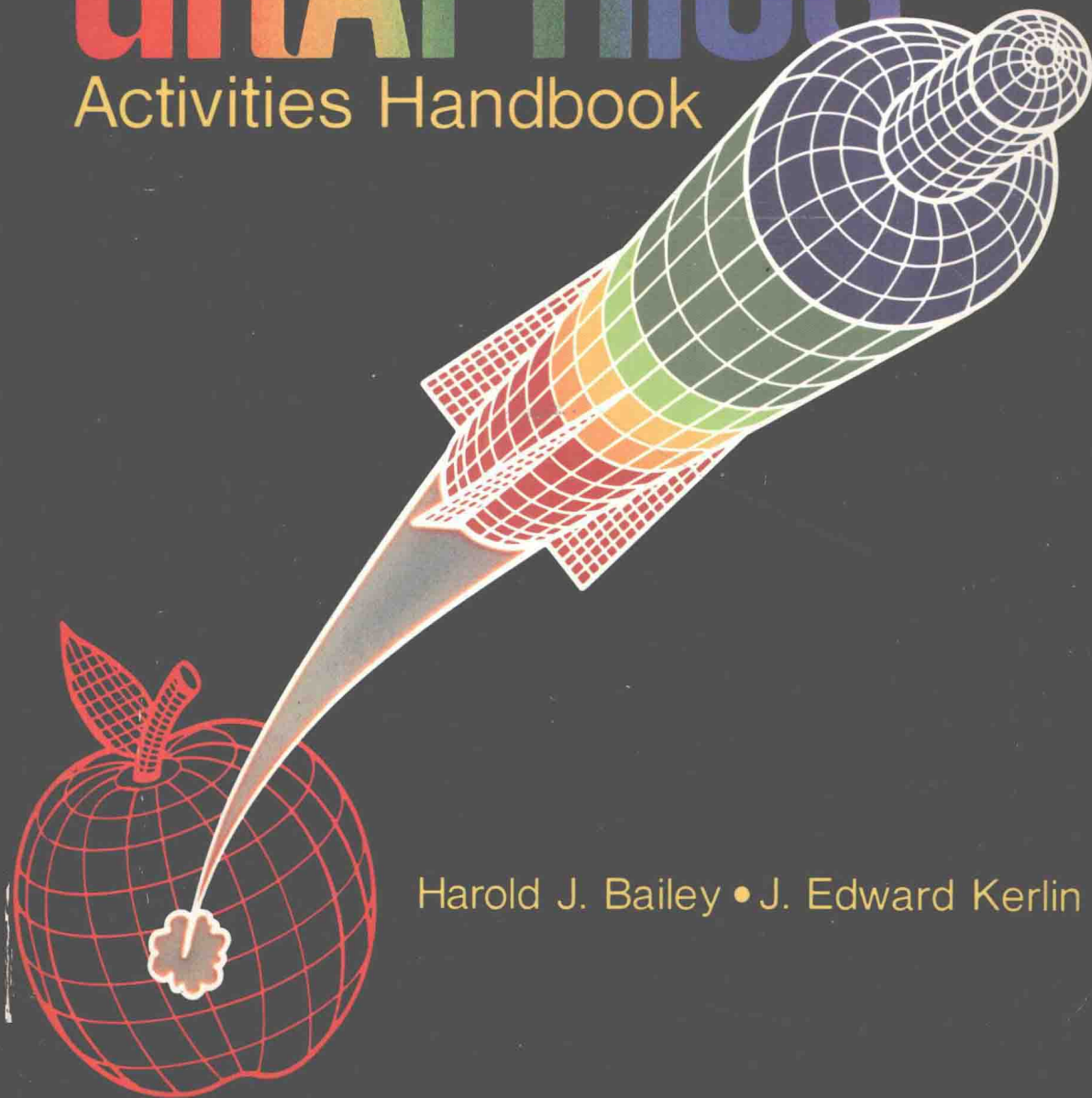


*Works on
The Apple*



APPLE GRAPHICS

Activities Handbook



Harold J. Bailey • J. Edward Kerlin

A P P L E G R A P H I C S

Activities Handbook

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Apple Graphics Activities Handbook

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Preface

Since the beginning of our existence, we have attempted to graphically display our thoughts. The necessity of using images to communicate ideas is evidenced as far back as the cave drawings of the Stone Ages. In today's world, detailed artistic designs are developed with light pens on video screens, graphics systems, and the like.

