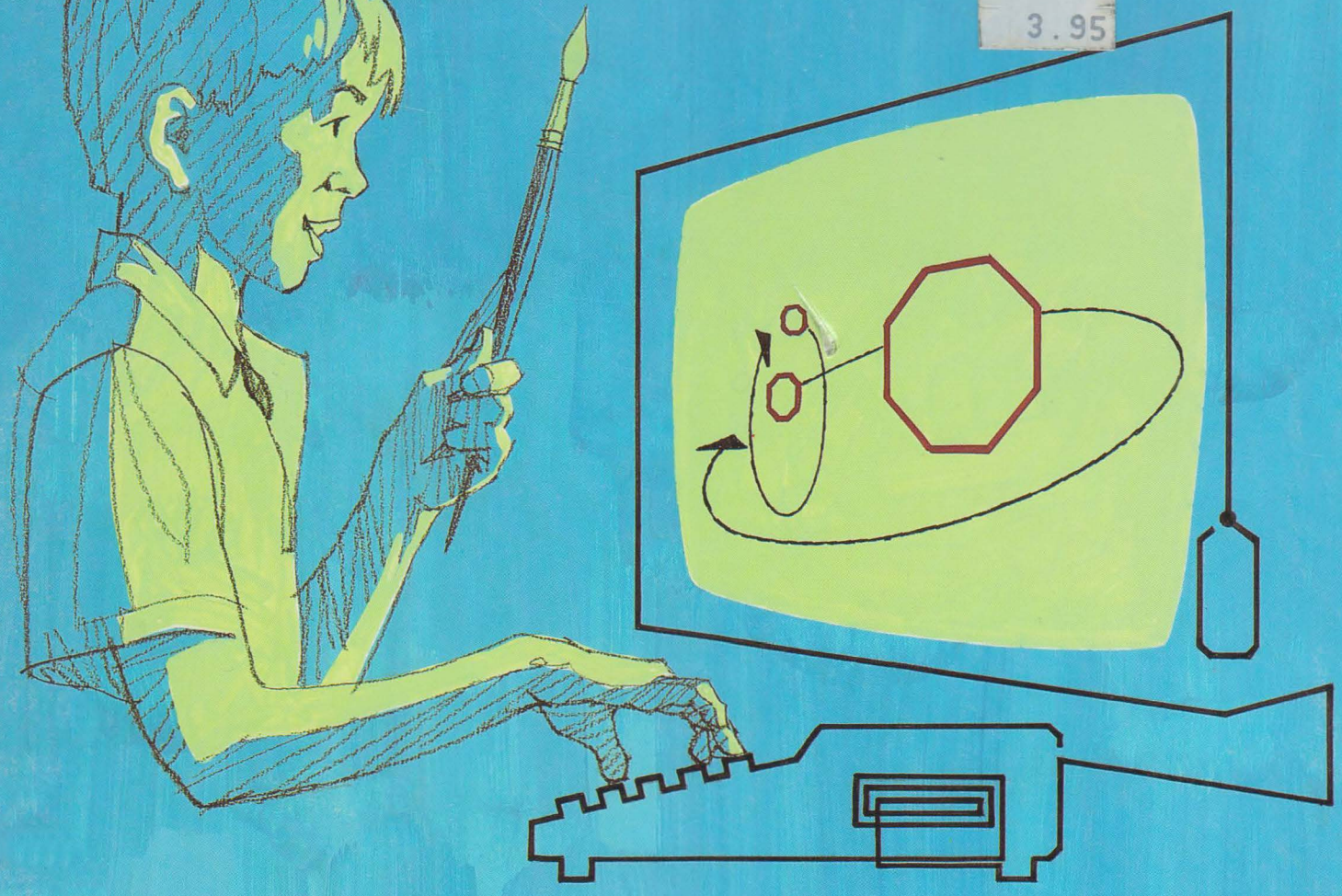
TRS-80® Color LOGO



Color LOGO Guide for Teachers: Book One

Cat. No. 26-2761

Radio Shack
TRS-80
COLOR COMPUTER

Color LOGO Guide for Teachers

Book One

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and

Bob Albrecht

First Edition

Color LOGO Guide for Teachers, Book One

Written by Don Inman and Bob Albrecht.

CONTENTS

Color LOGO is a educational computer language designed to help children learn by exploring. The language is easy to use – children can begin drawing pictures on the screen immediately. But Color LOGO can also be used to create complex designs and patterns. This range makes Color LOGO a good tool for learning mathematical concepts and problem-solving skills at a variety of levels.

USING COLOR LOGO IN THE CLASSROOM

With Color LOGO, the computer becomes the student's laboratory for defining and solving problems. In this learning process, the teacher ideally provides only background guidance for the student, assisting only when a student request is received. Color LOGO does not deliver information to the student; instead, students learn by exploring with Color LOGO.

Previous computer languages have required the teaching of long lists of commands, statements, and functions. Much time was spent in teaching the techniques of programming and providing a background of technical computer jargon. Color LOGO relieves the teacher from these tedious chores, and does not require a comprehensive knowledge of how computers operate.

This booklet is a guide for teachers on how to use Color LOGO in the classroom. It is presented in the same spirit that Color LOGO should be presented to the students. The booklet will not "teach" you a lock-step method for "teaching" Color LOGO to your students. Instead, it will guide you in methods that may be used to introduce and use the language in your classroom. It will give you a chance to learn Color LOGO along with your children. "Copy Me" pages are included so that you can reproduce learning materials and exercises for students' use.

Physical Components

Radio Shack provides Color LOGO in two physical forms:

(1) a plug-in cartridge that will operate in a minimum 16K Color Computer,

(2) a diskette that requires a disk controller, a disk drive, 32K Extended BASIC Color Computer

Regardless of the system used, Color LOGO works in the same way.

Your students will also want some way to save their favorite creations for future use. They can do this with either a cassette recorder (if using the cartridge system) or a disk drive (if using the disk system). A permanent record of procedures can be made if the Color Computer is connected to a printer.

Appendix A shows how to connect your Color Computer to your TV set. Appendix B shows the connections for a cassette recorder system, and Appendix D shows the connections for a disk system. In this booklet, we are using a cassette system with a 16K Color Computer and a Color LOGO plug-in cartridge.

Follow the directions in your Color LOGO manual to load LOGO into the system you have. Whichever way you load the language (cartridge or diskette), you eventually end up at the same place with a screen that shows:

```
COLOR LOGO COPYRIGHT 1982
LARRY KHERIATY & GEORGE GERHOLD
LICENSE TO TANDY CORP.
ALL RIGHTS RESERVED

LOGO:_
```

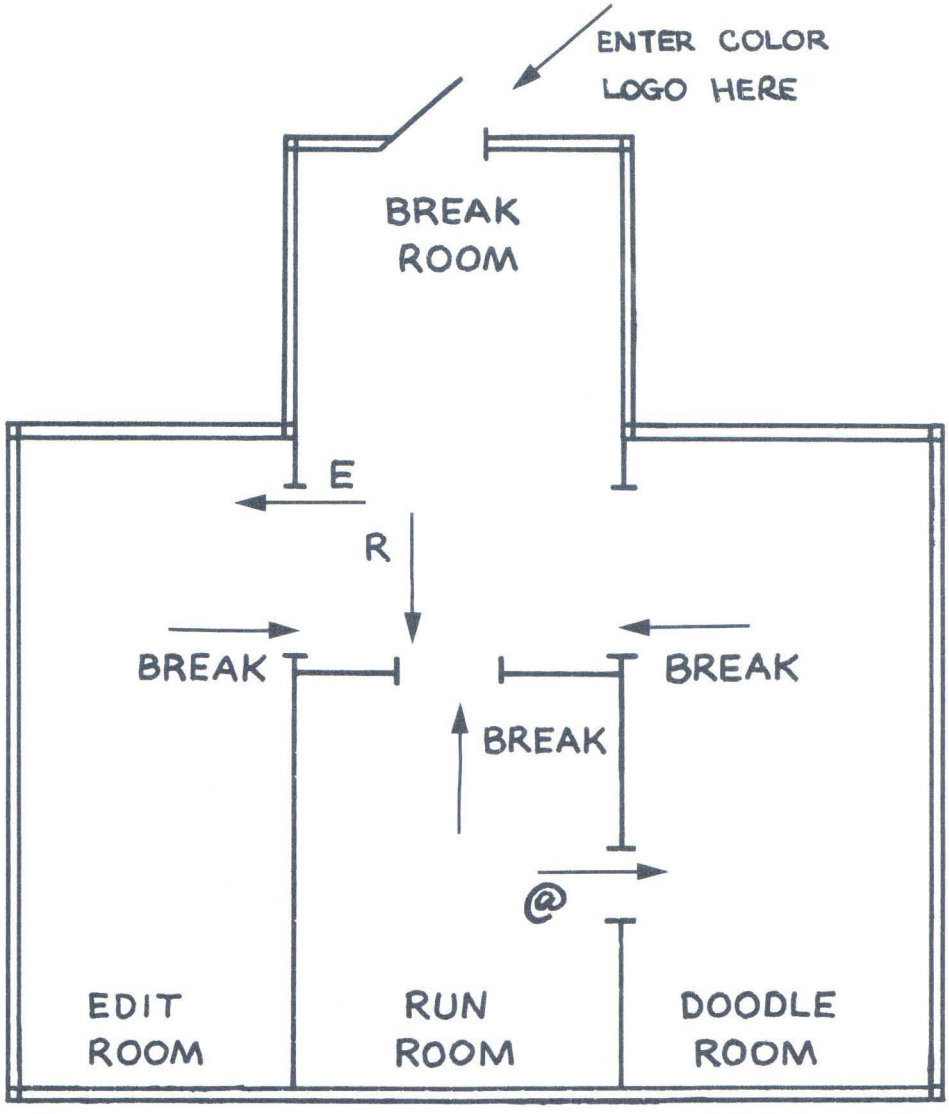
You are now in what is called the BREAK mode. The BREAK mode can always be recognized by the LOGO prompt:

```
LOGO:_
```

Where to Start

At first, the idea of several operating modes may be confusing, but it is really quite simple. Color LOGO has four operating modes. You can explain these operating modes to students with an analogy to four rooms in a house where various activities take place. The BREAK mode is like a central hallway, or main entrance, of the house. Each of the other rooms can be reached directly or indirectly from the entrance hall.

LOGO Rooms

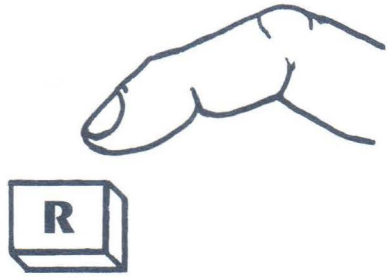

ENTER COLOR
LOGO HERE
BREAK
ROOM
E
R
BREAK
BREAK
BREAK
@
EDIT
ROOM
RUN
ROOM
DOODLE
ROOM

If you have just entered the Color LOGO language (cartridge or disk), you see the prompt – "LOGO: _" If you haven't entered Color LOGO, do so now so that we all start at the same place.

You are in the main room of the house, the BREAK mode. After leaving this room (or mode), you may return at any time by pressing the BREAK key (the red one at the upper right corner of the keyboard). That's why this is called the BREAK mode: you get there by pressing the BREAK key.

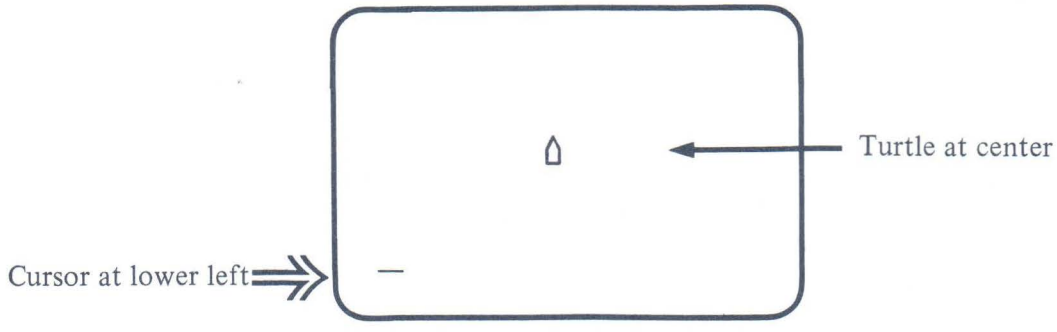
Entering Another Room

You and your students should explore the RUN mode first. This is the room where the computer springs into action to perform your every wish and command. You enter the RUN mode by pressing the R key.



When you do this, a small, odd-looking shape appears at the center of the screen. It is called a turtle. It may not look like most turtles you have seen, but that's because it probably isn't like any turtle you have ever known before. Note that the LOGO turtle seems to be facing (pointing towards) the top of the screen.

At the lower left corner of the screen, you see an underline mark (_). This is called the cursor. The cursor indicates that Color LOGO is ready for you to tell it something.

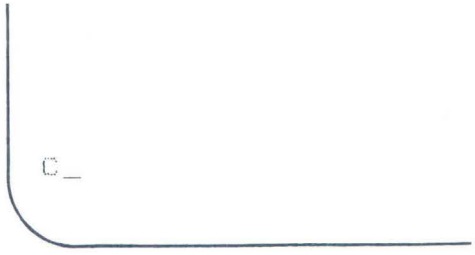


Students should be allowed to experiment immediately. Let them type something like their name or the name of the computer language that they are using, COLOR LOGO.

Examples:

(1) Type the letter C.

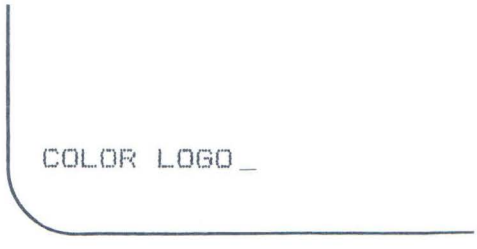
The C appears, and the cursor moves to the right



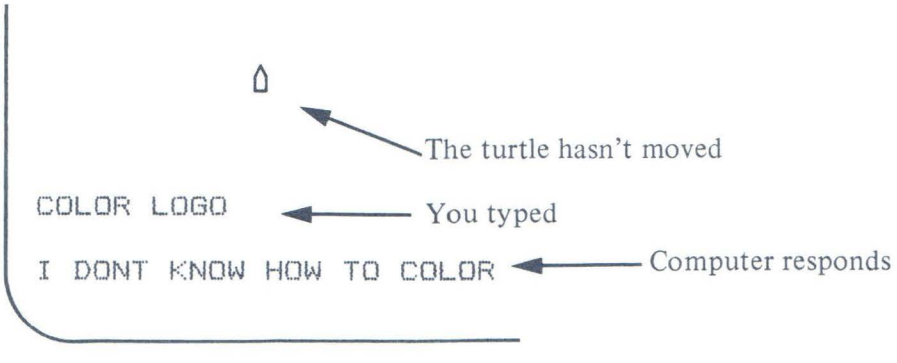
(2) Type the letter O.

Again, the cursor moves to the right

(3) Continue typing until all the letters COLOR LOGO are displayed. If you make a mistake, press the ← key to move the cursor back one space.



(4) When you have completed the word, press the ENTER key. This tells the computer that you have finished and that you want the computer to carry out your request.



The turtle knows how to do some things, but not others. It has told you that it doesn't know how to COLOR. The "I DON'T KNOW HOW TO - - - - -" message will appear whenever you give a command that is not in the Color LOGO language. You have two choices:

(1) Don't use that command; use a command from the set of Color LOGO commands.

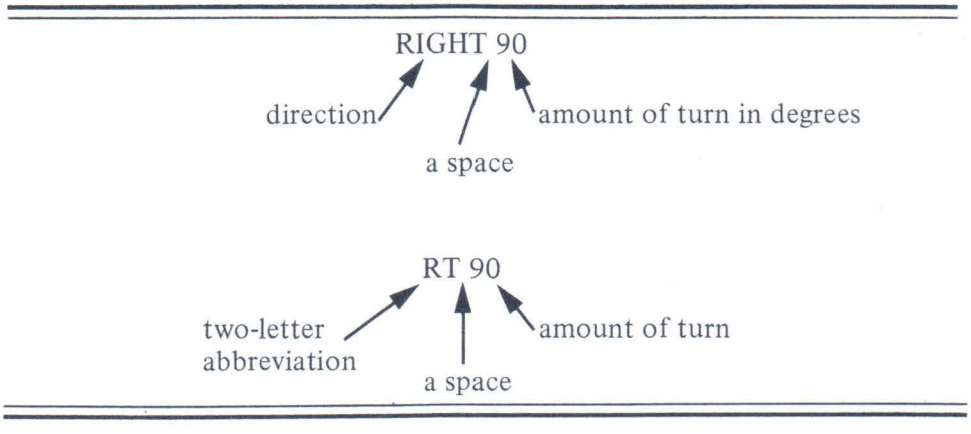
(2) Teach the computer how to follow your command using the Color LOGO commands that it does know.

TURNING IN PLACE

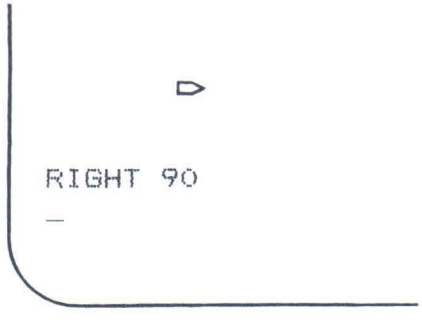
In order to use the second choice you must learn some LOGO commands. Let's look at a few of the commands that the computer does know.

Press ENTER to return the cursor to the left side of the screen. Then type CLEAR and press ENTER to clear off the screen.

