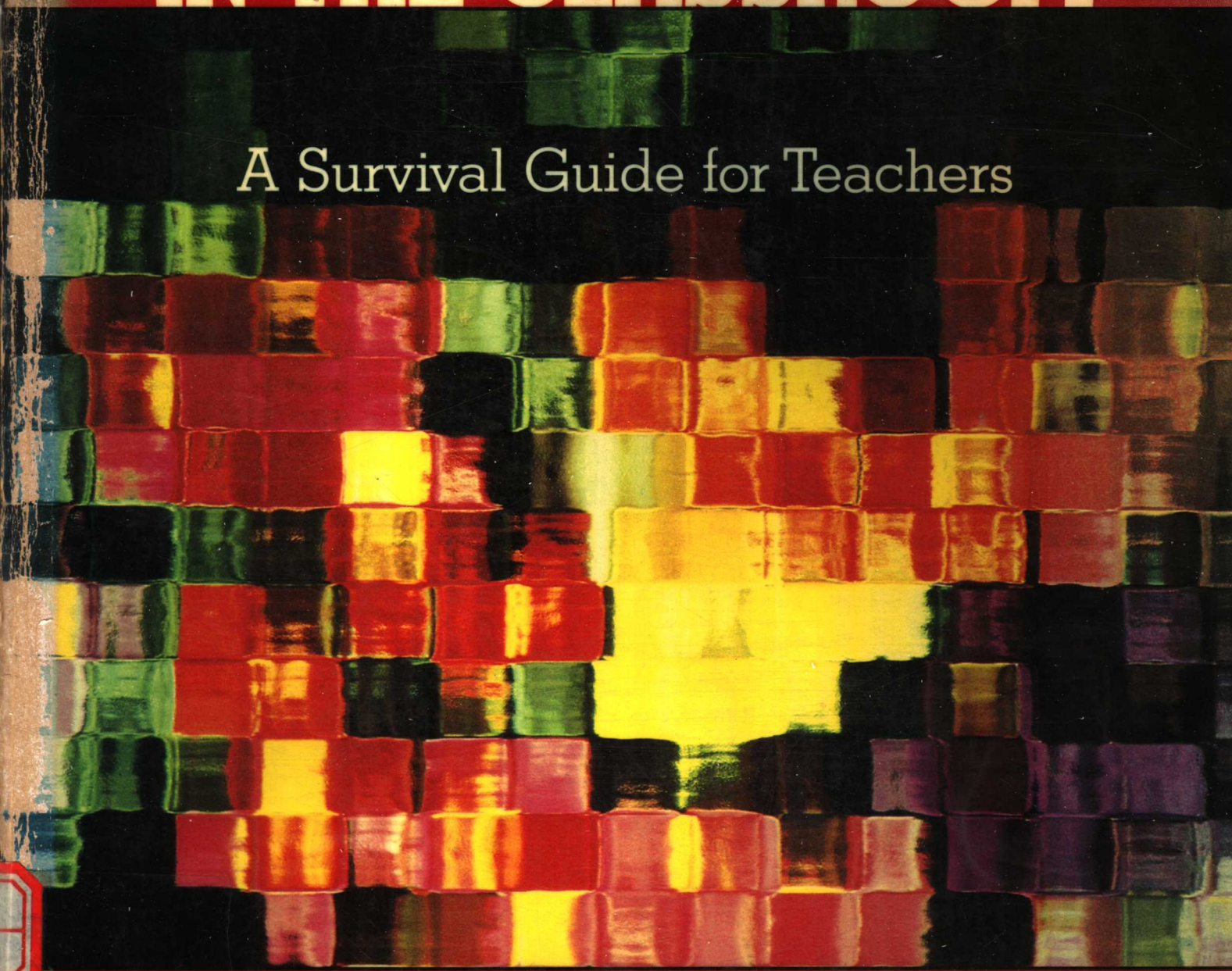
COMPUTERS IN THE CLASSROOM

A Survival Guide for Teachers



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A Survival Guide for Teachers

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This book is dedicated to our spouses, Helen Radin and Yan Lee, who have consistently given us support, understanding, and the encouragement to move ahead.

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Introduction

This book is intended to serve teachers and prospective teachers of students in grades 4-12. It will give such readers a working knowledge of the fast-moving computer education field, along with sample materials that they can use with their students in a computer literacy program. With this handbook teachers and their students can learn to use the microcomputers that many elementary and secondary schools have acquired. These machines are becoming more and more a part of everyday life, and computer literacy is thus becoming an important feature of teacher training.

Because of the newness of this field, the meanings of many of the terms used are not firmly established. The most commonly accepted definitions are used throughout this work.

This book is divided into three sections. Section I (Chapters 1-7) is devoted to computer literacy. This topic is subdivided into four basic units: the physical, social, historical, and control (programming) aspects of computing. Each topic is important in its own right, and each receives ample consideration. This section includes a review of computer applications in teaching and guides the reader in writing useful classroom practice drills in the most popular computer language, BASIC.*

Section II (Chapters 8-9) explores data file management. This section introduces some actual computer software that you can use on the more common microcomputers to help with administrative and word-processing tasks.