The advent of the microcomputer offers another medium by which the cliché "a picture is worth a thousand words" can be demonstrated. While low cost microcomputer systems cannot compete with sophisticated graphics systems, some are quite capable of displaying images acceptable for many purposes. Unfortunately, each computer system with graphic capabilities also has a unique and often complex way of handling it.

This book deals with creating graphics on a 48K RAM Apple II Plus, Apple IIe, or Franklin 1000 or 1200 microcomputer system, using the Applesoft BASIC language. The graphics created in the book are most effectively displayed with a color monitor. The book assumes you have no familiarity with graphics, but are familiar with Applesoft.

The practical approach to learning graphics concepts and techniques, via "hands-on" activities, makes this book suitable for anyone, particularly the novice.

Chapter 1 presents a comprehensive coverage of low resolution graphics, a mode which is easy to use and understand. Low resolution graphics also has many useful applications when precision designs are not required. High resolution graphics, as covered in Chapter 2, demonstrates how more precise images can be displayed. Both Chapters 1 and 2 assume the reader is inexperienced; consequently, they are introductory in nature. Each begins with the simple display of primitive images, then extends to the more complex graphing techniques of animation and the effective use of color. While it is suggested the reader follow the book in its intended sequential pattern, low resolution graphics in Chapter 1 could be omitted without detracting from the continuity of the book.

Chapters 3, 4, and 5 should be studied in the presented order. Chapter 3 investigates the more involved aspects of graphics such as shapes and a high resolution character generator, and deals with making better use of allocated memory. Chapter 4 involves scaling, clipping, and plotting curves in two dimensions. Three-dimensional graphics is discussed in Chapter 5.

While no treatment of two- and three-dimensional graphics can be completely devoid of mathematics, considerable effort has been made to minimize the mathematical background necessary to develop the techniques covered in Chapters 4 and 5. As a result, more advanced three-dimensional applications, such as hidden line and surface techniques (which involve more sophisticated mathematics) are not included in this book.

Each chapter consists of a collection of instructional activities. These carefully sequenced activities help the reader progress in a deliberate manner, culminating in a comprehensive understanding of Applesoft graphics. The structure of each activity includes five sections:

LEARNING BY DISCOVERY
DISCUSSION

COMPREHENSIVE EXAMPLE
EXERCISE
CHALLENGE

The LEARNING BY DISCOVERY section begins with a statement of the activity objective, followed by a series of “hands-on” experiences. The reader enters Applesoft commands and then is asked to describe (or discover) the resulting displays. These exercises demonstrate both the proper usage and common errors associated with the activity objective. The reader is encouraged to write descriptions, notes, and observations in the book.

A narrative reinforcement of the activity experience occurs in the DISCUSSION section. The reader should first complete the activity to understand the discussion more readily.

The COMPREHENSIVE EXAMPLE provides another Applesoft program to reinforce the correct application of the activity objective. This section also demonstrates another imaginative graphics example, which is intended to spark enthusiasm and interest in the reader to develop innovative graphic designs.

The EXERCISE section permits the reader to demonstrate an understanding of the activity objective by writing an Applesoft program for a given situation.

Finally, the CHALLENGE section presents one more exercise for the reader, but at a more advanced level.

Many of the programs contain remarks (REM statements) to assist the reader in understanding the program logic. It is not necessary to type these remarks when entering program segments. Because of the progressive nature of each activity, the reader must not diverge from the line numbering used to sequence program statements.

Acknowledgments

The writing of this book was motivated by students who were less than satisfied with studying graphics using traditional teaching methods and whose mathematical backgrounds did not permit learning from existing materials. The development of these “hands-on” activities resulted in an interactive and meaningful educational experience.

Much appreciation is expressed to our students for serving as a catalyst to the project and for reviewing the prepared materials. A special thanks must be given to colleague Julie Abell for her dedicated effort in proofreading and critiquing the manuscript.

Finally, we are particularly grateful to our wives, Linda and Kathy, for their typing and editorial comments, as well as their patience and understanding, during this entire project.

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Low Resolution Graphics

MODULE 1A Fundamental Low Resolution Commands

ACTIVITY 1.1 Plotting Points on the Mixed Graphics Screen

LEARNING BY DISCOVERY This activity introduces the drawing of the smallest possible diagram on the low resolution graphics mixed screen.