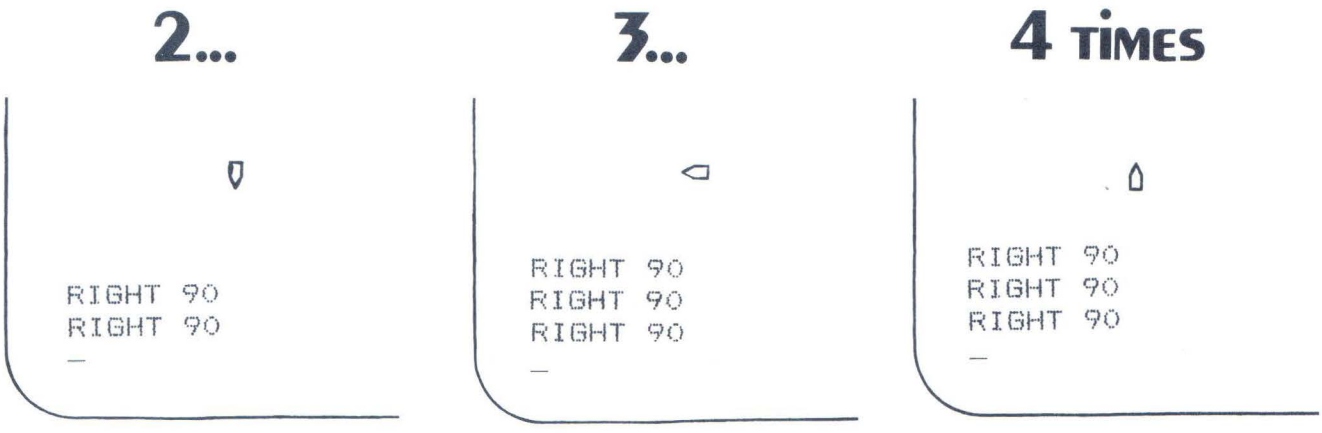
The turtle can turn to the left or to the right. The right turn command can be given in two forms:



The result of the RIGHT 90 command looks like this:



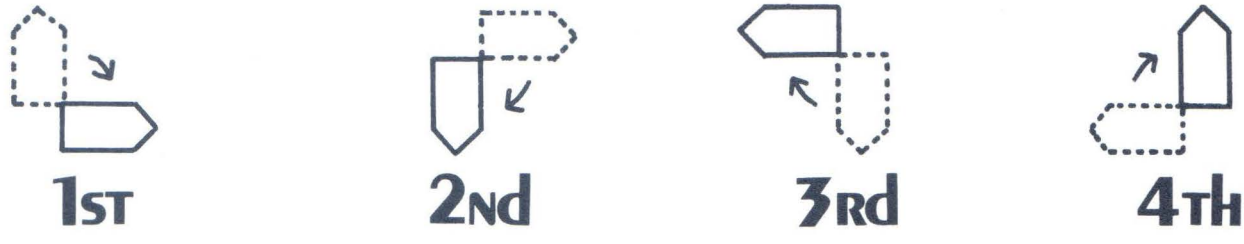
If the RIGHT 90 command is repeated, you will see the following:



Notice that the screen only shows four lines of text.

When the fourth RIGHT 90 command is given, the top line disappears. The last three commands are visible, and the bottom line is used for typing in the next command.

The turtle turned right 90 degrees from the direction that it was previously pointing each time the command was given. The turns are said to be relative. The turn is made relative to the direction in which the turtle is currently facing.



After four 90 degree turns, the turtle is facing in the original direction. This maneuver quickly conveys the ideas of completing a circle with 360 degrees (4 times 90 or 90 + 90 + 90 + 90).

Turtle Go Home

After several turtle commands, the screen can become rather cluttered. To erase the screen, type:

CLEAR and press the ENTER key

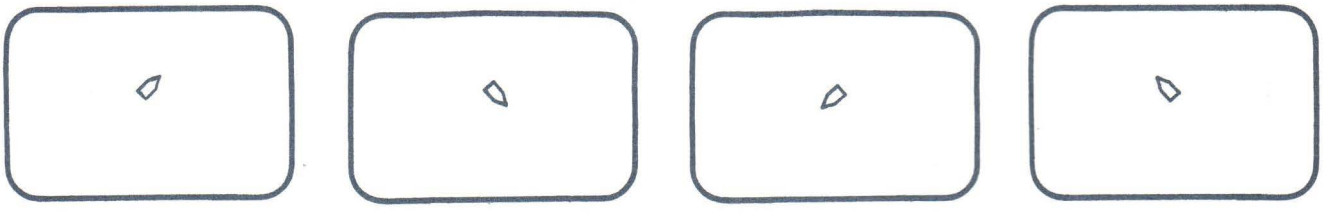
Do not use the CLEAR key; type the letters C L E A R

The CLEAR command erases the screen, and the turtle returns to the center of the screen. This is called its HOME position. The HOME command also returns the turtle to the center of the screen, but it does not clear the screen. Notice that the turtle always faces the top of the screen after either the CLEAR or the HOME command.

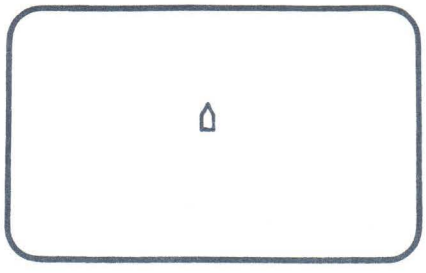
Right Turn

Now, CLEAR the screen and try giving a 45-degree right turn followed by three 90-degree right turns. Use the abbreviated form of the command this time.

RT 45 RT 90 RT 90 RT 90

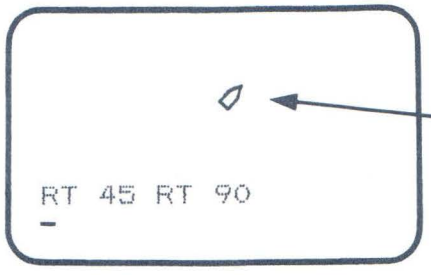


You can see that the turtle has not yet returned to its original position. It has turned 45 + 90 + 90 + 90 or 315 degrees. Give it one more RT 45 command, and it will be facing the same direction in which it started.



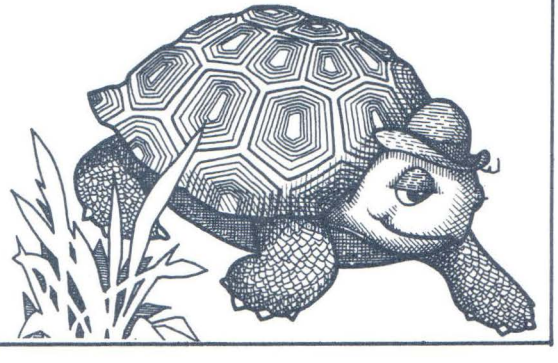
You might have noticed that we have entered only one command on a line before pressing the ENTER key. If you enter more than one command on a line in the RUN room, the computer will ignore all but the first command.

Example: Type: RT 45 RT 90 and press ENTER.



Turtle turns right 45
but does not turn right 90

When you start writing procedures in the EDIT room, you may put more than one command on a line. In the RUN room, only one command per line is accepted.

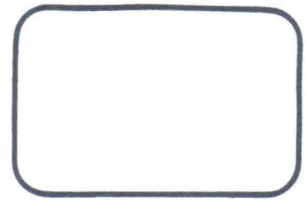


Activity 1

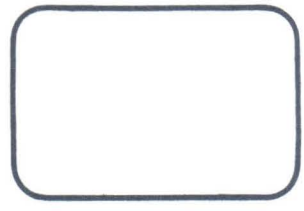
COPY ME

Perform the following sequence of commands and draw the final position of the turtle for each sequence. CLEAR the screen before starting each sequence.

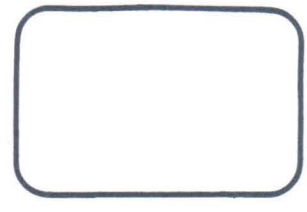
(1) RIGHT 45
RIGHT 180
RIGHT 90



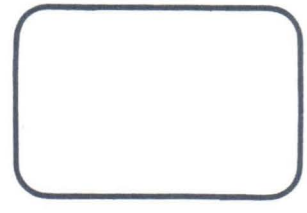
(2) RT 135
RT 45
RT 90



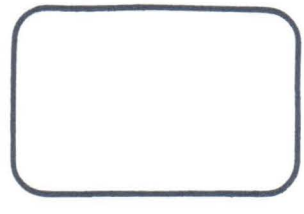
(3) RIGHT 180
RT 60
RT 30



(4) RT 30
RT 90
RT 60



(5) RT 45
RT 360
RT 135
RT 540



Mix in Left Turns

Of course, the turtle can turn the other way with the LEFT command. A 90-degree left turn command would be:

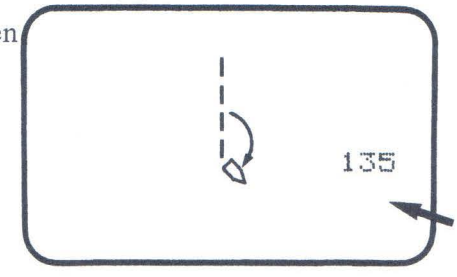
LEFT 90 or LT 90

A combination of left and right turns could very easily be turned into addition and subtraction problems for your students. Of course, the students would much rather solve them using Color LOGO than with pencil and paper. The two methods could be used together. A game might be used to match student pairs – one student working with pencil and paper; the other using Color LOGO's turtle, estimating the answer from the turtle's final position. For instance:

Find the result of:

RT 180
LT 45
LT 60
RT 15
RT 90
LT 45

Final screen



Not so obvious

Pencil and Paper

```
  180
- 45
-----
  135
- 60
-----
   75
+ 15
-----
   90
+ 90
-----
  180
- 45
-----
  135
```

The only problem with this kind of arithmetic is that the turtle keeps track of the numbers very well, but it can only turn on the screen in increments of 45 degrees (it will turn to the closest multiple of 45). For example, suppose the following sequence of commands is given.

COMMAND	SCREEN RESULT
HOME	Turtle facing top of screen
RT 10	Turtle image on the screen does not turn; 10 is closer to 0 than to 45.
RT 10	Turtle image on the screen does not turn; 20 is closer to 0 than to 45
RT 10	Turtle image turns 45 degrees; 30 is closer to 45 than to 0.

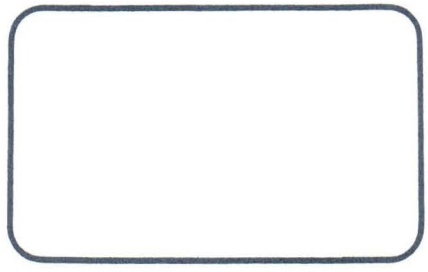
Select turn values carefully so that the final position is some multiple of 45. The following page of exercises could lead into a discussion of negative numbers, represented by left turns. It could also be used to introduce modular arithmetic (mod 360).

Activity 2

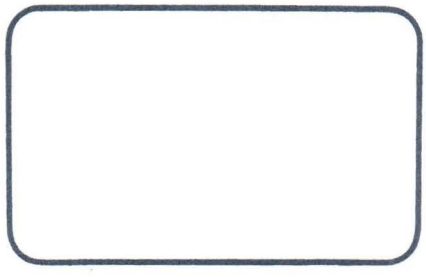
COPY ME

Give the result for each of the following lists of turtle commands. Add the RIGHT turns and subtract for LEFT turns. Draw the turtle's final position.

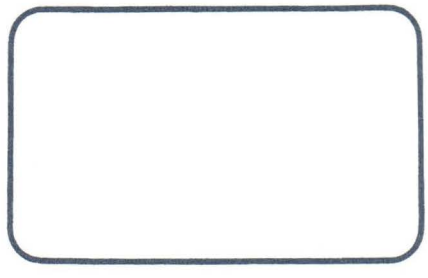
(1) RT 135
RT 90
LT 45
RT 180
LT 90
RT 270



(2) RT 60
RT 60
RT 90
LT 120
RT 30
LT 60
RT 315
LT 105

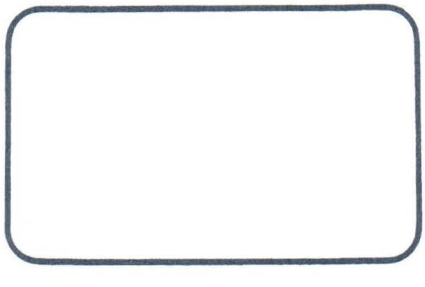


(3) RT 405
LT 180
RT 90
LT 270
RT 45
RT 135
LT 45
RT 90



(4) This one has more lefts than rights – negative numbers?

RT 90
LT 45
RT 270
LT 180
RT 45
LT 90
LT 135



Moving On

Your students know that we use many units of measure to describe distances. They know the length of 10 inches, 10 feet, 10 yards, and may even have some feeling for the length of 10 miles.

You might demonstrate Color LOGO commands by having students act out the parts of the Turtle and the Turtle Commander in the classroom. This activity could illustrate the simple commands FORWARD, BACK, RIGHT, and LEFT. The physical dimensions of the classroom could substitute for the physical dimensions of the video screen.

The idea that a given magnitude (in steps) must be given with the FORWARD command can quickly be conveyed in the classroom. If no limitation on the magnitude is given, a forward movement may run the Turtle Actor into a solid wall. If the Turtle Commander does not give a magnitude, the Turtle Actor should not move at all. Define the unit of movement of the Turtle Actor to be one step. When the students return to the computer, it will be natural for them to think of turtle steps as movement units on the video screen. They will soon discover that turtle steps are very small when compared to those used in the classroom.

How long is a turtle step? That depends upon the size of the video screen you are using. If you have a color TV set, the screen's diagonal measurement may vary from around 9 inches to 25 inches. Regardless, your students will soon develop a realistic concept of the distances described for a given screen. They will even be able to adjust rapidly to different sized screens.

By exploring statements such as FORWARD 10, FORWARD 100, BACK 10, and BACK 100 in the RUN room, students will see the turtle leave a trail in proportion to the distance specified in the command. They will explore and soon discover the difference between the two given distances. This can be done in the form of a game with one or more players in the RUN room.

Example of a two-player game played by Jeff and Kit:

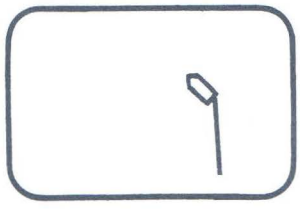
The game starts with no rules other than each player is to enter, in turn, a BACK or FORWARD movement and a RIGHT or LEFT turn.

Clear the screen in the RUN room by typing CLEAR. Then the game starts with Jeff going first.

1 Jeff enters:

FD 20
LT 45

Abbreviation for FORWARD



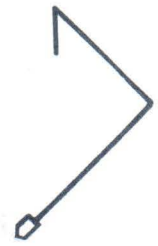
2 Kit:

BK 50
LT 90

Abbreviation for BACK

3 Jeff:

FD 80
RT 80



The turtle has moved into the area used by the four lines of text. The turtle shape has been destroyed. At this point, Jeff and Kit decided on rule 1.

(1) **Keep the turtle out of the area used by the text. If a player causes the turtle to move into the text area, that player loses the game.**

The screen was then cleared, and Kit and Jeff started over.

1 Jeff:

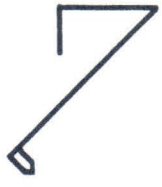
FD 40
LT 90

2 Kit:

BK 50
LT 45

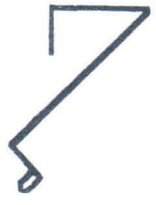
3 Jeff:

FD 90
LT 90



4 Kit:

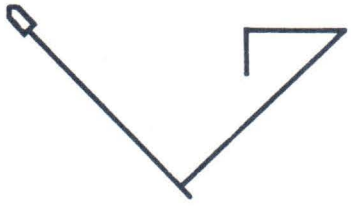
FD 10
RT 90



Kit is forcing the turtle towards text

5 Jeff:

RT 90
FD 100

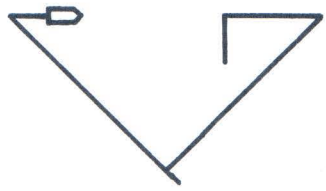


Jeff escapes by turning before moving forward

At this point, Kit and Jeff stopped to discuss rules again. Should a player be allowed to turn before moving FORWARD or BACK? Or should the order of movement be fixed by a rule? They decided to allow the movements and turns to be in any order and went on with their game • • •

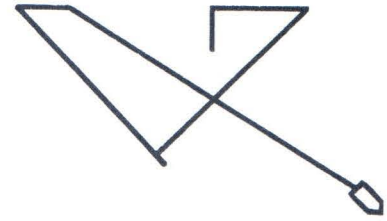
6 Kit:

RT 135
FD 20



7 Jeff:

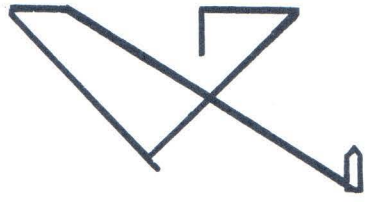
RT 30
FD 150



Note that the turtle's image points at a 45-degree angle, but the trail is drawn at 30 degrees.

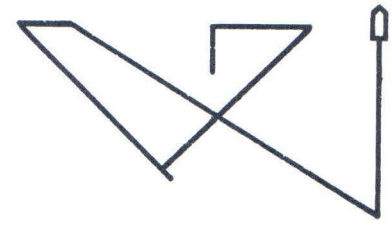
8 Kit:

FD 10
LT 120



9 Jeff:

FD 80
LT 0



Another stop was made here to discuss the rules. Can a player turn 0 degrees? That is not a turn at all. If a zero turn is allowed, how about a zero move FORWARD or BACK? This would allow a player to pass up a turn without moving. Jeff and Kit decided on these two new rules.

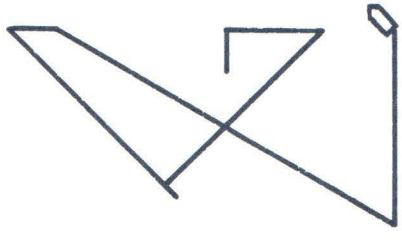
(2) **A player must turn at least five degrees.**

(3) **A player must move FORWARD or BACK at least five steps.**

Other players might decide on different rules.

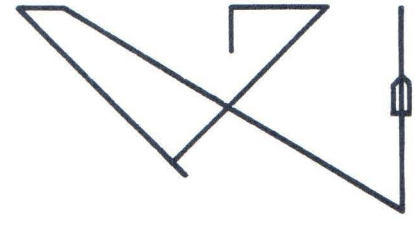
Jeff continued by putting in a turn of LEFT 45.

10 LT 45



11 Kit:

RT 45
BK 40



Note how the turtle retraced the path with the BACK move.

At this point, Kit and Jeff decided the game would be more interesting if they hid the turtle. The turtle becomes invisible when you enter HIDETURTLE or HT. To show the turtle again, enter SHOWTURTLE or ST. Therefore, they decided to start a new game with these rules.

(1). **Start with a CLEAR screen, and hide the turtle.**

(2) **Each turn consists of two commands in any order:**

a) **LT or RT of 5 through 180 degrees, inclusive**
b) **FD or BK moves of 5 or more steps**

(3) **The turtle must stay on the video screen.**

1 Jeff:

FD 40
RT 90

2 Kit:

LT 180
BK 50

3 Jeff:

LT 45
FD 100

4 Kit:

BK 70
RT 90

Notice that you see no change. The turtle retraced its trail. Heading?

5 Jeff:

FD 90
RT 45

It's now dangerously near the top. What should Kit do?

6 Kit:

LT 45
BK 15

No new trail. Where's the turtle? Kit reversed Jeff's turn and backtracked 5 steps.

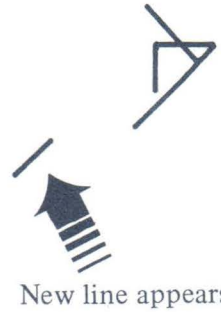
7 Jeff:

FD 100
RT 85

Still no trail. What's going on? Did the turtle go off the screen?