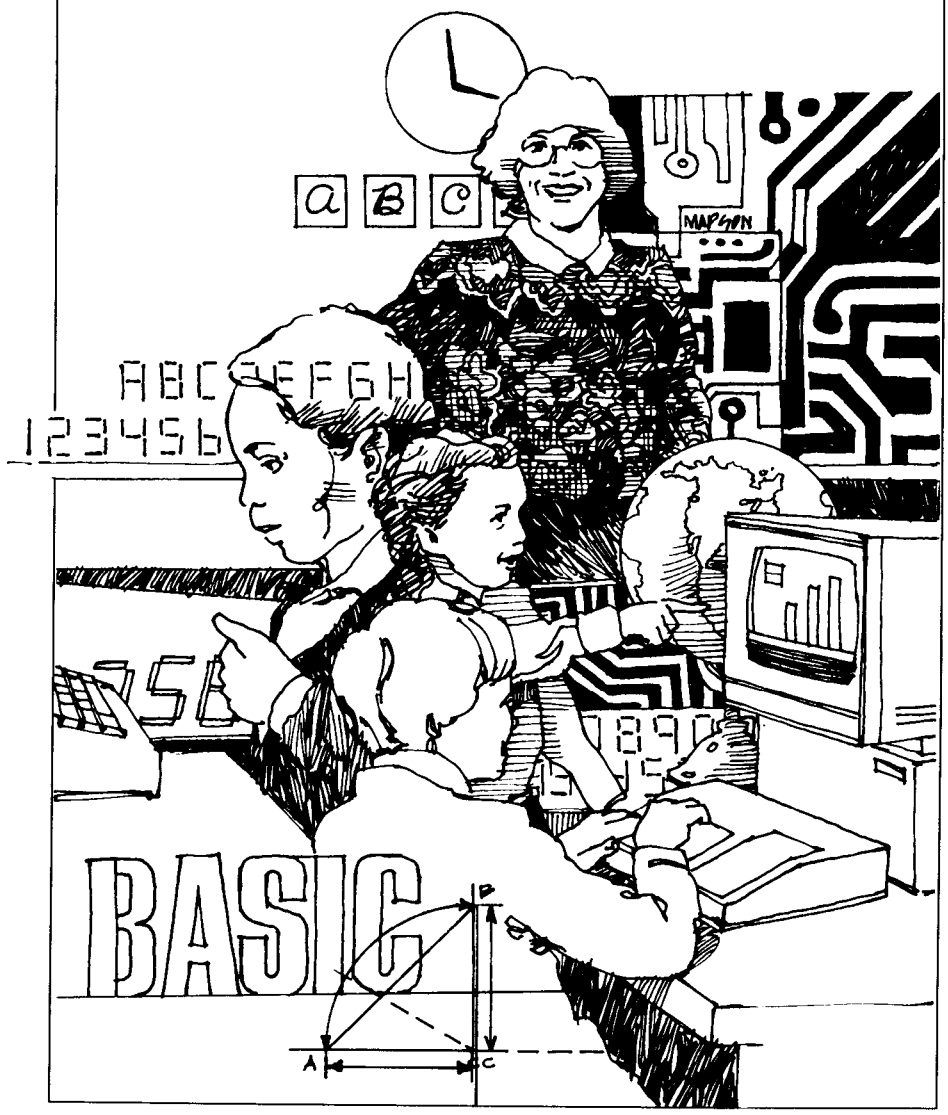
Section III (Chapters 10-11) gives practical guidelines for setting up a computer facility. This section discusses funding as well as the successful use of community resources to build and expand a facility. Finally, it analyzes the hardware and software needs of all school levels in the four primary areas of computer education and gives some good, money-saving advice.

*Appendix K includes specific material to assist teachers in presenting to their students the knowledge obtained from reading this section.

Section

I

ONWARD TO COMPUTER LITERACY



Section I is devoted to the four areas of knowledge that together comprise computer literacy:

1. Computer Architecture (Chapters 2-3). No one can understand computers without some grasp of their basic structure and operation. Chapter 2 reviews the basic components of modern computers, while Chapter 3 discusses the software that drives them. Important concepts and vocabulary are introduced and amply explained. (Note that we concentrate in this book on the microcomputer, the type most often found in the classroom.)
2. Computers in Society (Chapter 4). Computers have penetrated into almost every corner of our society and the trend can only continue. Very few jobs are likely to remain untouched by these machines, so a basic competence with computers will become imperative for the job-seekers of the future. Students should be aware of the ongoing growth and change in the social impact of computers and of the important role they can play—both for good and for evil—in our future lives as citizens and as workers.
3. History of Computing (Chapter 4). Understanding the historical context is important in any field. This discussion reviews the slow development of computing aids, from the anonymous invention of the abacus through Blaise Pascal's ingenious adding machine to the room-sized forerunners of today's high-speed electronic computers.
4. Computer Control (Chapters 5-7). Once students sit down at a computer for the first time, it's hard to keep them away from it. Even teachers soon lose any fear of the machine. Once you see what a few BASIC words can do—how much time you can save and how much student interest can be generated—you will gladly accept the computer as a valuable ally. These three chapters lead you through BASIC vocabulary and programs, developing some programs and refining them as further concepts are introduced.