1. Enter the following commands.

```
NEW  
HOME  
10 GR  
30 PLOT 30, 5  
RUN
```

Describe what happens. _____

2. Add line 20 as follows:

```
TEXT : HOME  
20 COLOR = 1  
LIST  
RUN
```

Observe the screen display:

What geometric object appears? _____

What color is the object? _____

Where is the object located? _____

3. Retype lines 20 and 30 and add line 40 as follows:

```
TEXT : HOME
20  COLOR = 9
30  PLOT 2, 25
40  PRINT "AN ORANGE BRICK"
LIST
RUN
```

Observe the screen display:

What color is the object? _____

Where is the object located? _____

Where does the message appear? _____

4. Retype line 30 as follows:

```
TEXT : HOME
30  PLOT 40, 5
LIST
RUN
```

Describe what happens. _____

5. Retype line 30 as follows:

```
TEXT : HOME
30  PLOT 5, 40
LIST
RUN
```

Describe what happens. _____

NOTE: The typing of LIST before each RUN is suggested so the reader can observe the modified program as additions and deletions are made. For the sake of brevity, the LIST command will be omitted throughout the remainder of the book, but should be used when needed.

DISCUSSION The GR command converts the screen to low resolution mixed graphics mode. Figure 1.1.1 displays the layout and boundary limits of the mixed graphics screen.

When GR is executed, the graphics portion of the screen is cleared to black and the cursor is moved to the bottom of the text window.

COLOR = sets the color for low resolution graphics. Numerals 0 through 15 are used to obtain the various hues. Table 1.1.1 defines the available color codes.

The PLOT command displays a rectangular "brick" of a specified color on the screen at a particular column and row. If the COLOR command is omitted, as in Section 1, the PLOT command results in an invisible "brick," since GR sets the color to black(0).

In Section 1, PLOT 30, 5 displays the brick at the intersection of column 30 and

row 5. PLOT 40, 5 in Section 4 gives an error message, since 40 is beyond the allowable column limits of 0 through 39. PLOT 5, 40 in Section 5 gives no graphics display, since row 40 is outside the graphics area, in the text window area.

In Section 3, the PRINT command causes a message to appear at the bottom of the text window.

The TEXT command returns the screen to full screen text mode from graphics mode. The strange screen display caused by the TEXT command is the textual representation of the graphics mode, since both low resolution graphics and the text area share the same APPLE memory locations. By following the TEXT command with the HOME command, this distracting nonsense is cleared from the screen.

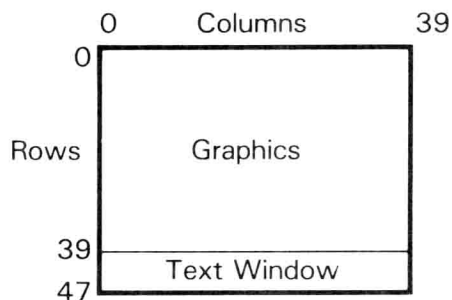


Figure 1.1.1

COLOR	NUMERAL
Black	0
Magenta	1
Dark blue	2
Purple	3
Dark green	4
Gray 1	5
Medium blue	6
Light blue	7
Brown	8
Orange	9
Gray 2	10
Pink	11
Light green	12
Yellow	13
Aqua	14
White	15

Table 1.1.1

COMPREHENSIVE EXAMPLE Study the following APPLESOFT program to de-

termine the screen display. Check your answer by entering the program into the computer. Note: $\text{INT}(16 * \text{RND}(1))$ randomly generates numbers 0 through 15.

```

TEXT : HOME : NEW
10 REM *****
11 REM *                CE1.1                *
12 REM *****
15 GR
20 FOR I = 0 TO 39
30 COLOR = INT (16 * RND (1))
40 PLOT I, I
50 NEXT
60 PRINT "SCOTTISH LACE"
65 GET Q$ : TEXT : HOME : REM USER PRESS ANY KEY TO
  COMPLETE PROGRAM
70 END

```

Check Your Comprehension

What lines control the number of "beads" in the lace? _____

What APPLESOFT commands provide for the different colored "bead?" _____

Describe the coordinates of each "bead." _____

NOTE: It is good style to end all APPLESOFT programs with the commands listed on line 65. The GET Q\$ command stops the execution of the program and awaits any keyboard response by the user. This technique permits the user to control the duration of the screen display. The TEXT and HOME commands return the computer to normal text mode with a clear screen.

EXERCISE Write a program to place a brick, each of a different color, in the four corners of the low resolution screen with the message "FOUR BRICKS" appearing in the text window.

CHALLENGE Write a program that randomly places twenty different randomly generated colored "bricks" on the screen.

ACTIVITY 1.2 Drawing Lines on the Mixed Graphics Screen

LEARNING BY DISCOVERY This activity introduces the drawing of horizontal and vertical lines on the low resolution mixed graphics screen.