8 Kit:

FD 40
LT 90

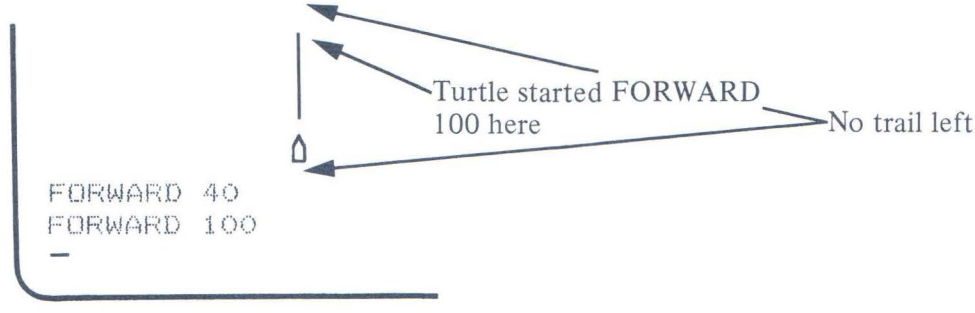


New line appears.

If the turtle goes off the top of the screen, it will "wrap-around" and reappear at the bottom of the screen. When a command causes the turtle to wrap-around, it does not leave a trail. The turtle can also wrap-around from bottom to top, from left to right, or from right to left. To demonstrate a wrap-around, try these commands in the order shown.

```
CLEAR
FORWARD 40
FORWARD 100
```

← Or some other large value that will cause a wrap-around



At this point, Kit becomes suspicious. She thinks there has been a wrap-around. But how can she prove it? With the turtle hidden, she can't think of a way to find out. She opened the Radio Shack Color LOGO Manual to read more about wrap-around. Suddenly she found the NOWRAP command and read that it took the screen out of the wrap-around mode. If NOWRAP is entered and the turtle runs off the screen, the computer will print:

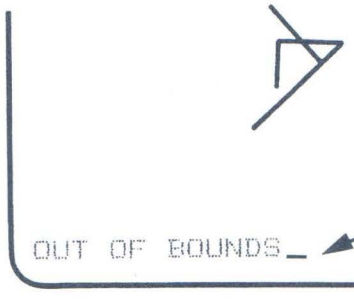
OUT OF BOUNDS

Kit and Jeff decided to enter the NOWRAP command at the start of each game. Luckily, they had written down each move they had made. Kit proposes that they type NOWRAP and re-do each step of the game.

At Play 6 (Kit's play), they saw:

Kit had backed the turtle up 5 steps, retracing part of Jeff's move in play 5.

At Play 7 (Jeff's play), they saw:



Yes, the turtle tried to wrap around from the top of the screen to the bottom.

KIT WINS!

Sometimes it is nice to be able to wrap around the screen. At other times, you may want to eliminate the wrap-around.

To eliminate wrap-around, enter NOWRAP.
To restore wrap-around, enter WRAP.

The important thing for you, the teacher, to remember is to let the students decide on their own rules as the game develops. The result of LEFT, RIGHT, FORWARD, and BACK movements can be learned in an entertaining way. Decisions can be made by the students. Don't let rules interfere with discovery.

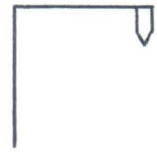
During one of their games, Kit and Jeff decided to cooperate in their efforts. This is how the game progressed.

1 Jeff:

FD 80
RT 90

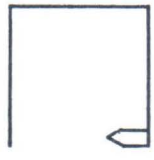
2 Kit:

FD 80
RT 90



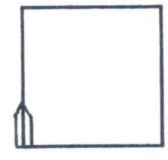
3 Jeff:

FD 80
RT 90



4 Kit:

FD 80
RT 90

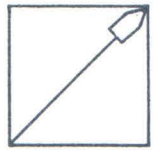


A square

Jeff and Kit huddled at this point and decided to try to draw the diagonals of their square. Since they had used 90-degree turns for the square, they decided one-half that amount should be used for the diagonal. They weren't sure about the length of the forward movement, but felt that it should be greater than 90, the length of the sides. They decided to try 100.

5 Jeff:

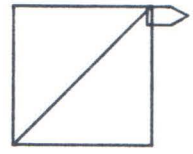
RT 45
FD 100



The turtle reached the corner, but the trail is a little short.

6 Kit decided to add 10 more steps:

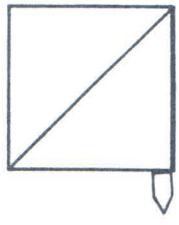
FD 10
RT 45



Close, but they're not sure. Jeff turns the turtle some more and moves on, hoping to re-trace one side of the square.

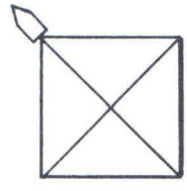
7 Jeff:

RT 90
FD 80

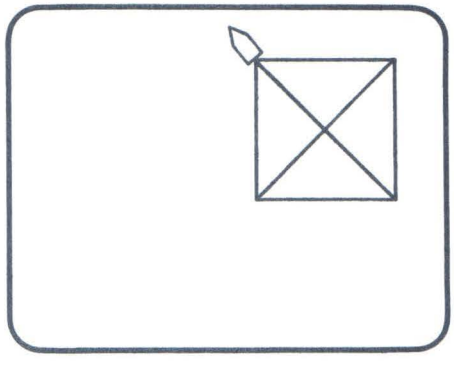


8 Kit:

RT 135 (90 + 45)
FD 110



Jeff and Kit pondered over their picture. They felt it wasn't quite right. They decided they should have made their diagonal a little longer. Jeff thought it should have been 114. Kit thought 112. They compromised on 113, cleared the screen, and tried again.



Much better this time

Activity 3

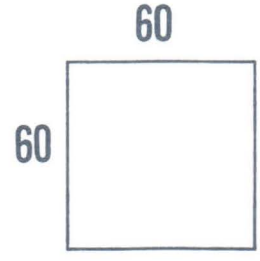
COPY ME

Here are some more things that your students might want to explore.

(1) Starting at the center of the screen, what's the greatest number of steps that a turtle can take without going off the top of the screen?

_____

(2) Find several different procedures that will draw this square.

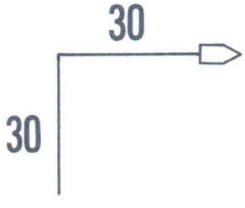


(3) Find commands to make the third angle and the third side that will complete these triangles.

FD 30
RT 90
FD 30

_____

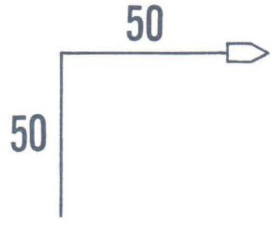
_____



FD 50
RT 90
FD 50

_____

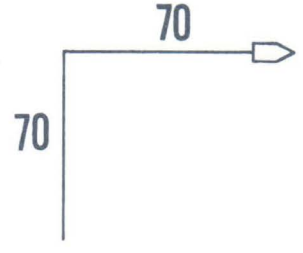
_____



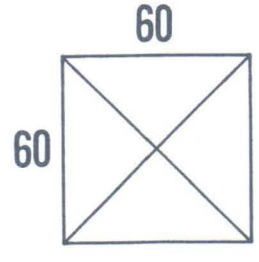
FD 70
RT 90
FD 70

_____

_____



(4) Repeat exercise (2) with the addition of the diagonals as shown in this figure.

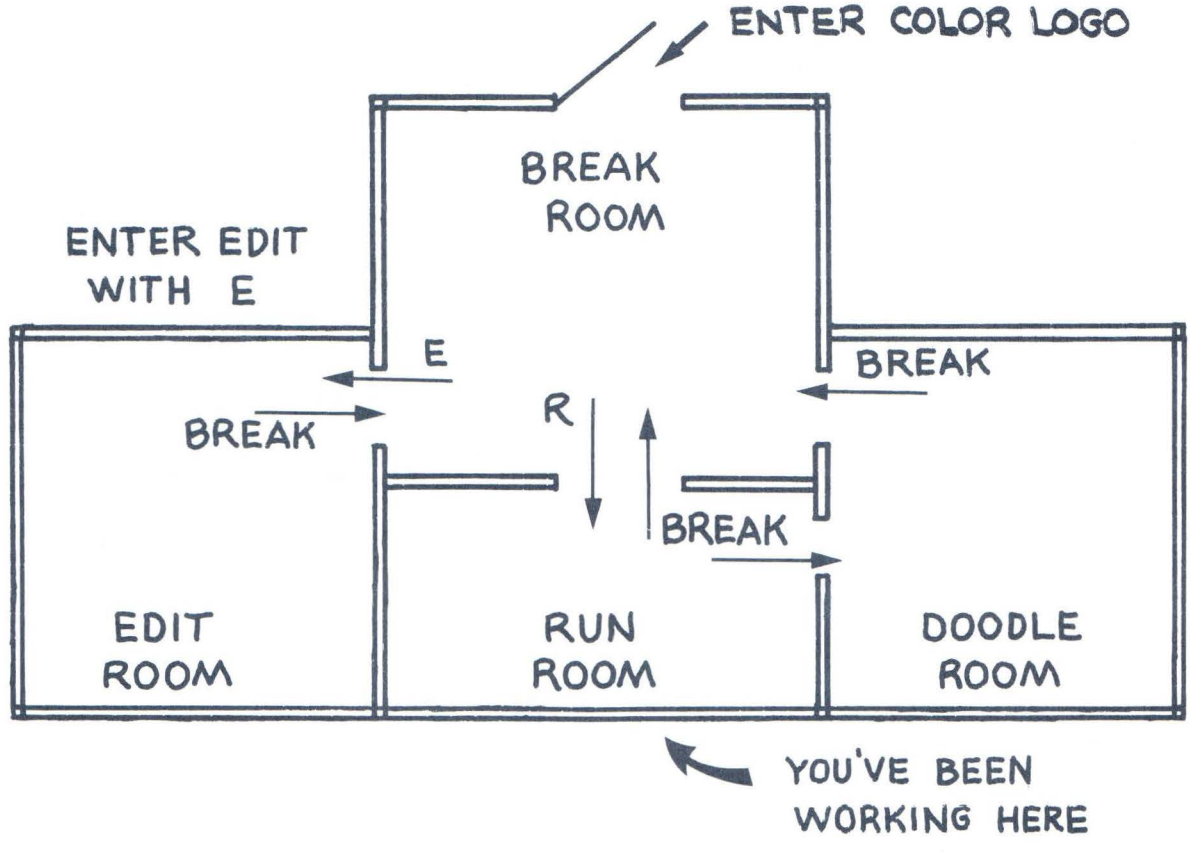


Other Rooms

Color LOGO action takes place in the RUN room. You have seen that each command has caused a specific action. The method used so far requires much typing and does not produce a continuous series of actions. In order to tie a string of actions together, you must learn to write a procedure.

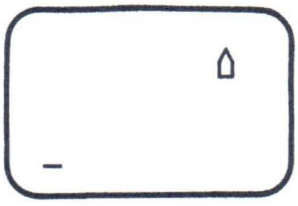
A Color LOGO procedure consists of a sequence of commands just like the ones you have been using in the RUN mode. However, procedures must be written in the EDIT room, and each procedure must be given a name. As long as the computer is not turned off, it will remember every procedure you write. Even though procedures are written in the EDIT room, they can only be used in the RUN room. Therefore, you can see that you must learn to move about the LOGO house from room to room.

Let's look back to a part of our earlier diagram of LOGO rooms and explore what's beyond the door leading to the EDIT room.

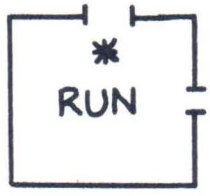


As the diagram shows, there is no direct connection between the RUN room and the EDIT room. You must first go from the RUN room back to the BREAK room by pressing the BREAK key. The EDIT room has only one door, and it can be entered only by pressing the letter E when you are in the BREAK room.

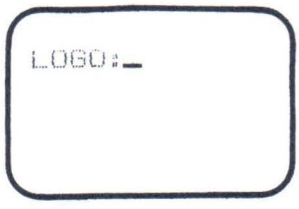
Here is how it looks on the video screen as you move from room to room.



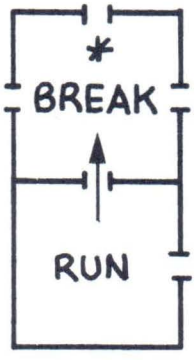
RUN room
(turtle showing)



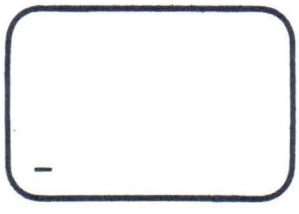
Press: BREAK



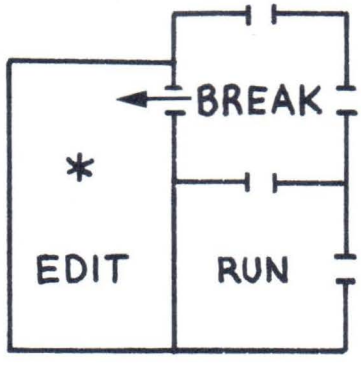
BREAK room
(LOGO prompt)



Press: E



EDIT room
(no turtle)



Editing

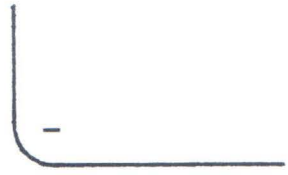
Sometimes we make mistakes when typing. I suspect that you may have typed some mistakes also. Color LOGO has editing capabilities to help you correct mistakes. It is easy to use. Only a few keys are needed to move the cursor, move whole lines up or down, add or delete characters in a line, and perform other useful deeds.

You know by now that pressing E when in the BREAK room is the only way to get to the EDIT room. Rather than immediately give you a list of rules that are hard to remember, we will provide a few activities to allow you and your students to learn to edit. A summary of the rules is given after you have had a chance to familiarize yourself with the editing process.

Press BREAK to get into the BREAK room. If you have procedures in memory, you can erase them by holding down SHIFT while pressing CLEAR. This method can only be used in the BREAK room.

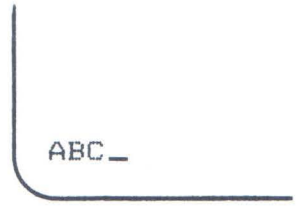
Press [E] to enter the EDIT room.

The cursor will appear on the bottom line.



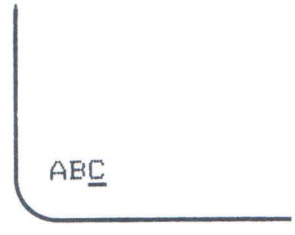
Type the letters ABC.

Notice that the cursor moved to the right one space as each letter appeared.



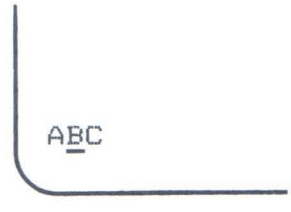
Press [←]

The cursor moved left one place, stopping under the C.



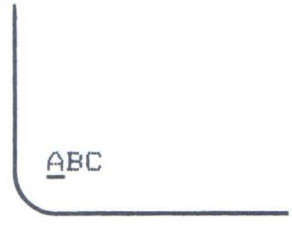
Press [←] again.

The cursor moved left one place, stopping under the B.



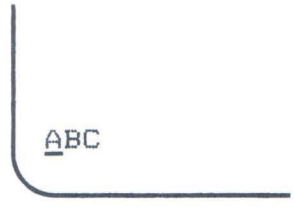
Press [←] again.

The cursor moved left one place, stopping under the A.



Press [←] again.

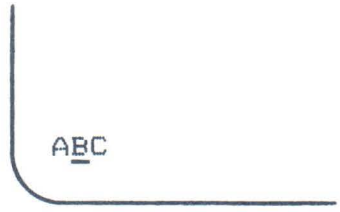
The cursor did not move.



Pressing the [←] key moves the cursor one place to the left unless it is already at the beginning of a line. In that case, the cursor does not move.

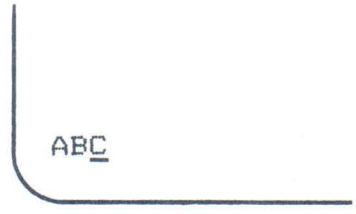
Now, press [→]

The cursor moved right one place, stopping under the B.



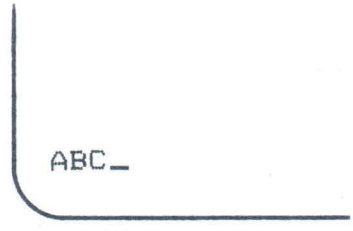
Press [→] again.

The cursor moved right one place, stopping under the C.



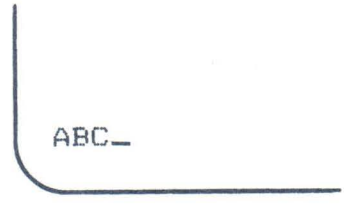
Press [→] again.

The cursor moved right one place, stopping one place to the right of the C.

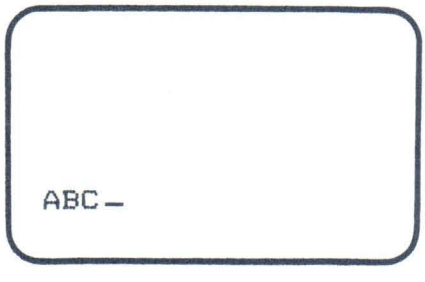


Press [→] again.

The cursor did not move.



Pressing the [→] key moves the cursor one place to the right unless it is already at the end of the characters on the line. In that case, the cursor does not move.

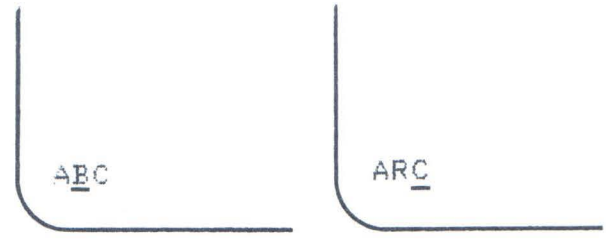


You can introduce the use of left– and right– arrow keys with some interesting word games. Let's use what we have on the screen as an example.

Two students, George and Annalee, have decided to play. They flipped a coin to see who would go first. George won.

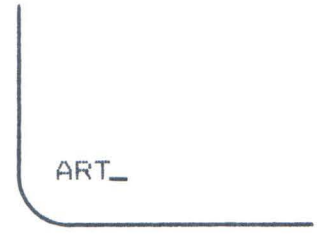
George moved the cursor under the B and typed the letter R. The cursor, of course, moved under the C when the R was typed.

ONE POINT for George because ARC is a word.



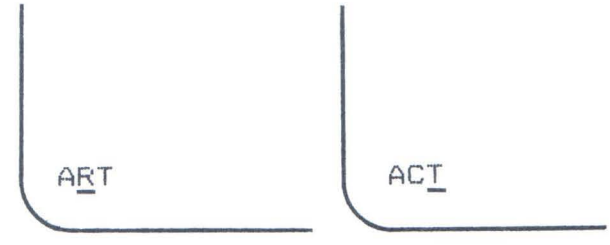
Annalee decided that she didn't need to move the cursor to make another word. She typed the letter T. The cursor moved to the right of the T as the letter was typed.

ONE POINT for Annalee because ART is a word.



George moved the cursor under the R and typed the letter C. The cursor moved under the letter T.

ONE MORE POINT for George because ACT is a word.



The game goes on in this way until:

(1) they tire of playing, or

(2) someone doesn't make a word, or

(3) someone makes a word that is not in the dictionary.

You can probably think up many variations of this game, such as:

- **Use SCRABBLE scores for words.**
- **Start with other letters.**
- **Use four-letter words or more-letter words.**
- **Start with 00 or some other two-digit number. Give a point for each prime number created. Or use three-digit numbers.**
- **Use Lewis Carroll DOUBLETS. Change CAT to DOG, one letter at a time with each change forming a new word.**

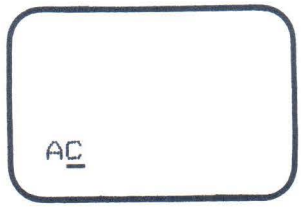
In order to learn some of the other editing keys, change back to the original letters and place the cursor immediately to the right of the C.

Move the cursor under the B.

Hold down SHIFT and press ←

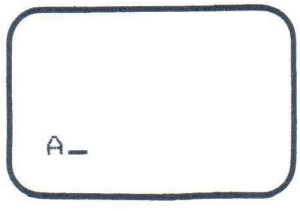
The B is erased and the C moves to the left.

Hold down SHIFT and press ← again.



The C is erased, and the cursor stays where it was.

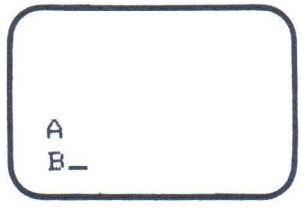
Hold down SHIFT and press ← again.



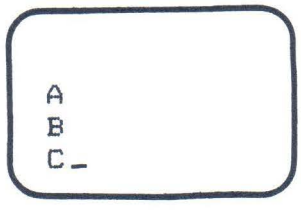
Nothing changed.

SHIFT LEFT-ARROW deletes the character above the cursor and moves the remainder of the line left to close the gap. If the cursor is not in the first column and there are no characters to the right of the cursor and no character above it, nothing happens. If the cursor is in column 1 with no characters to the right of it, the next line below will scroll up.

With the cursor one place to the right of the letter A, press the ENTER key. Then type the letter B.



Press ENTER again, and type the letter C.



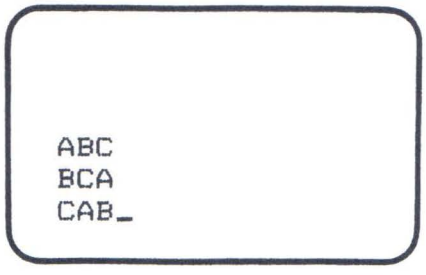
Move the cursor under the C by pressing ←

Now you are ready to repeat the word games that you used with the left–, right– arrow keys. Only this time, use the up– and down– arrow keys.

Pressing the [↓] key moves all lines down one unless the cursor is already on the top line.

Pressing the [↑] key moves all lines up one unless the cursor is already on the last line of text.

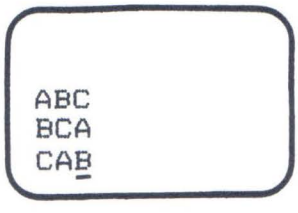
Once the students are familiar with the left–, right–, up–, and down– arrow keys, another variation to the word game suggests itself. Set up the screen so that it look like this.



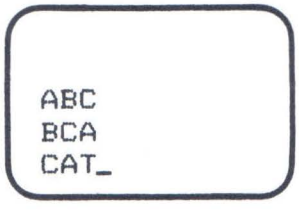
Now, a point is given for a new three-letter word in either horizontal, vertical, or diagonal directions.

George and Annalee decided to try this game. Annalee went first.

Annalee pressed the [←] key.



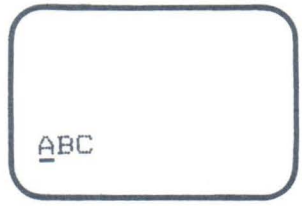
She typed a [T]



Annalee scored 3 points. One for C  **one for CAT**  **and one for A** 

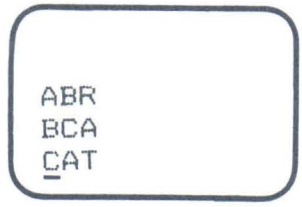
George pressed [↓] twice.

He then pressed [→] twice.



He then typed an [R], and

pressed [↑] twice.

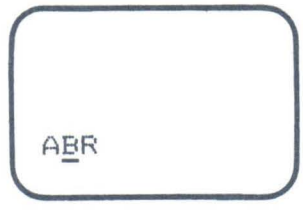


George scored 1 point for R A T

Annalee pressed [↓] twice

and [→] once. She then typed an

[I], and pressed [↑] twice.



Annalee scored 1 point for AIR

George pressed [↓], then [→]

He then typed an [A] and pressed [↑]

What did George score? R A C **is a word, but what about BAA?**

Now you need a dictionary to see if George scored 1 or 2 points. . .the game goes on. You decide on the rules for stopping.

When you're done, press [↓] several times until only the first line is showing. Then hold down SHIFT and press [←] several times until all the letters have been deleted.

INSERTIONS

You have learned to move the cursor about within text, to delete text characters, and to change text characters. However, sometimes typing errors arise as omissions. So you must learn how to insert a character between two others.

Suppose you have misspelled editor.

You see your mistake and wish to insert the letter I between D and the T.

(1) Move the cursor until it is one place to the right of the desired insertion.

(2) Hold down SHIFT and press [→]. A blank space appears at the cursor position and the letters TOR are moved right one place.

(3) Type the omitted letter [I]. The cursor moves right one place.

Now, suppose you wish to insert a whole word. For example, you really wish to type: THE EDITOR, which means you have to insert three letters and a space in front of the word EDITOR.

(1) Move the cursor to the E.

(2) Hold down SHIFT and press [→] 4 times. Each time a blank space is inserted, the characters all move to the right.

(3) Type the word to be inserted, THE. The cursor moves to the blank space between the two words.

SHIFT RIGHT-ARROW inserts a blank into the line at the cursor location by moving the remainder of the line one space to the right. If the line is already full, no action takes place.

You can create a new word game to teach insertions and to review the editing keys discussed previously.

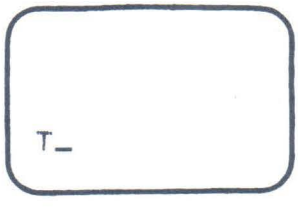
Growing Words

Start with a single letter – say a T. Each time a player may make a new word by:

(1) inserting one letter – 2 points
(2) changing one letter – 1 point
(3) deleting one letter – 0 points

This game could be played by one or more students.

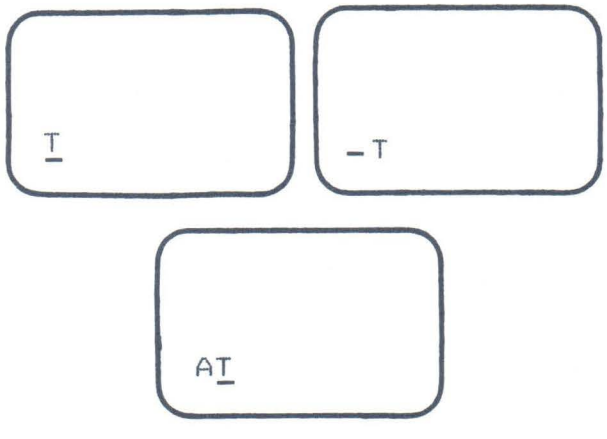
START of game



ROUND ONE

(1) player presses [←]
(2) player presses SHIFT [→]
(3) player types [A]

TWO POINTS, player added a letter.

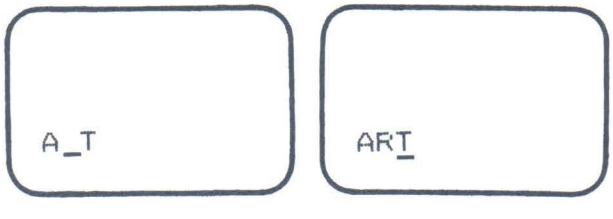


ROUND TWO

(1) player presses SHIFT [→]
(2) player types [R]

TWO POINTS, player added a letter.

TOTAL = 4



ROUND THREE

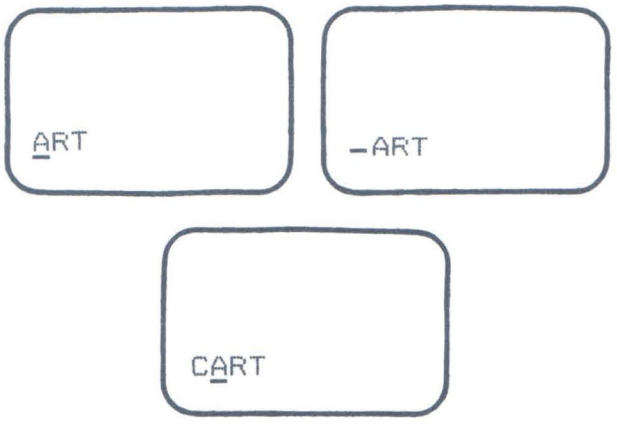
(1) player presses [←] 2 times.

(2) player presses SHIFT [→]

(3) player types [C]

TWO POINTS, player added a letter.

TOTAL = 6



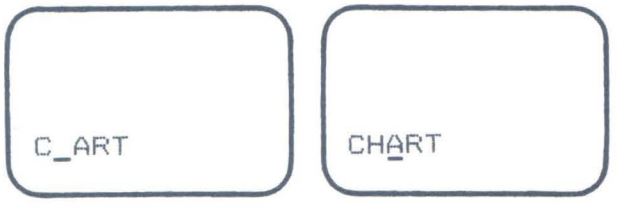
ROUND FOUR

(1) player presses SHIFT [→]

(2) player types [H]

TWO POINTS, player added a letter.

TOTAL = 8



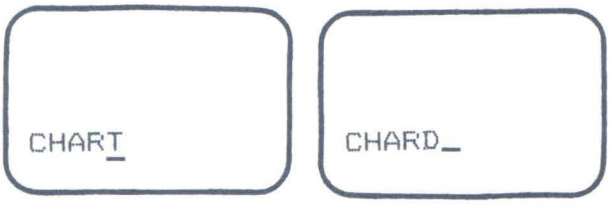
ROUND FIVE

(1) player presses [→] 2 times.

(2) player types [D]

ONE POINT, player changed a letter.

TOTAL = 9



ROUND SIX

(1) player presses [←]

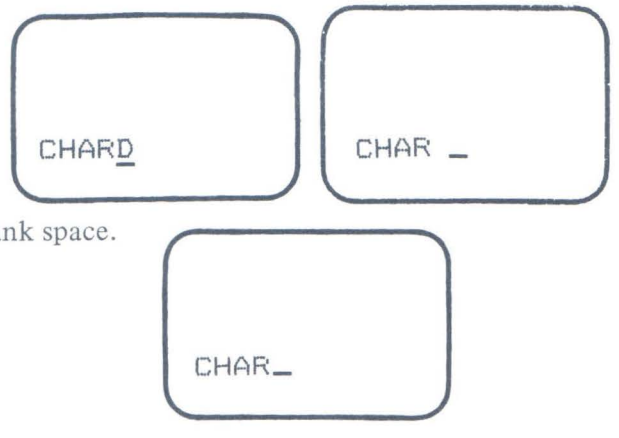
(2) player presses SPACE

The space bar deletes the character above it leaving a blank space.

The player could also have pressed SHIFT [←]

NO POINTS, player deleted a letter.

TOTAL still 9



The game can go on in this way until some predetermined total is reached or until it is impossible to make another new word.

Other Editing Keys

The remaining editing keys allow you to move around quickly within the text you have typed. To see how this works, type in the following text. Be sure to press ENTER after each line.

```
THIS IS A DEMONSTRATION OF
THE USE OF OTHER EDITING
KEYS:  DOWN-ARROW WITH
SHIFT, UP-ARROW WITH
SHIFT, AND CLEAR.  START
WITH THE CURSOR HERE._
```

Move the cursor under the W in the word WITH, then press SHIFT ↓

```
THIS IS A DEMONSTRATION OF
THE USE OF OTHER EDITING
KEYS:  DOWN-ARROW WITH
SHIFT, UP-ARROW WITH
SHIFT, AND CLEAR.  START
_
```

Blank line appears

Type: THE DEMONSTRATION and press ENTER.

```
THIS IS A DEMONSTRATION OF
THE USE OF OTHER EDITING
KEYS:  DOWN-ARROW WITH
SHIFT, UP-ARROW WITH
SHIFT, AND CLEAR.  START
THE DEMONSTRATION
WITH THE CURSOR HERE.
_
```

Pressing SHIFT DOWN-ARROW inserts a blank line in front of the cursor line if the cursor is in column 1.

Press CLEAR.

```
THIS IS A DEMONSTRATION OF
_
```

Pressing CLEAR moves to the top line of the text with the cursor in column 1.

Move the cursor between the words THIS and IS.

```
THIS_IS A DEMONSTRATION OF
```

Press SHIFT [↓]

```
THIS_
```

Pressing SHIFT DOWN-ARROW when the cursor is not in column 1 splits the line at the cursor location into two lines.

Press SHIFT [↑]

```
THIS
IS A DEMONSTRATION OF
THE USE OF OTHER EDITING
KEYS:  DOWN-ARROW WITH
SHIFT, UP-ARROW WITH
SHIFT, AND CLEAR.  START
THE DEMONSTRATION
WITH THE CURSOR HERE.
_
```

Pressing SHIFT UP-ARROW scrolls the text up continuously until the end of the text is reached or until any key is pressed.

The EDIT mode can be used for writing simple word processing applications. After editing the text, it may be printed or saved on disk or cassette. We printed our text file by going to the BREAK room and typing the letter P (of course, the printer must be connected to your computer and turned on). This is what was printed:

```
THIS
 IS A DEMONSTRATION OF
THE USE OF OTHER EDITING
KEYS:  DOWN-ARROW WITH
SHIFT, UP-ARROW WITH
SHIFT, AND CLEAR.  START
THE DEMONSTRATION
WITH THE CURSOR HERE.
```

There is one more key that is useful when printing text on a printer. Since the editor has a maximum line length of 32 characters, a facility is provided to allow printing longer text lines. You may want to combine two or more lines of text on the screen, onto one line on the printer. If you press the "@" key twice at the end of a line, a single "@" appears.

If a line ends with a "@" character, then no carriage return is output at the end of the computer's 32-character line. Your printer is in control of the line length. Here is how the text looked on the screen.

```
THIS
 IS A DEMONSTRATION OF @
THE USE OF OTHER EDITING @
KEYS:  DOWN-ARROW WITH @
SHIFT, UP-ARROW WITH @
SHIFT, AND CLEAR.  START @
THE DEMONSTRATION @
WITH THE CURSOR HERE.
_
```

The @ character must be pressed twice when used in this way.

Here is a printout using "@" at the end of all but the first and last lines.

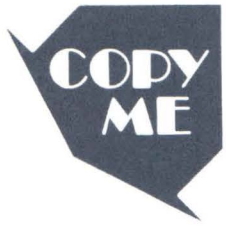
```
THIS
 IS A DEMONSTRATION OF THE USE OF OTHER EDITING KEYS:  DOWN-ARROW WITH SHIFT, UP
-ARROW WITH SHIFT, AND CLEAR.  START THE DEMONSTRATION WITH THE CURSOR HERE.
```

To clear text from the computer's memory:

Press BREAK to get to the BREAK room.

Then hold down SHIFT and press CLEAR

Summary of Edit Keys



←	moves the cursor one place to the left unless it is already at the beginning of a line. In that case, the cursor does not move.
→	moves the cursor one place to the right unless it is already at the end of the line. In that case, the cursor does not move.
↓	moves all lines down one unless the cursor is on the top line. In that case, the cursor does not move.
↑	moves all lines up one unless the cursor is on the last line of text. In that case, the cursor does not move.
SHIFT CLEAR	erases all procedures in memory when used in the BREAK room.
SHIFT →	inserts a blank into the line at the cursor location by moving the remainder of the line one space to the right. If the line is full, no action takes place.
SHIFT ←	deletes the character above the cursor and moves the remainder of the line left to close the gap. If there are no characters to the right of the cursor and no character above it, nothing happens.
SHIFT ↓	moves the line at which the cursor exists down, leaving a blank line (if the cursor is in column 1). If the cursor is not in column 1, the line is split into two lines at the cursor position.
SHIFT ↑	scrolls the text up continuously until the end of text is reached or until any key is pressed.
CLEAR	moves all text down with only the top line showing. The cursor is in column 1.
@	(when pressed twice) is used when text is to be sent to a printer. The @ character causes the computer to omit the carriage return at the end of a video screen line. The printer then has control of carriage returns.

Entering A Procedure

Now that you know how to use the edit keys, it is time to practice writing procedures. If you are not in the EDIT room, go there now. Let's write a procedure that flips the turtle first to the right and then back to the left. The procedure must be given a name. The name must not contain any spaces and must not be the same as a Color LOGO command or an abbreviation (such as RIGHT or RT). Let's use the name FLIP-FLOP.

The name of a procedure must be preceded by the word TO when it is defined in the EDIT room. Press

BREAK SHIFT – CLEAR then E

to clear memory and return to the EDIT room.

Type: TO FLIP-FLOP and press ENTER.

```
TO FLIP-FLOP
_
```

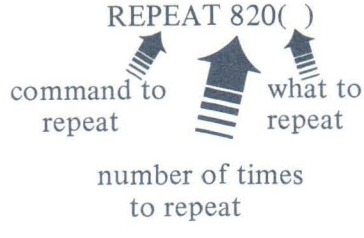
The computer is now ready for the commands which will make up the procedure called FLIP-FLOP.

Type in each of the following commands. Press the ENTER key after each command.

Use either form

```
TO FLIP-FLOP          TO FLIP-FLOP
  RIGHT 90              RT 90
  REPEAT 820()          REPEAT 820()
  LEFT 90               LT 90
```

The FLIP-FLOP procedure contains a new command, REPEAT. There is no abbreviation for REPEAT.



This REPEAT command works just like an empty FOR-NEXT loop in BASIC.

in LOGO	in BASIC
`REPEAT 820()`	`FOR N = 1 TO 820` `NEXT N`

The number 820 tells the computer to repeat (820 times) whatever follows in the parentheses. Notice that we put nothing inside the parentheses. This tells the computer to do nothing 820 times. However, it does take some time for the computer to read the repeat statement 820 times. Therefore, the repeat statement with nothing between parentheses acts as a time delay (about 1 second) between the right and the left turns.

Since the computer stores your procedures in memory, you must tell the computer where the END of each procedure is. Then, when several procedures exist in memory, the computer can tell where one ends and another begins. After the last command of the procedure, type:

END and press ENTER

The procedure, with its name and END statement, looks like this on the screen:

```
TO FLIP-FLOP
  RT 90
  REPEAT 820()
  LT 90
END
_
```

First line contains name

Body of the procedure

Last line tells LOGO where the procedure stops

You should emphasize the following to your students:

(1) A procedure:

- **(a) is defined in the EDIT room.**
- **(b) must have a name.**
- **(c) consists of one or more Color LOGO commands.**
- **(d) must have END as the last command.**
- **(e) is executed in the RUN mode.**

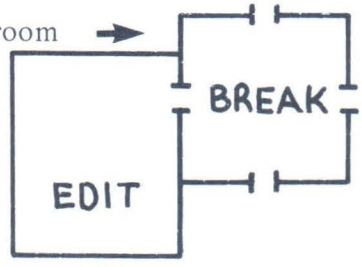
(2) More than one command may be entered on a given line of a procedure, but commands entered in this way must be separated by at least one space.