1. Enter the following commands.

```

TEXT : HOME : NEW
20 GR

```

```
30 COLOR = 14
40 HLIN 5, 30 AT 10
50 PRINT "AN AQUA HORIZONTAL LINE"
RUN
```

Observe the screen display:

What is the result of an HLIN command? _____

Estimate the length of the line in terms of "bricks." _____

What is the purpose of the 10 in line 40? _____

2. Retype lines 30, 40, 50 and add line 10 as follows:

```
TEXT : HOME
10 HOME
30 COLOR = 11
40 VLIN 15, 35 AT 20
50 PRINT "A PINK VERTICAL LINE"
RUN
```

Observe the screen display:

What is the result of a VLIN command? _____

Estimate the length of the line in terms of "bricks." _____

What is the purpose of the 20 in line 40? _____

What is the purpose of the HOME command? _____

3. Enter the following commands.

```
TEXT : HOME : NEW
10 HOME
15 GR
20 COLOR = 4
25 HLIN 0, 39 AT 0
30 VLIN 0, 39 AT 39
35 HLIN 0, 39 AT 39
40 VLIN 0, 39 AT 0
RUN
```

Describe what happens. _____

4. Enter the following commands.

```
TEXT : HOME : NEW
10 HOME
15 GR
20 COLOR = 12
25 FOR I = 10 TO 30
30 HLIN 12, 33 AT I
35 NEXT
```

RUN

Describe what happens. _____

DISCUSSION The HLIN and VLIN commands are used, respectively, to draw horizontal and vertical lines on the screen in low resolution graphics.

In Section 1, the command, HLIN 5, 30 AT 10 draws a horizontal line from column 5 to column 30 at row 10. The length of this line is 26 (or $(30 - 5) + 1$) "bricks." VLIN 15, 35 AT 20 in Section 2 draws a vertical line from row 15 to row 35 at column 20, giving a length of 21 (or $(35 - 15) + 1$) "bricks."

Both the VLIN and HLIN commands must be preceded by the GR command (to establish graphics mode) and the COLOR command (to specify the color of the line). Since GR establishes a mixed graphics screen, any PRINT statements cause the messages to appear in the text window.

The HOME command introduced in Section 2 clears the text window, removing the typing of the RUN command. It is good style to begin all programs with the HOME command.

In Section 3, a sequence of HLIN and VLIN commands is used to display a border on the screen. Section 4 demonstrates that shaded regions can be displayed by including an HLIN or VLIN command in a loop.

COMPREHENSIVE EXAMPLE Study the following APPLESOFT program to determine the screen display. Check your answer by entering the program into the computer.

```

NEW
10 REM *****
11 REM *           CE1.2           *
12 REM *****
15 HOME
20 GR
25 COLOR = 2
30 FOR I = 0 TO 39
40 VLIN 0, 39 AT I
50 NEXT
60 COLOR = 15
70 HLIN 8, 10 AT 7
75 HLIN 7, 11 AT 8
80 HLIN 7, 12 AT 9
85 HLIN 8, 11 AT 10
90 HLIN 9, 10 AT 11
95 PRINT "A NEARLY PERFECT SKY"
97 GET Q$ : TEXT : HOME
99 END

```

Check Your Comprehension

What lines color the sky blue? _____

Describe the method used to color the sky. _____

What lines draw the cloud? _____

EXERCISE Write a program to place a graphics yellow "H" in the center of the screen with a height of 11 "bricks," a width of 6 "bricks," and with the message "CAPITAL H".

CHALLENGE Write a program that uses PLOT, HLIN, and VLIN commands to draw a pink face with blue eyes, a black nose, magenta lips, and brown ears.

ACTIVITY 1.3 Subsequent Drawing on the Mixed Graphics Screen

LEARNING BY DISCOVERY This activity demonstrates how to effectively change the text window and graphics portion of the low resolution screen when drawing a sequence of graphics displays.

1. Enter the following commands.

```
NEW : HOME
10 HOME
15 GOTO 40
20 FOR I = 0 TO 10
25 HLIN 15 - I, 15 + I AT 15 + I
30 NEXT I
35 RETURN
40 GR : COLOR = 9
45 GOSUB 20
50 PRINT "AN ORANGE TRIANGLE"
55 GET Q$ : REM PRESS ANY KEY TO CONTINUE
RUN
```

Observe the screen display.

Describe the position of the message within the text window. _____

Is a cursor or prompt visible on the screen? _____

Now press any key and describe the position of the message and cursor within the text window. _____

2. Add lines 60 through 75 as follows:

```
TEXT : HOME
60 COLOR = 3
65 GOSUB 20
70 PRINT "A VIOLET TRIANGLE"
75 GET Q$
RUN
```