(3) The computer stores (saves) procedures in its memory for future use.

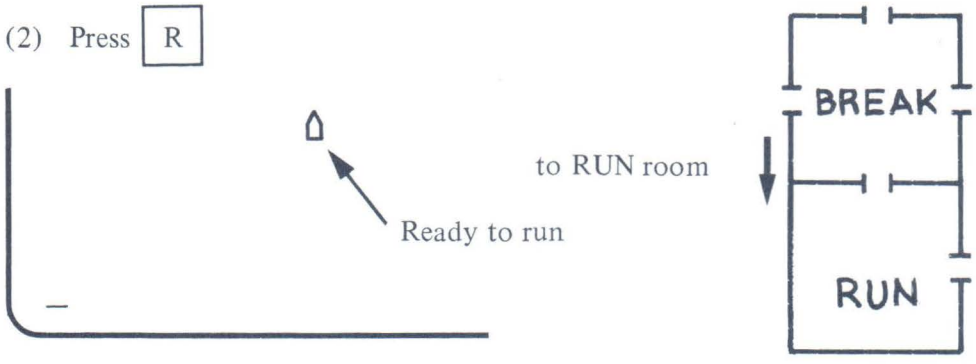
Running A Procedure

When you have entered the procedure, you must return to the RUN room to execute it. Remember, there is no direct path from the EDIT room to the RUN room. You must pass through the BREAK room to get there.

(1) Press BREAK



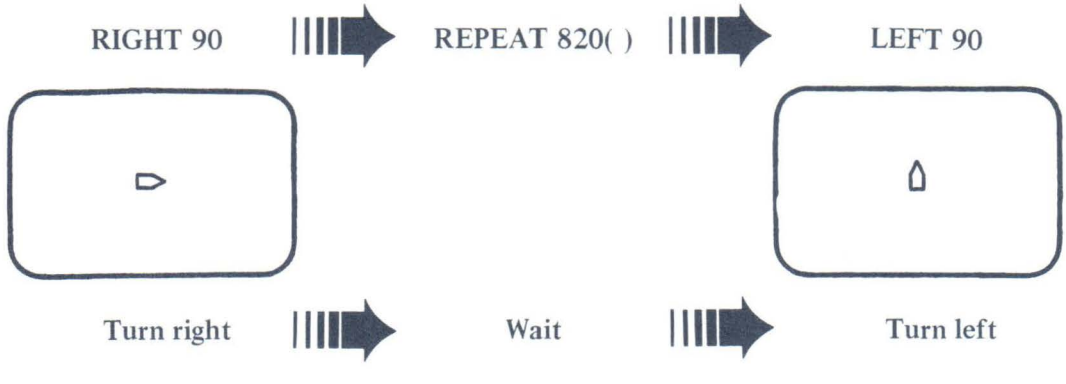
(2) Press R



(3) RUN the procedure FLIP-FLOP:

(a) Type: FLIP-FLOP

(b) Press: ENTER

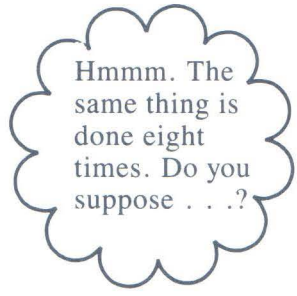


You now know how to go back and forth between RUN and EDIT. You also know how to enter and execute procedures. Use your knowledge to enter and execute the following procedure.

```
TO ROTATEONE
  RT 45
  REPEAT 820()
  RT 45
  REPEAT 820()
  RT 45
  REPEAT 820()
  RT 45
  REPEAT 820()
  RT 45
  REPEAT 820()
  RT 45
  REPEAT 820()
  RT 45
  REPEAT 820()
END
```

When ROTATEONE is executed, the turtle steps through 45-degree turns in a clockwise direction until it has returned to its original position. The procedure is rather long. You can shorten it somewhat by putting more than one command on a line as in the following variation. There must be at least one space between the commands when used in this way.

```
TO ROTATETWO
  RT 45 REPEAT 820()
  RT 45 REPEAT 820()
  RT 45 REPEAT 820()
  RT 45 REPEAT 820()
  RT 45 REPEAT 820()
  RT 45 REPEAT 820()
  RT 45 REPEAT 820()
  RT 45 REPEAT 820()
END
```



Try both versions to assure yourself that they perform the same action.

Notice the repetitions of the commands RT 45 and REPEAT 820( ). The REPEAT command can be used in other ways than time delays. The following procedure shows how it may be used to shorten the rotate procedure.

```
TO ROTATETHREE
  REPEAT 8(RT 45 REPEAT 820())
END
```

At least one space between commands

All three procedures – ROTATEONE, ROTATETWO and ROTATETHREE perform the same action. ROTATETHREE is certainly the shortest and easiest to type.

Remember, you can put more than one command on a line in a procedure. You cannot put more than one command on a line when you are directly executing commands in the RUN room.

SAVE & LOAD PROCEDURES ON TAPE

Very shortly after introducing procedures, you should discuss saving procedures on cassette tape. The SAVE command sends all the procedures in the computer's memory to the tape recorder. If you have some procedures in memory that you don't want to save, erase them before recording. The methods of saving and loading procedures are discussed in Appendix C.

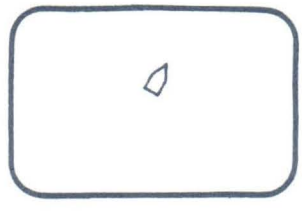
Activity 4

The procedure SQUIGGLE performs a series of turns in different directions. Rewrite the procedure using REPEAT 420( ) commands to provide delays between turns.

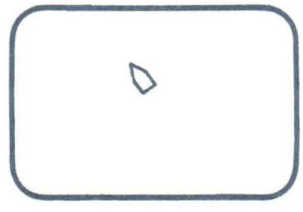
```
TO SQUIGGLE
  RT 45 LT 90
  RT 90 LT 90
  RT 90 LT 90
  RT 45
END
```

YOUR REVISION TO SQUIGGLE

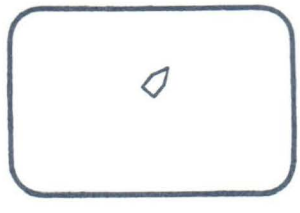
1



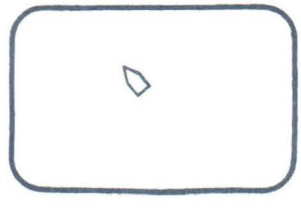
2



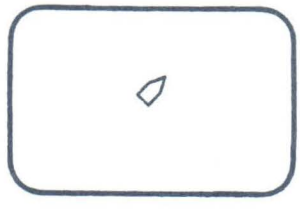
3



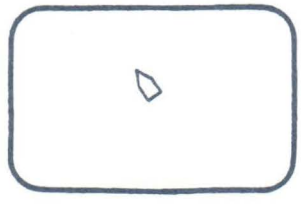
4



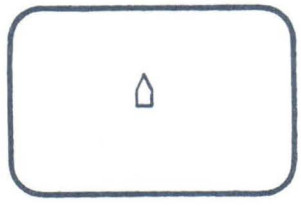
5



6



7



Wiggle

Your students might be more interested in wiggling the turtle rather than rotating it or flipping it back and forth. Here are several different ways to wiggle.

(1) Wiggle to the right in place:

```
TO WIGGLERT
  REPEAT 8(RT 45 REPEAT 410())
  LT 45 REPEAT 410())
END
```

Remember, REPEAT 410( ) is a time delay.

(2) Wiggle to the left in place:

```
TO WIGGLELT
  REPEAT 8(LT 45 REPEAT 410()
  RT 45 REPEAT 410())
END
```

(3) Wiggle right, then left in place:

```
TO WIGGLERTLT
  REPEAT 8(RT 45 REPEAT 410()
  LT 90 REPEAT 410() RT 45)
END
```

If the turtle wiggles hard enough, it should be able to move forward. By typing the word FORWARD, followed by a space and then the number of turtle steps to be taken, you can make the turtle move in the direction that it is heading.

FORWARD 10 or FD 10

The next two procedures use the FORWARD command to wiggle the turtle around the screen.

(4) Wiggle upward:

```
TO WIGGLEUP
  REPEAT 4 (RT 45 FD 10
  REPEAT 410() LT 90 FD 10
  REPEAT 410() RT 45)
END
```

(5) Wiggle around:

```
TO WIGGLEAROUND
  REPEAT 3(RT 45 FD 10
  REPEAT 410() LT 90 FD 10
  REPEAT 410() RT 90 FD 10
  WIGGLEAROUND)
END
```

Notice the command just before END in number 5. The command WIGGLEAROUND is the same as the name of the procedure. This causes the procedure to go back to the beginning. Thus the procedure repeats itself over and over. To stop the program, press the BREAK key. That interrupts the procedure and sends the computer back to the BREAK room.

The following activity contains sample procedures to give students practice in entering and running them. If mistakes are made, the students will have opportunities to practice their editing skills. Care must be used in the placement of spaces, in spelling, and in the use of parentheses. Students should not be concerned with the commands used in the procedures. We have used many commands that will be discussed in detail later. This is a fun activity with no questions and no answers.

Activity 5

Here are several procedures for you to enter and run. Use what you have learned about editing. Don't worry about how or why the procedures work. Type very carefully, making sure each space, parenthesis, and character is placed exactly as shown.

```
TO FLASH
 HT MAKE :COLOR 0
 REPEAT 2(MAKE :GROUND 0
 REPEAT 2(COLORSET :COLOR
 REPEAT 4(BG :GROUND
 REPEAT 410()
 MAKE :GROUND :GROUND+1)
 MAKE :COLOR :COLOR+1))
END
```

```
TO MANYPOINT
 REPEAT 24(REPEAT 4(FD 40
 RT 90) RT 15)
END
```

```
TO SQUAREAROUND
 SETX 60 MAKE :PEN 0
 COLORSET 1 BG 0 HT
 REPEAT 4(MAKE :PEN :PEN+1
 PC :PEN
 REPEAT 72(REPEAT 4(FD 20
 RT 90) FD 5 RT 5))
END
```

```
TO OVERLAY
 COLORSET 1 BG 3 HT
 MAKE :PEN 0 REPEAT 4(
 REPEAT 3(PC :PEN
 MAKE :LONG 5
 REPEAT 20(FD :LONG RT 60
 MAKE :LONG :LONG+2)
 REPEAT 20(FD :LONG RT 60
 MAKE :LONG :LONG-2))
 MAKE :PEN :PEN+1)
 COLORSET 0 BG 3
 HOME
END
```

```
TO CIRCLESQUARE
 REPEAT 40(REPEAT 2(FD 50 RT 90
 FD 30 RT 90) LT 81)
END
```

```
TO FIVEPOINT
 RT 45
 REPEAT 10(REPEAT 4( FD 50
 RT 90) RT 36)
END
```

```
TO CRAWL
 SLOW 64 REPEAT 6(FD 15
 REPEAT 8(FD 3 RT 45)
 FD 15 REPEAT 8(FD 3
 LT 45)) FD 5
END
```

```
TO DART
 HT REPEAT 12(
 COLORSET RANDOM 2
 BG RANDOM 4
 REPEAT 100(
 MAKE :LONG RANDOM 400
 MAKE :ANG RANDOM 18
 MAKE :PEN RANDOM 4
 PD PC :PEN RT :ANG FD :LONG
 PU BK :LONG))
END
```

```
TO WHEEL
 COLORSET 1 HT REPEAT 90(
 REPEAT 4(PC 1 FD 50 RT 90
 PC 2 FD 20 RT 90 FD 50 RT 90
 PC 1 FD 20) RT 1)
END
```

Activity 6

COPY ME

Enter the procedure in the EDIT room. Below each list, draw a picture of what you think you will see on the screen. Then, go to the RUN room and execute the procedure to see if you are correct. Last of all, write a procedure for exercises 2 and 3 in a shortened form as we have done for number 1.

1

```
TO MYSTERY1
 FORWARD 30
 RIGHT 90
 FORWARD 30
 RIGHT 90
 FORWARD 30
 RIGHT 90
 FORWARD 30
 RIGHT 90
END
```

2

```
TO MYSTERY2
 FORWARD 60
 RIGHT 120
 FORWARD 60
 RIGHT 120
 FORWARD 60
 RIGHT 120
END
```

3

```
TO MYSTERY3
 BACK 50
 LEFT 90
 FORWARD 50
 RIGHT 90
 FORWARD 50
 LEFT 90
 BACK 50
 RIGHT 90
END
```

1

```
TO MYSTERY1
 REPEAT 4(FD 30 RT 90)
END
```

2 _____

_____

_____

3 _____

_____

_____

_____

_____

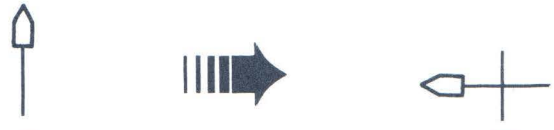
_____

Turtle Trails

The turtle has left a trail in all previous experiments. Now, we don't even pretend to know how the turtle leaves its trail. However, we do know that there is a way to tell the turtle not to leave a trail. Imagine that the turtle is carrying a pen. If it carries the pen over its shoulder, the pen will not leave a mark. If it lowers the pen to the ground, it leaves a mark (or trail) wherever it goes.

Suppose you want to use its pen to make a large "plus" sign.

The plus sign can be made by using the turtle as before with the pen down, but you would have to retrace some parts of the turtle's path. It would be much simpler to draw two distinct lines.



1. 2.

This can be accomplished by lifting the turtle's pen at the end of the first line, moving the turtle to the start of the second line, and lowering the pen for the second line. To do this, you can make use of these two new commands:

PENUP or PU ← Lifts the turtle's pen so there will be no trail.

PENDOWN or PD ← Lowers the turtle's pen so it will leave a trail.

The plus sign (+) can be made with the following sequence of commands.

FORWARD 40	draw first line
PENUP	lift the pen
RIGHT 135	turn
FORWARD 30	move without trail
RIGHT 135	turn
PENDOWN	lower the pen
FORWARD 40	draw second line

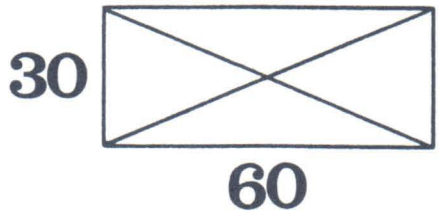
Put these commands into a procedure. Then think of two procedures that would draw the same cross with a different sequence of commands. Remember, you can use BACK and LEFT as well as FORWARD and RIGHT.

Examples:

```
TO CROSS1          TO CROSS2
  FD 40              FD 40
  LT 135             LT 45
  PU                 PU
  FD 30              BK 30
  RT 45              LT 45
  PD                 PD
  BK 40              FD 40
END                END
```

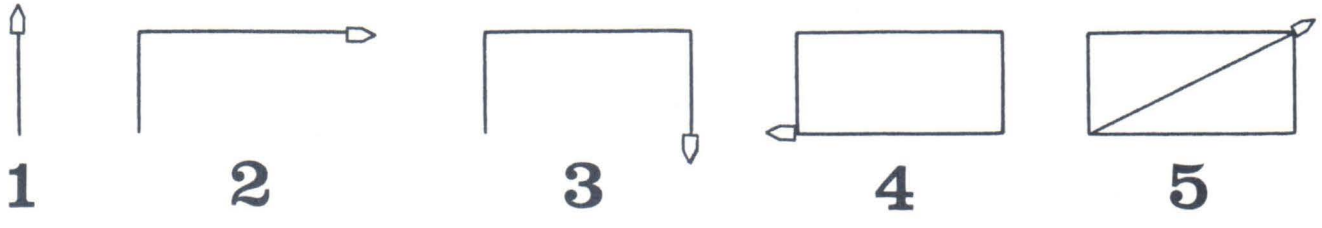
Put yours in these columns.

The next exercise requires the student to draw a rectangle with its diagonals.



This exercise will probably require some experimentation. In Activity 3, students were asked to draw the diagonals of a square by experiments in the RUN room. A rectangle is a little more difficult because the diagonals do not form a 45-degree angle with the horizontal side.

The first five steps are to be drawn leaving a turtle trail.



Then the student is to provide commands that would lift the turtle's pen and move to the upper left corner of the rectangle before making the second diagonal.

Activity 7

A rectangle and its diagonals are to be drawn as shown in the following steps. Each time you retrace a line that has already been drawn, lift the turtle's pen. Be sure to lower it when ready to draw a new line. Fill in the missing instructions.

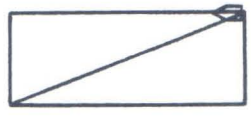
(1) FORWARD 30
RIGHT 90

(2) FORWARD 60
RIGHT 90

(3) FORWARD 30
RIGHT 90

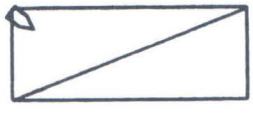
(4) FORWARD 60
RIGHT _____

(5) FORWARD _____
LEFT _____



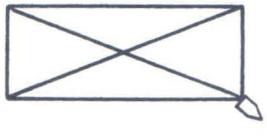
(6) _____ Lift pen

(7) FORWARD _____
_____

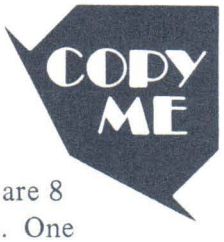


(8) _____ Lower pen

(9) FORWARD _____



Activity 8



Use the PENUP and PENDOWN commands to draw the following dashed lines. Long dashes are 8 turtle steps. Short dashes are 2 turtle steps. The spaces between the dashes are 4 turtle steps. One example is shown with the procedure given.

Example 

```
TO EXAMPLE
  PD RT 90 FD 8
  PU FD 4
  PD FD 2
  PU FD 4
  PD FD 8
  PU FD 4
  PD FD 2
  PU FD 4
END
```

(1) 

TO ONE

(2) 

TO TWO

(3) 

TO THREE

The Magic of Disappearance

You and your students may find that the turtle sometimes interferes with what you are doing on the screen. You can make the turtle disappear (or hide) by using the command:

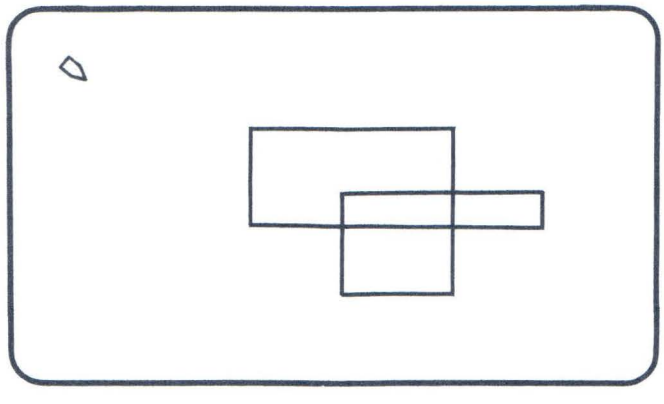
HIDETURTLE or HT

The turtle can still be moved, even though hidden. It will leave a trail if its pen is down. Of course, if you hide the turtle and lift its pen, you can't tell where the turtle is or what direction it is facing. That could lead to some interesting guessing games. If you really lose the turtle and want to see it again, you can make it visible with the command:

SHOWTURTLE or ST

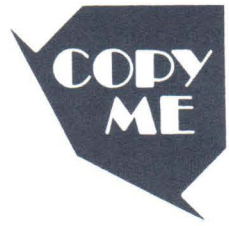
Here is a procedure that uses a hidden turtle to draw a design. At the end, it lifts its pen and moves to the upper left of the screen where it reappears, pointing at its design.

```
TO PLAY
 HT FD 30
 RT 90 FD 40
 RT 90 FD 50
 RT 90 FD 20
 RT 90 FD 30
 RT 90 FD 40
 RT 90 FD 10
 RT 90 FD 60
 PU RT 35 FD 135
 RT 180 ST
END
```



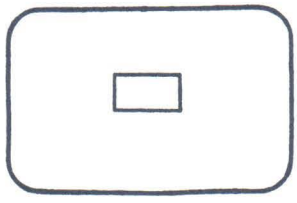
Final Screen Display

Activity 9

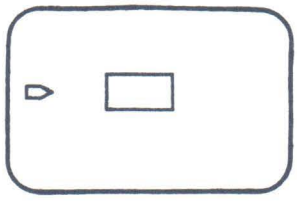


Write a procedure that will perform the following steps.

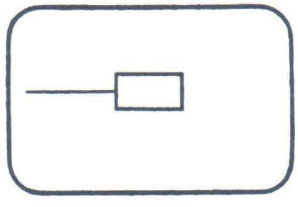
(1) Draw a box 40 steps long and 30 steps wide.



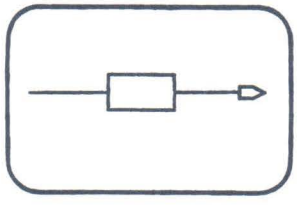
(2) Lift the turtle's pen and move it to the left-center of the screen facing the center of the box.



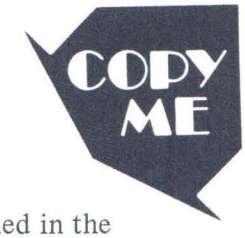
(3) Lower the pen and draw a trail to the box. When the turtle reaches the box, hide the turtle.



(4) Move to the opposite side of the box without leaving a trail. Then make the turtle reappear and leave a trail as it moves to the right side of the screen.



Activity 10



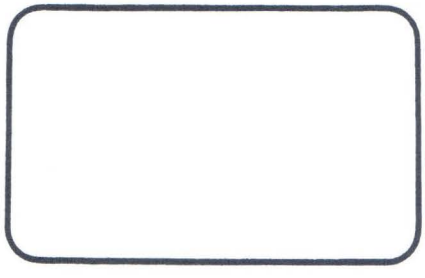
The FOUR procedure draws the numeral **4** on the screen. The procedure must be defined in the EDIT room, and it is run in the RUN room. Follow the directions below.

(1) Enter this procedure in the EDIT room.

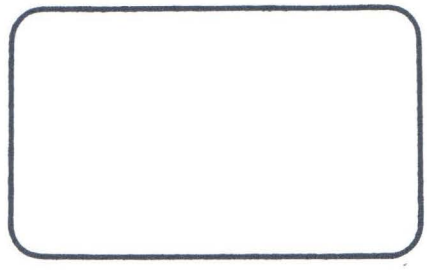
```
TO FOUR
  HIDETURTLE
  FD 40  LT 135
  FD 30  LT 135
  FD 40
  SHOWTURTLE
END
```

(2) Go to the RUN room, and RUN the procedure four times.
Draw a picture of the screen after each RUN.

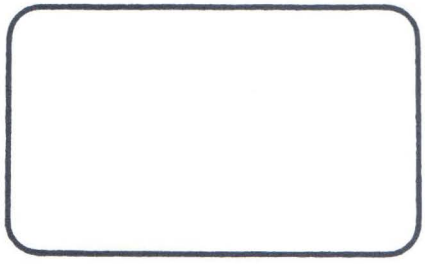
After RUN 1



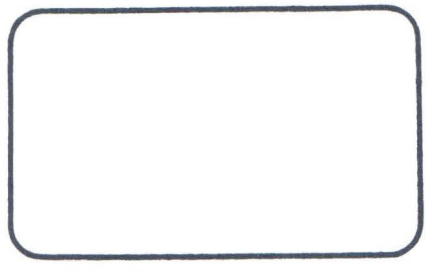
After RUN 2



After RUN 3



After RUN 4



Changing Colors

So far, we have been working with black lines drawn on a green background. Since this language is called Color LOGO, you surely expect that there must be a variety of colors available. There are. Color LOGO has two color sets, each made up of four colors. You can change the color used to draw the lines and also change the background color on which the lines are drawn.

Ink

While using a green background, Color LOGO provides four different colors for the turtle's pen. The colors will vary somewhat depending on what kind of display you are using and how you have the color controls of the display set. On our set, the colors appear to be black, green, blue, and a deep shade of red. Of course, if green is used on a green background, you can't see the turtle's trail. This fact makes green useful in erasing turtle trails.

The commands used to change the color of the pen's ink are:

PENCOLOR 0	or	PC 0
PENCOLOR 1	or	PC 1
PENCOLOR 2	or	PC 2
PENCOLOR 3	or	PC 3

To demonstrate the pencolors, enter the following procedure.

```
TO MANYINK
 PENCOLOR 0 RT 90
  DRAW
 PENCOLOR 1
  DRAW
 PENCOLOR 2
  DRAW
END
```

If you were to run MANYINK, the computer would change the color of the pen to number 0, and the turtle would turn right 90 degrees. Then you would see the message:

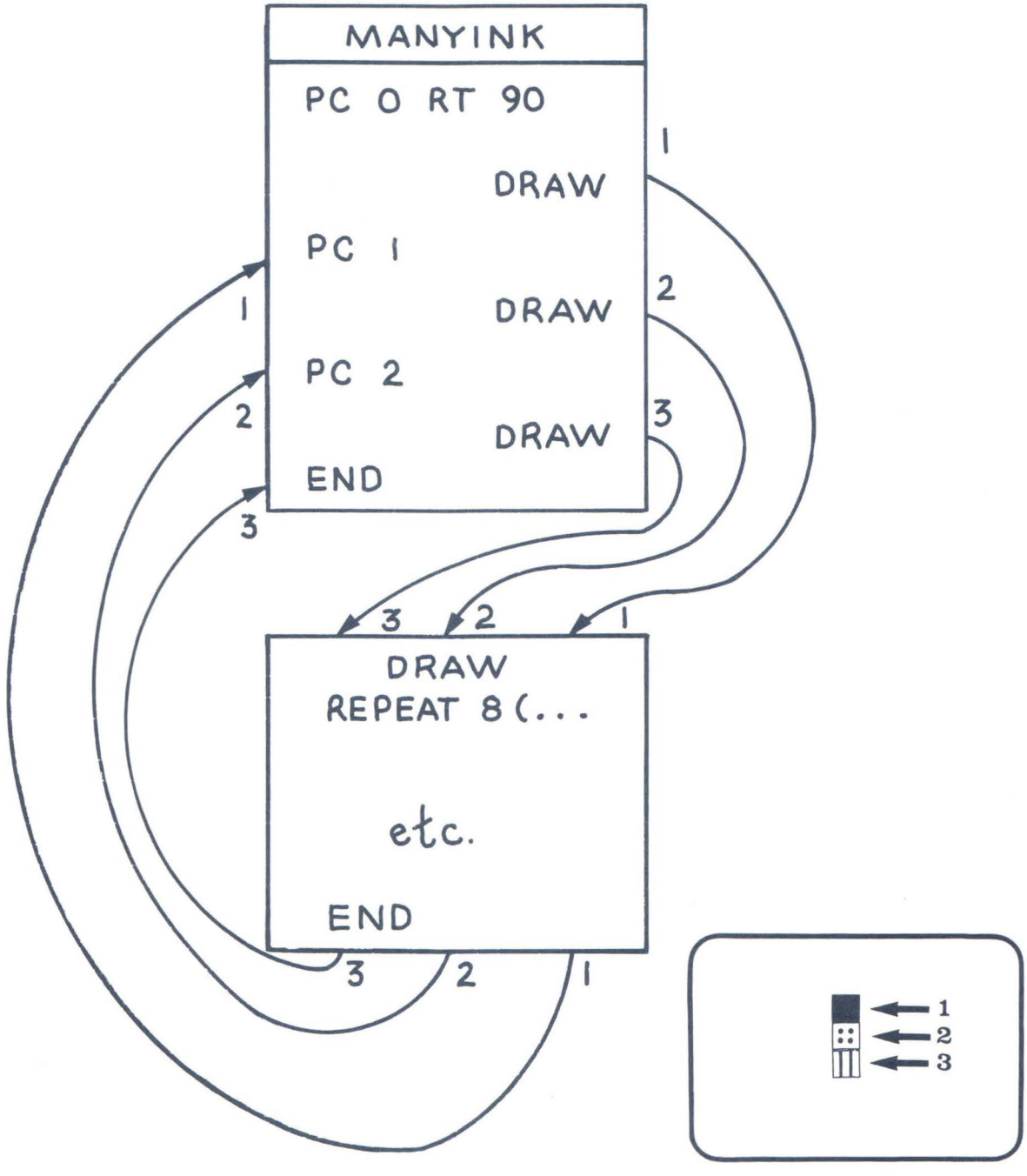
I DONT KNOW HOW TO DRAW

DRAW is a procedure that will have to be written to draw a solid rectangle of the given color. You can use one procedure within another as long as both procedures have been defined. It works like calling a subroutine (GOSUB) in BASIC.

Therefore, the procedure MANYINK and the procedure DRAW must both be in the computer's memory before MANYINK will run successfully. Enter DRAW following MANYINK in the EDIT room. Then go to the RUN room and run MANYINK.

```
TO DRAW
 REPEAT 8(FD 30 RT 90 FD 1
 RT 90 FD 30 LT 90 FD 1 LT 90)
END
```

Each time the pen changes color (in MANYINK), the DRAW command is executed. The DRAW procedure draws a solid colored rectangle. When the DRAW procedure is completed, the computer returns to MANYINK to see if there are any more commands to be executed. The DRAW procedure is executed three times, each time using a different PENCOLOR supplied by MANYINK. The order in which the procedures are executed is shown in the following diagram.



Color Sets

When the computer is turned on, the color set with the green background (called COLORSET 0) is automatically selected along with PENCOLOR 0. The MANYINK procedure used COLORSET 0. In order to investigate the second set of colors (called COLORSET 1), it is time to practice your editing abilities. The MANYINK procedure can be easily changed to provide for the new set of colors. Go to the EDIT room and change the first indented line to:

COLORSET 1 PENCOLOR 0 RT 90

➔To insert COLORSET 1 into the line, use the [↓] key to get cursor into this position.

```
TO MANYINK
_PENCOLOR 0 RT 90
```

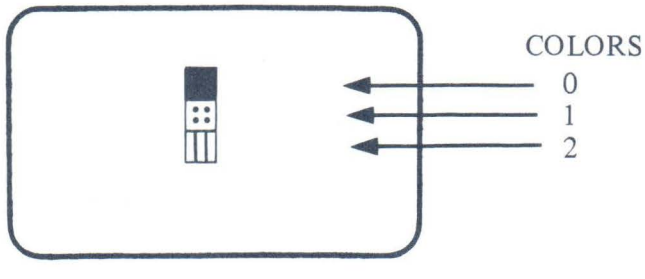
➔Then use SHIFT [→] to insert enough blank spaces to insert the COLORSET 1 command.

```
TO MANYINK
_                PENCOLOR 0 RT 90
```

➔Type: COLORSET 1

```
TO MANYINK
  COLORSET 1_PENCOLOR 0 RT 90
```

➔Return to the RUN room and execute the procedure as changed. The colors are different this time.



Notice that MANYINK consists of identical instructions for the PENCOLORS 0, 1, and 2. If you could find a way to automatically change the ink, the procedure could use another REPEAT command to simplify the procedure.

Variables can be used to represent changing values. Children are used to applying names to real objects such as tree, bus, Mary, my weight, etc. They may talk about their weight as a numerical value, such as, "My weight is 95 pounds." The amount of their weight changes from time to time, but it is still called their weight. We will do something similar by assigning a name to the value of PENCOLOR. Instead of PENCOLOR 0 or PENCOLOR 1, we will use:

```
PENCOLOR  :NUMBER
```

A colon is used to tell the computer that NUMBER is a name for the numerical value (which may be 0, 1, 2, or 3).

The other thing you need to be able to do is assign a beginning number to the name. This is done with the MAKE command.

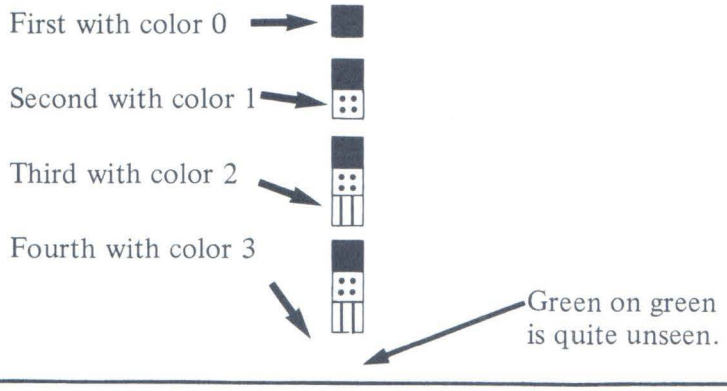
```
MAKE  :NUMBER 0
```

to this name — assign this value

Some people call these names (used to represent changing numbers) variables. Let's see how you can use a variable to simplify the MANYINK procedure. We'll call this one FOURINK. It also uses the DRAW procedure.

```
TO FOURINK
 RT 90 MAKE :NUMBER 0                    <- Assign 0 to NUMBER
 REPEAT 4(PC :NUMBER                     <- Make PENCOLOR value of NUMBER
 DRAW                                    <- Draw rectangle
 MAKE :NUMBER :NUMBER+1) HOME            <- Increase number by 1
END                                      <- Done, send turtle home
TO DRAW
 REPEAT 8(FD 30 RT 90 FD 1
 RT 90 FD 30 LT 90 FD 1 LT 90)
END
```

The sequence of commands following REPEAT 8 in parentheses draws the rectangles with the MAKE command increasing the pen's color number each time for the REPEAT 4 command.



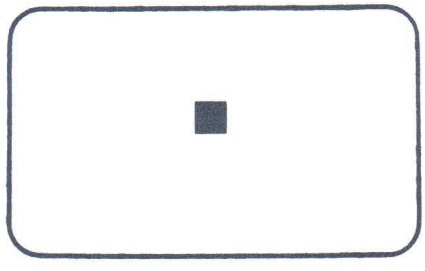
Notice that the fourth rectangle cannot be seen, as the PENCOLOR is the same (green) as the background color. The background color can be used to erase, as shown in the following procedure. One new line is added and two lines are changed to make this new procedure.

```
TO INKONINK
 RT 90 MAKE :NUMBER 0
 REPEAT 4(PC :NUMBER
 DRAW
 HOME RT 90          <-- Go back for new PENCOLOR
 MAKE :NUMBER :NUMBER+1)
END
```

1

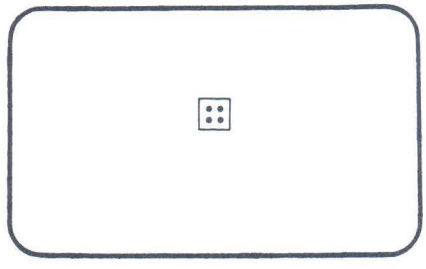
:NUMBER 0

Color 0



2

:NUMBER 1

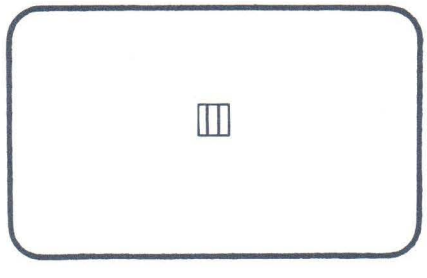


Color 1 is overlaid

3

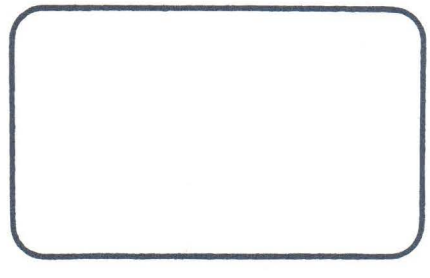
:NUMBER 2

Color 2 is overlaid



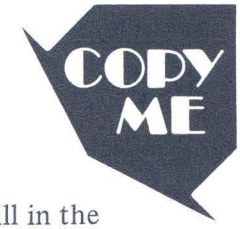
4

:NUMBER 3



Erased by green

Activity 11



Complete the procedure, INKSET1, so that COLORSET 1 is used. Run the program and fill in the blanks to state what colors the rectangles are on your TV set.

(1)
```
TO INKSET1
_____ RT 90  MAKE :NUMBER 0
 REPEAT 4(PC :NUMBER
  REPEAT 8(FD 30 RT 90 FD 1
  RT 90 FD 30 LT 90 FD 1 LT 90)
 HOME RT 90
 MAKE :NUMBER :NUMBER+1)
END
```

(2) The colors of the rectangles in the order they appeared were:

_____ _____ _____ _____

(3) Which color number erased the screen? _____

(4) Rewrite INKSET1 so that it draws rectangles in 4 colors, first using COLORSET 0 and then COLORSET 1.

Background Color

Any of four colors, within a given color set, can be used as the background color. The Color LOGO command is:

BACKGROUND 3 or BG 3

Original background is 3

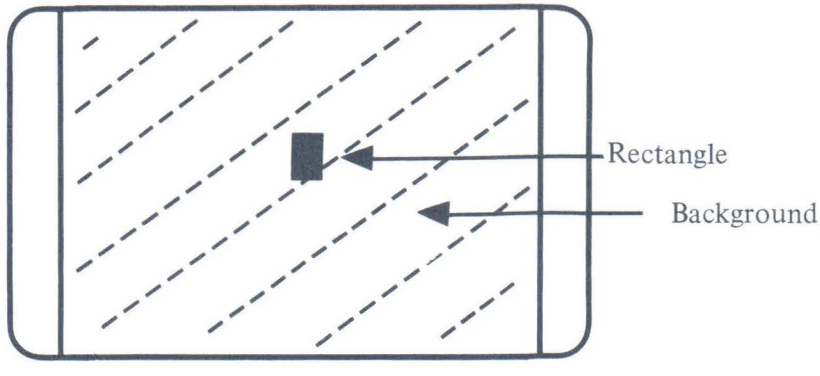
You could wrap another repeat loop around INKONINK by using the BACKGROUND command with GROUND as the variable.

```
TO INKONINK
 MAKE :GROUND 3
 REPEAT 4(BACKGROUND :GROUND
 RT 90 MAKE :NUMBER 0
  REPEAT 4(PC :NUMBER
  DRAW
  HOME RT 90
  MAKE :NUMBER :NUMBER+1)
 MAKE :GROUND :GROUND-1 LT 90)
 HOME BG 3
END
TO DRAW
 REPEAT 8(FD 30 RT 90 FD 1
 RT 90 FD 30 LT 90 FD 1 LT 90)
END
```

← Subtract 1 this time

Change back to original

When this version of INKONINK is RUN, the four pencolors draw the rectangles on each of four background colors, giving a wide variety of color combinations.



The rectangle is erased when the pencolor is the same as the background color. The number of the color that causes erasures depends upon which background color is being used.

Special Effects

The turtle has moved quite rapidly when running the procedures you have used so far. Color LOGO has a command that can slow down the turtle movements. Naturally, it is called SLOW.

The SLOW command causes the execution of the procedure to slow down so that the action can be watched more closely. You can control the slowness by following the word SLOW with a numerical value denoting the amount of slowness.

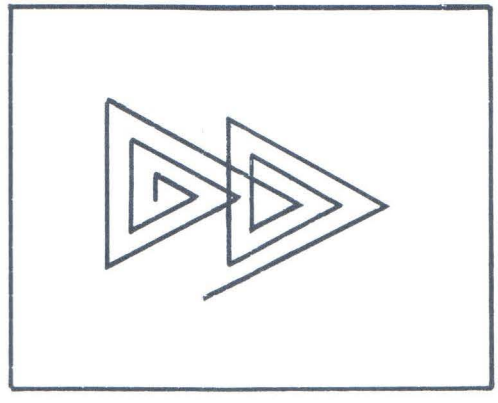
SLOW 127 ◄——— Provides the slowest speed.

SLOW 0 ◄——— Provides full speed.

The higher the numerical value, the slower the speed. To demonstrate SLOW, enter and run the following procedure.

```
TO TWOSPEED
  COLORSET 1 BG 0 PC 3
  REPEAT 2(FD 4 RT 120 FD 8
  RT 120 FD 12 RT 120 FD 16
  RT 120 FD 20 RT 120 FD 24
  RT 120 FD 28 RT 120 FD 32
  RT 120 SLOW 63 PC 2 LT 120)
END
```

The display when run:



Drawn quickly in one color, then slowly with second color.

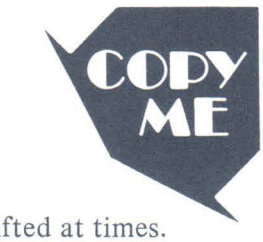
The program starts at full speed with a black background and PENCOLOR 3. Notice the statements in parentheses, which are repeated. In the last line, the speed is slowed to about half, and the pencolor is changed to 2.

You should be ready to answer your students when they ask, "If TWOSPEED is run again, will the procedure run at full-speed or at half-speed?" In other words, will the last commanded speed stay in effect until a different speed is requested? Or will Color LOGO revert back to normal speed when the procedure is executed each time?

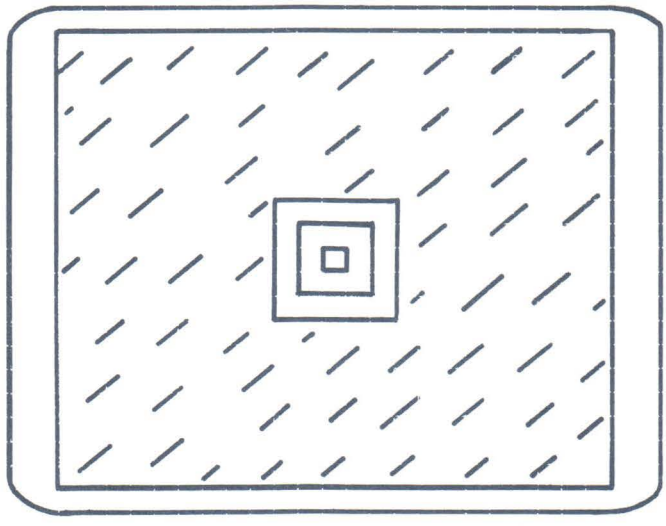
The best answer you can give is, "Try it again and find out for yourself." Keep in mind that the computer is at its best when used as an experimental tool. Don't give your students all the answers. Let them find out for themselves.

I must admit that our curiosity got the best of us, and we re-ran the procedure to find out what speed it would use. You try it, too. If you want to check your experience with ours, check the answer on page 68.

Activity 12



Write a procedure that will draw the display shown. Notice that the pen will have to be lifted at times. Edit your procedure, run it, and answer the questions at the bottom of the page.



Use this information in the procedure:

- inner square – each side 10 units, PENCOLOR 1, speed 126
- middle square – each side 20 units, PENCOLOR 2, speed 63
- outer square – each side 30 units, PENCOLOR 3, speed 31

COLORSET 1, BACKGROUND 0

TO SPEEDUP

_____

_____

_____

_____

_____

_____

_____

(1) Did the figures on the display look like squares (same height and width)? _____

(2) Which square seemed to be drawn in the shortest period of time? _____

IRREGULARS

As you know, things do not always happen in a regular way. Although the computer does things repeatedly as it is told, you can introduce some randomness into its actions. Color LOGO has a random number function to accomplish this feat.

RANDOM nn	the value nn will be restricted to positive integers for now.

The RANDOM statement produces a random integer from 0 through nn−1.

RANDOM 3	could produce 0, 1, or 2
RANDOM 5	could produce 0, 1, 2, 3, or 4

We will use the RANDOM function in the next procedure in several ways.

RANDOM 4 will give pencolors of 0, 1, 2, or 3.

RANDOM 80 will give FORWARD movements of 0 through 79.

RANDOM 360 will give RIGHT turns of 0 through 359.

RANDOM 64 will give SLOW speeds of 0 through 63.

Each time the procedure is run, up to 20 lines will be generated with random lengths, directions, colors, and speeds.

```
TO STARBURST1
 COLORSET 1 BG 0
 REPEAT 20(MAKE :INK RANDOM 4
 MAKE :LONG RANDOM 80
 MAKE :TURN RANDOM 360
 MAKE :SPEED RANDOM 64
 PC :INK RT :TURN FD :LONG
 HOME SLOW :SPEED)
 SLOW 0
END
```

STARBURST1 can become much more striking as a design-maker with a few modifications. TURN will be changed so that each line is drawn 5 degrees from the preceding line. The speed variable will be removed so that the designs will be drawn at a faster speed. STARBURST2 will loop back to the beginning by using its name as the last command in the procedure (before END). The background will be randomly chosen to present all color combinations in COLORSET 1.

```
TO STARBURST2
 COLORSET 1 HT MAKE :TURN 0
 MAKE :GROUND RANDOM 4
 BG :GROUND          <-- New background
  REPEAT 70(MAKE :INK RANDOM 4
  MAKE :LONG RANDOM 80
  MAKE :TURN :TURN+5 <-- Turn 5 degrees
  PC :INK RT :TURN FD :LONG
  HOME)
 REPEAT 820() CLEAR      Wait, then clear screen
 STARBURST2 <-------- Do it again
END
```

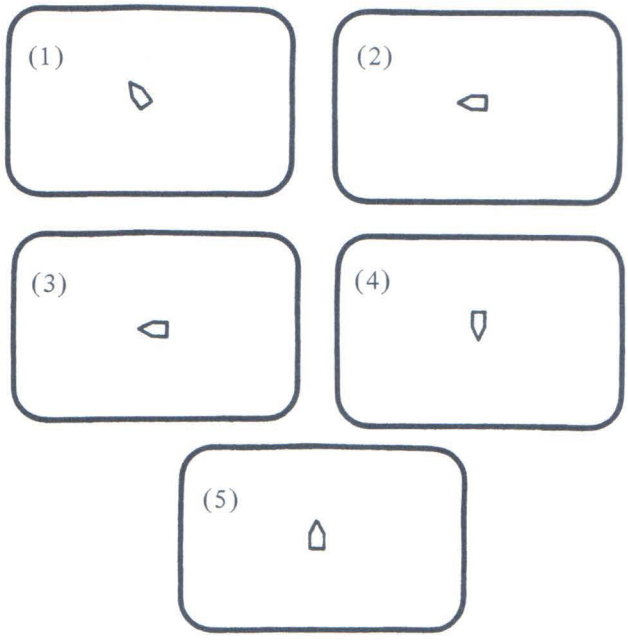
Conclusion

We have barely scratched the surface of Color LOGO's capabilities in this first booklet, but the material should give you a good start. The Color LOGO Guide for Teachers, Book 2 will go on from here with more commands and techniques.

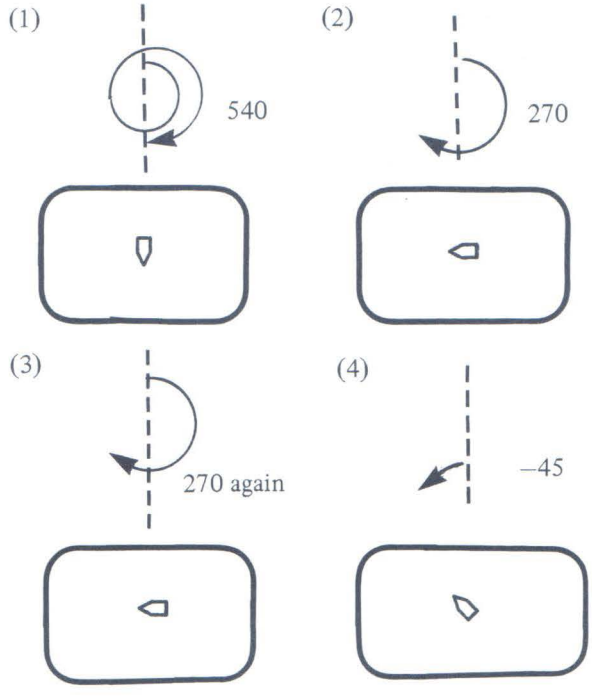
Keep in mind that Color LOGO is a language designed for creation. It should not be introduced or used in a formal, rigid format. We urge you to present Color LOGO in an experimental way and to let your students discover its capabilities on their own. Answer questions they may raise with, "Try it," whenever possible.

ANSWERS TO ACTIVITIES

ANSWERS TO ACTIVITY 1



ANSWERS TO ACTIVITY 2



ANSWERS TO ACTIVITY 3

(1) The turtle shows completely at the top of the screen if it takes 87 steps. If you use a number larger than that, the tip of the turtle (or all of it) goes off the top.

(2) Here is one possibility. There are many more.

```
TO SQUARE
 REPEAT 4(FD 60 RT 90)
END
```

(3)

(a)	(b)	(c)
RT 135	RT 135	RT 135
FD 42	FD 71	FD 99

Answers that are close to these should be considered correct. Try them to see how the display looks.

(4)

```
TO SQUARE
 REPEAT 4(FD 60 RT 90)
 RT 45 FD 85
 RT 135 FD 60 RT 135 FD 85
END
```

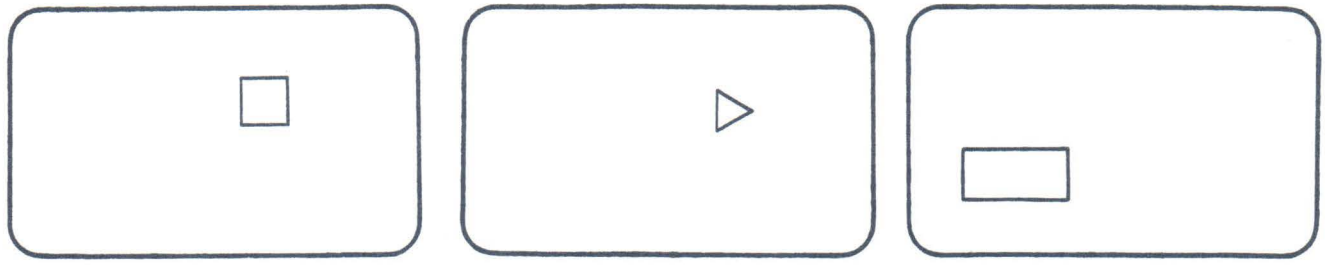
ANSWERS TO ACTIVITY 4

Answers from students will vary. Here are some possible versions of the procedure.

```
TO SQUIGGLE
 RT 45 REPEAT 410()
 LT 90 REPEAT 410()
 RT 90 REPEAT 410()
 LT 90 REPEAT 410()
 RT 90 REPEAT 410()
 LT 90 REPEAT 410()
 RT 45 REPEAT 410()
END
```

```
TO SQUIGGLE
 RT 45 REPEAT 410()
  REPEAT 2(LT 90 REPEAT 410()
  RT 90 REPEAT 410())
  LT 90 REPEAT 410()
 RT 45 REPEAT 410()
END
```

ANSWERS TO ACTIVITY 6



1 **2** **3**

MYSTERY1 draws a rectangle to the right and above the screen's center with sides of length 30. Notice that the display does not look like a square.

MYSTERY2 draws a triangle whose sides and angles are equal (called equilateral triangles or equiangular triangles).

MYSTERY3 draws a rectangle to the left and below the screen's center with sides of length 50.

(2)
```
TO MYSTERY2
 REPEAT 3(FD 60 RT 120)
END
```

(3)
```
TO MYSTERY3
 BK 50 LT 90 FD 50 RT 90
 FD 50 LT 90 BK 50 RT 90
END
```

Students' procedures for MYSTERY2 and MYSTERY3 will vary from our version. If they work, they are correct.

ANSWERS TO ACTIVITY 7

(4) RIGHT 153

(5) FORWARD 67
LEFT 153

(6) PU

(7) FORWARD 60
LT 153

(8) PD

(9) FORWARD 67

ANSWERS TO ACTIVITY 8

(1)
```
TO ONE
 PD RT 90 FD 2
 PU FD 4
 PD FD 2
 PU FD 4
 PD FD 8
 PU FD 4
 PD FD 8
 PU FD 4
 PD FD 2
 PU FD 4
 PD FD 2
 PU FD 4
END
```

(2)
```
TO TWO
 PD FD 8
 PU FD 4
 PD FD 2
 PU FD 4
 PD FD 2
 PU FD 4
 PD FD 8
 RT 90 PU FD 4
 PD FD 2
 PU FD 4
END
```

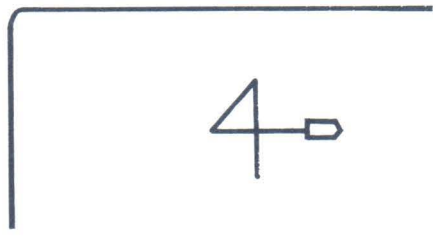
(3)
```
TO THREE
 PD FD 8
 PU FD 4
 PD FD 2
 PU FD 4
 RT 45 PD FD 8
 PU FD 4
 PD FD 2
 PU FD 4
 PD FD 8
 PU FD 4
END
```

ANSWERS TO ACTIVITY 9

```
TO GOBEHIND

  CLEAR PD

   REPEAT 2(FD 30 RT 90

   FD 40 RT 90)

  PU FD 15 RT 90 BK 100

  PD FD 100 HT PU FD 40

  ST PD FD 60

 END
```

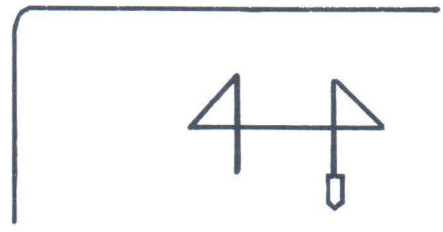
ANSWERS TO ACTIVITY 10

After RUN 1



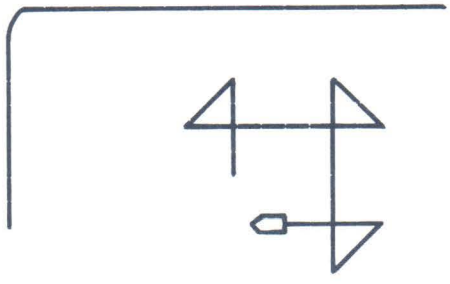
First 4 is drawn with turtle
in new position, pointing right.

After RUN 2



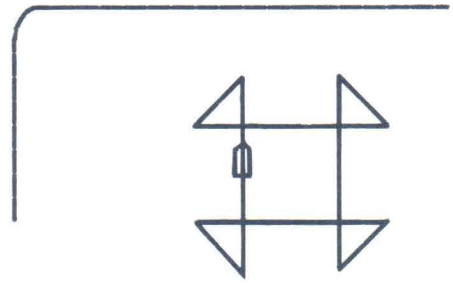
Second 4 is drawn backwards; turtle
in new position, pointing down.

After RUN 3



Third 4 is drawn upside down and backward;
turtle in new position, pointing left.

After RUN 4



Design is completed; turtle is
back where it started, pointing up.

ANSWERS TO ACTIVITY 11

(1) TO INKSET 1

COLORSET 1 RT 90 MAKE :NUMBER 0

COLORSET 1 will change the four colors used for PENCOLOR. The background is set to cyan unless another background is chosen.

(2) The colors of the rectangles in the order they appeared were:

1 Black 2 Orange 3 Magenta 4 cyan

These are the four colors as they appeared on our TV as it was color-adjusted. Your answers may be different due to your TV or your color sensitivity.

(3) Color number 3

Color number 3 (cyan) is the normal background color for COLORSET 1. Therefore, PENCOLOR 3 will not show.

```
TO INKSET2
 MAKE :SET 0 RT 90
 REPEAT 2(MAKE :NUMBER 0
  COLORSET :SET
  REPEAT 4(PC :NUMBER
   REPEAT 8(FD 30 RT 90 FD 1
   RT 90 FD 30 LT 90 FD 1 LT 90)
 HOME RT 90
 MAKE :NUMBER :NUMBER+1)
 MAKE :SET :SET+1) LT 90
END
```

Other variations of this procedure may work. Have the students show you that their programs will work.

ANSWERS TO ACTIVITY 12

Students will come up with many different procedures to accomplish this activity. To find out if they are correct, you'll have to see each one run. Here are three versions that work.

```
TO SPEEDUP1
 COLORSET 1 BG 0 PC 1 SLOW 126
  REPEAT 4(FD 10 RT 90)          <- First square
 PU LT 90 FD 3 RT 90 BK 5        Move to new square
 PD PC 2 SLOW 63                 Set pencolor, speed
  REPEAT 4(FD 20 RT 90)          <- Second square
 PU LT 90 FD 6 RT 90 BK 5        Move to new square
 PD PC 3 SLOW 31                 Set pencolor, speed
  REPEAT 4(FD 30 RT 90)          <- Third square
END
```

```
TO SPEEDUP2
 COLORSET 1 BG 0
 MAKE :INK 1 MAKE :SPEED 126     <- Variables used:
 MAKE :LONG 10                      INK for pencolor
  REPEAT 3(PC :INK SLOW :SPEED      SPEED for SLOW
   REPEAT 4(FD :LONG RT 90)         LONG for FORWARD
  MAKE :INK :INK+1
  MAKE :LONG :LONG+10
  MAKE :SPEED :SPEED/2            <- 126/2=63
  PU LT 90 FD 4 RT 90 BK 5 PD)       63/2=31
END                                  Color LOGO discards remainders when dividing
```

(1) No, they appear to have a greater height than width.

(2) Although the speed of the pen movement increases, each square is larger than the last. Therefore, the total time to draw each square is about the same.

Answer to speed question on page 59

If TWOSPEED is run again, the half-speed command will stay in effect. In order to restore full-speed, you press the BREAK key to get in the BREAK room, press the R key to get in the RUN room, and execute the program again. Whenever you write a procedure that uses the SLOW command, you should restore the normal speed at the end of the procedure. A better TWOSPEED procedure would be:

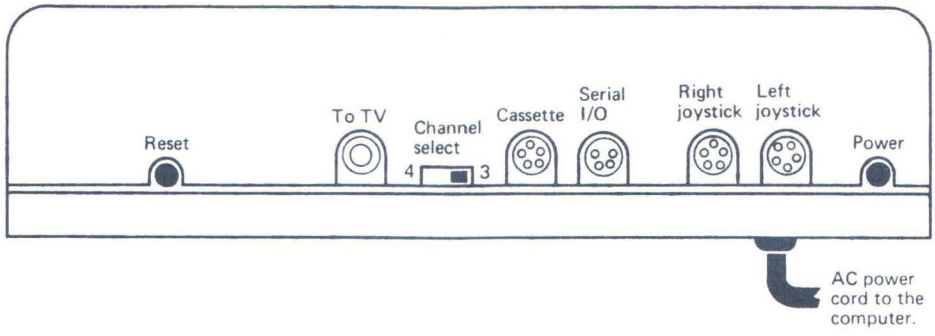
```
TO TWOSPEED
 COLORSET 1 BG 0 PC 3
 REPEAT 2(FD 4 RT 120 FD 8
 RT 120 FD 12 RT 120 FD 16
 RT 120 FD 20 RT 120 FD 24
 RT 120 FD 28 RT 120 FD 32
 RT 120 SLOW 63 PC 2 LT 120)
 SLOW 0
END
```

New line restores normal speed

APPENDIX A

HOOKING UP YOUR COLOR COMPUTER

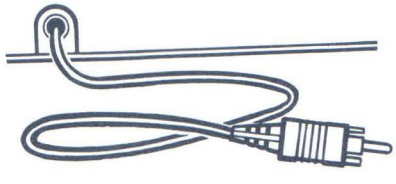
The back of your Color Computer looks like this:



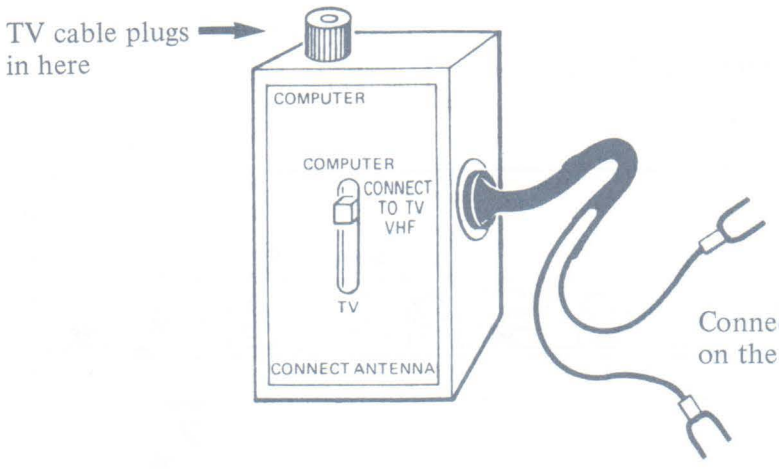
The AC power cord is permanently attached to the computer. Plug the power cord into a 110-volt outlet. Press the power button (right side when looking at the back) to turn the computer on. Press it again to turn it off.

The Color Computer sends signals to the TV through a cable that looks like this:

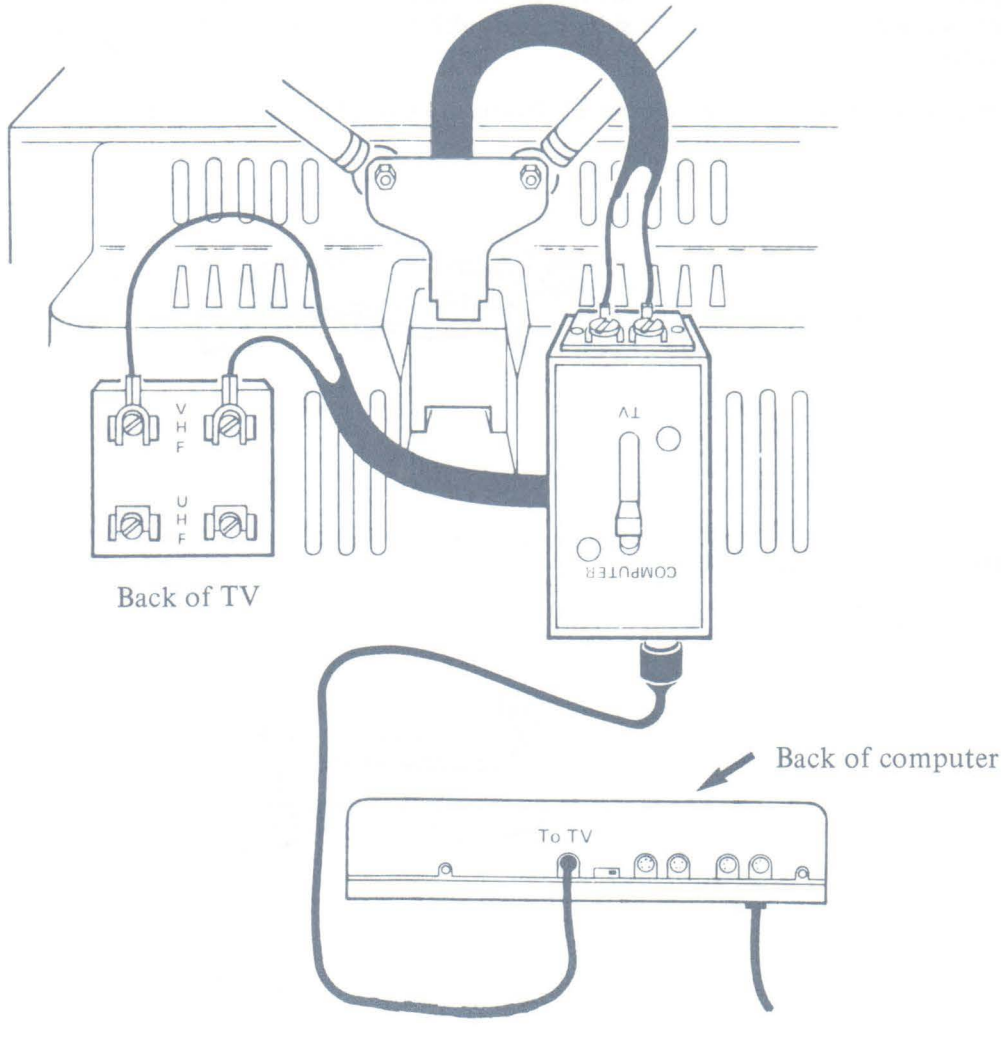
Before connecting it, turn the computer off. Then plug one end of the cable into the connector on the back of the computer marked "TO TV."



The other end of the TV cable plugs into a switchbox that looks like this:



A complete hook-up might look like this:



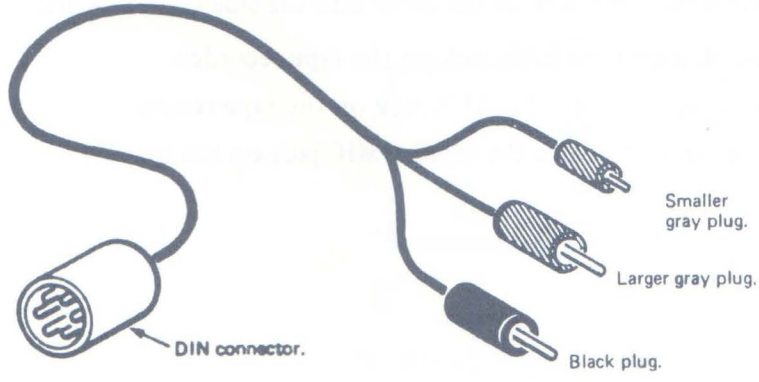
APPENDIX B

CONNECTING THE TAPE RECORDER

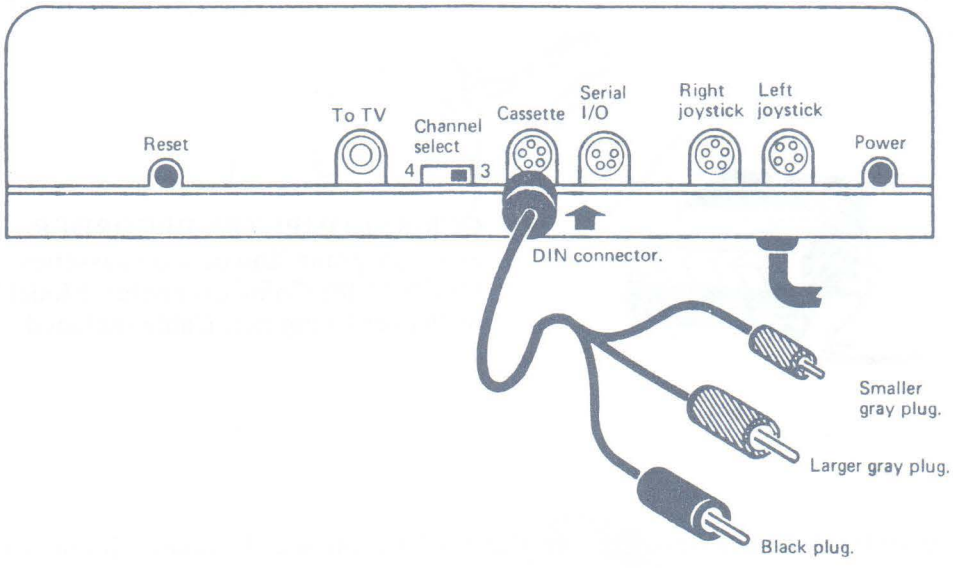
Radio Shack sells several recorders that will work with the Color Computer. Their current model, designed for the Color Computer, Model III, or Pocket Computer is the CCR-81 Computer Recorder (catalog number 26–1208).

CCR-81 COMPUTER RECORDER
Store programs and data on cassettes.
Designed for Color Computer, Model III
or Pocket Computer. Cable included.

To connect the recorder to the Color Computer, you need a cable which comes with the CCR-81. It looks like this:



The DIN connector is plugged into the computer at the cassette jack on the back. Rotate the DIN connector until it slides into the jack. DO NOT FORCE IT!



Connect the three plugs on the other end of the cable into the side of the recorder.

(1) Plug the black plug into the EAR jack on the tape recorder.

(2) Plug the larger gray plug into the AUX jack on the tape recorder.

(3) Plug the smaller gray plug into the smaller MIC jack on the tape recorder.

APPENDIX C

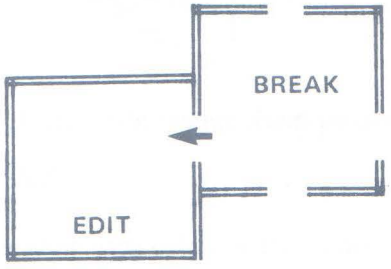
TAPE SAVING AND LOADING

Although Color LOGO procedures are usually short, you and your students will write many procedures that you may want to repeat at a later time. Students will want to show their creations to friends and family members, etc. You will also want to keep procedures to show parents what the students are learning. Procedures can be stored on cassette tape very easily.

All procedures in memory are stored as one module. Therefore, you should erase any unwanted procedures in memory before saving the ones that you want to keep. To delete procedures, you must enter the EDIT mode and delete them character by character.

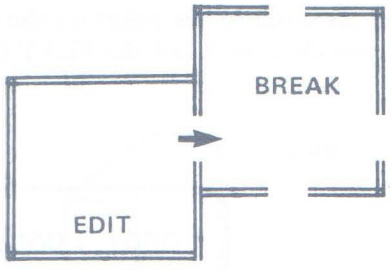
EDIT room to delete undesired procedures

Press [E]



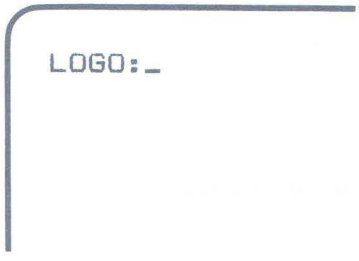
When you are ready to save the desired procedures on tape, go to the BREAK room.

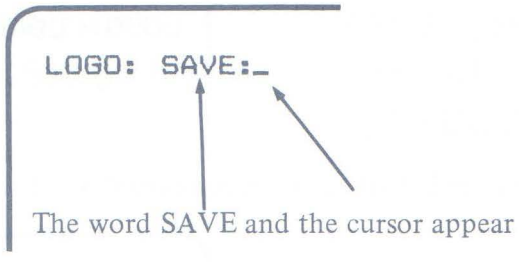
SAVE procedures in the BREAK room



(1) Press BREAK :

(2) Press [S] (for save).





At this time, you should check to make sure the recorder is connected and turned on. The volume setting should be close to 5. The tape should be rewound to a blank area on the tape. Then press down the RECORD and PLAY buttons at the same time.

(3) Press [T] (for Tape), then ENTER (to start recording).

```
LOGO: SAVE:T
```

(4) When the recording is finished, the BREAK prompt will be displayed again.

```
LOGO: SAVE:T
LOGO:_
```

If a number and a question mark appear after the T, then the procedures were not saved properly. Try again.

Loading procedures from cassette is also very simple. You must again be in the BREAK room.

(1)

```
LOGO:_
```

The cassette should be rewound to the point on the tape where the procedures were recorded. The volume should be set close to 5 and the PLAY button pressed down.

(2) Press [L] (for Load),

```
LOGO: LOAD:_
```

(3) Press [T] (for Tape), then ENTER.

```
LOGO: LOAD:T
```

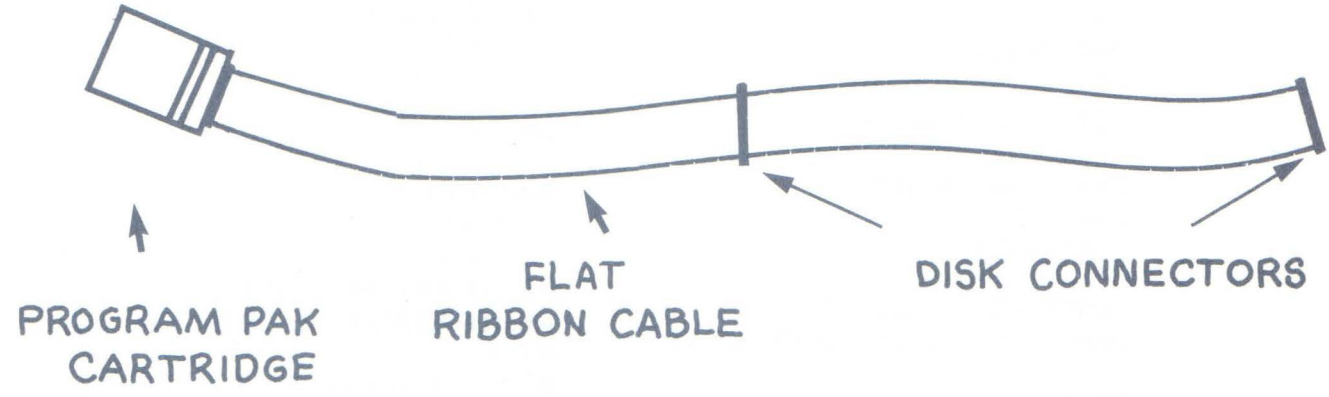
(4) When the LOAD has been completed, the BREAK prompt will be displayed again.

```
LOGO: LOAD:T

LOGO:_
```

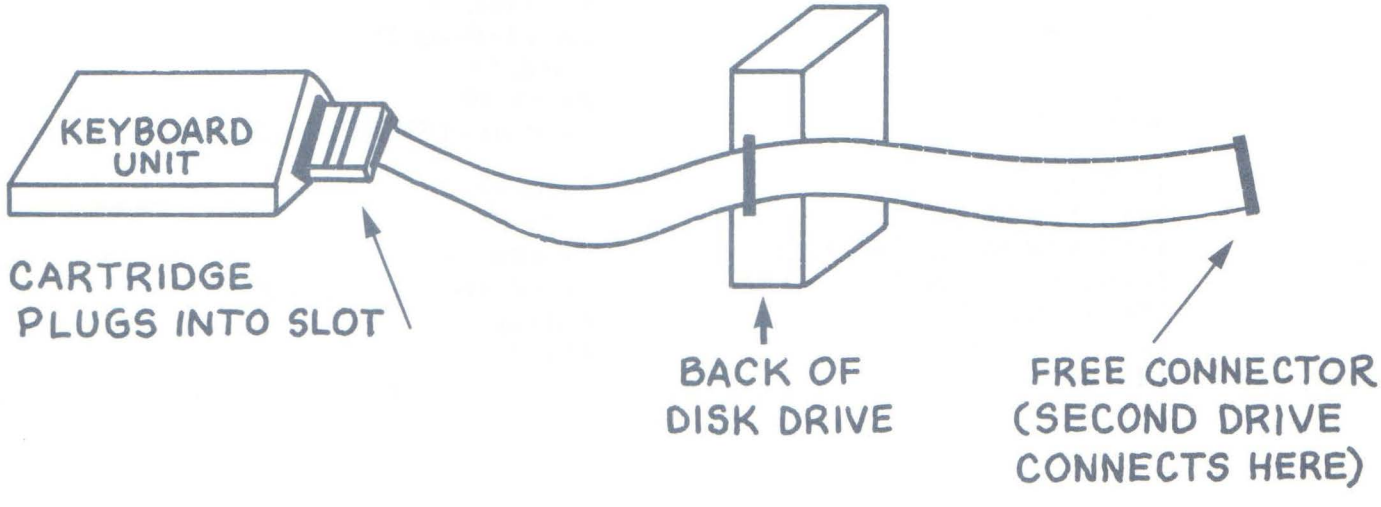
APPENDIX D

CONNECTING THE DISK

If you have one or more disk drives for your Color Computer, the connection to the computer is made through a flat ribbon cable which has a Program Pak cartridge connected to one end. The other end of the cable has at least two connectors which go to the back of the disk drive(s).



The connector that is closest to the Program Pak cartridge is connected to the first disk drive (no. 0). If you are using only one disk, the connections would look like this:



Connect the disk drive first. The computer's keyboard unit should be turned OFF before plugging in the Program Pak cartridge.

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