TEACHER DEVELOPMENT

Essentially, teachers have the necessary skills to teach the first three topics of Section I, regardless of the state of their computer literacy. The skills used to teach social studies and science apply here equally well.

The fourth topic, however, does require the development of new skills. But you can't learn how to program a computer just by reading how to do it. The only effective way to learn to program a computer is by practicing on one under the guidance of someone who has been there. Chapters 5-7 are designed to serve as your guide through the mysteries of programming.

Chapter

1

Computers in the Classroom: An Overview

Chapter 1 Wordbank

Experts in every field have their own special words. Doctors refer to a "sublingual hematoma" when they mean a black-and-blue mark, and lawyers talk of "torts" when they mean criminal acts. The computer field has as many of these special words as any other technical area. At the beginning of each chapter of this book you will find a list of the words that chapter introduces. You do not have to master these before reading the chapter; they are there to be referred to when needed. The new words, as well as cross-references within a chapter list, are indicated in boldface type. All these words can also be found in the glossary at the end of this book.

Bug A defect. This word generally refers to an incorrect statement or sequence of statements in a computer program.

Data Information that a computer holds or manages: for example, a mailing list or a *program.* Any information we ask a machine to remember is called "data."

File A stored collection of *data.* Computers can store information either in internal memory or on external devices.

K "Thousands." When a computer company says that their machine has 48K of memory capacity, they are telling you that the machine can hold approximately 48,000 characters (or *bytes*) in memory at any one time. (Actually, 1K = 1024 not 1000, but 1000 is close enough for our purposes.)

Program A collection of instructions that tells a computer how to do a specific job.

Programmer A person who designs a computer *program* and prepares it so that a machine can use it.

Simulation A program that allows a *user* to test solutions to "real life" problems. The user suggests an answer to the problem and the computer projects the consequences. Simulation allows users to test different approaches to a situation on a machine, without the risks and difficulties of experimenting in real life.

User A person who uses a computer. Computer users, including those in the field of education, often know very little about computers, but they do know how to follow directions. They simply turn on their machines and follow the English instructions provided by a prepackaged *program.*

Word processing Writing documents with the aid of a computer. We wrote this book with a computer and a word-processing *program.* It enabled us to type in the text, modify it, store it, and print it out in a formatted (standardized) fashion. Word processing reduces the time spent typing repetitive documents; it can cut time spent on secretarial functions in half.

DEMYSTIFYING THE COMPUTER

All the discussion about the powers and influence of computers in our society today has convinced many people that they could never master such a complex device. This is probably the most fundamental misunderstanding about computers.

Computers are only inanimate objects—like TVs and automobiles—designed to serve human needs. Anyone who can read simple English can learn to manage a computer. Modern language students master this new machine as easily as do math or science students. Despite what you might think, you can operate a computer very successfully without knowing any algebra or calculus. So take heart! No matter what your area of expertise, you can make these machines serve you.

The word "computer" generally refers to a device that, with its many parts, allows people to communicate their needs and to manipulate what is often very complicated information. Computers play a central role in arcade games (such as Space Invaders), medical procedures, business data-processing departments, and many other areas of our society.

These metal and plastic machines have basically two strengths: (1) they can do repetitive chores very rapidly, without strain or fatigue, and (2) they can store and manipulate large amounts of information. Thus computers can improve the speed and accuracy with which staff members accomplish many of the more mundane school functions. This frees the staff to spend their time in a more profitable, professional manner. Many a school debating team or other club has been organized by teachers whose clerical burdens were lightened so significantly that they finally had time to really pitch in and take on other, more challenging tasks.

Computers are also being used increasingly as an aid to intellectual activity and as a tool for creative work, in great measure because of their ability to manipulate large amounts of data quickly. The real challenge for teachers and students is to design programs that can develop creative uses for what are essentially nonthinking machines. Let's look at the field from the inside out, beginning with the parts of the computer itself.

UNDERSTANDING HARDWARE AND SOFTWARE

Computer hardware is just what the word implies: the physical parts that do the work. As we shall see, most computers have three or four basic hardware components. We select specific components according to the function we want the machine to perform. This process is very much like purchasing a car and ordering it with four-wheel drive for mountain driving or with an automatic transmission for easier shifting.

Hardware is made of various metal, silicon, and plastic components. It can basically be divided into four segments: a central processing unit, input devices, output devices, and memory. The last three of these fit under the general category of peripheral devices. We have found that an anthropomorphic analogy helps both teachers and students understand the interrelations involved, so we will use that format here.

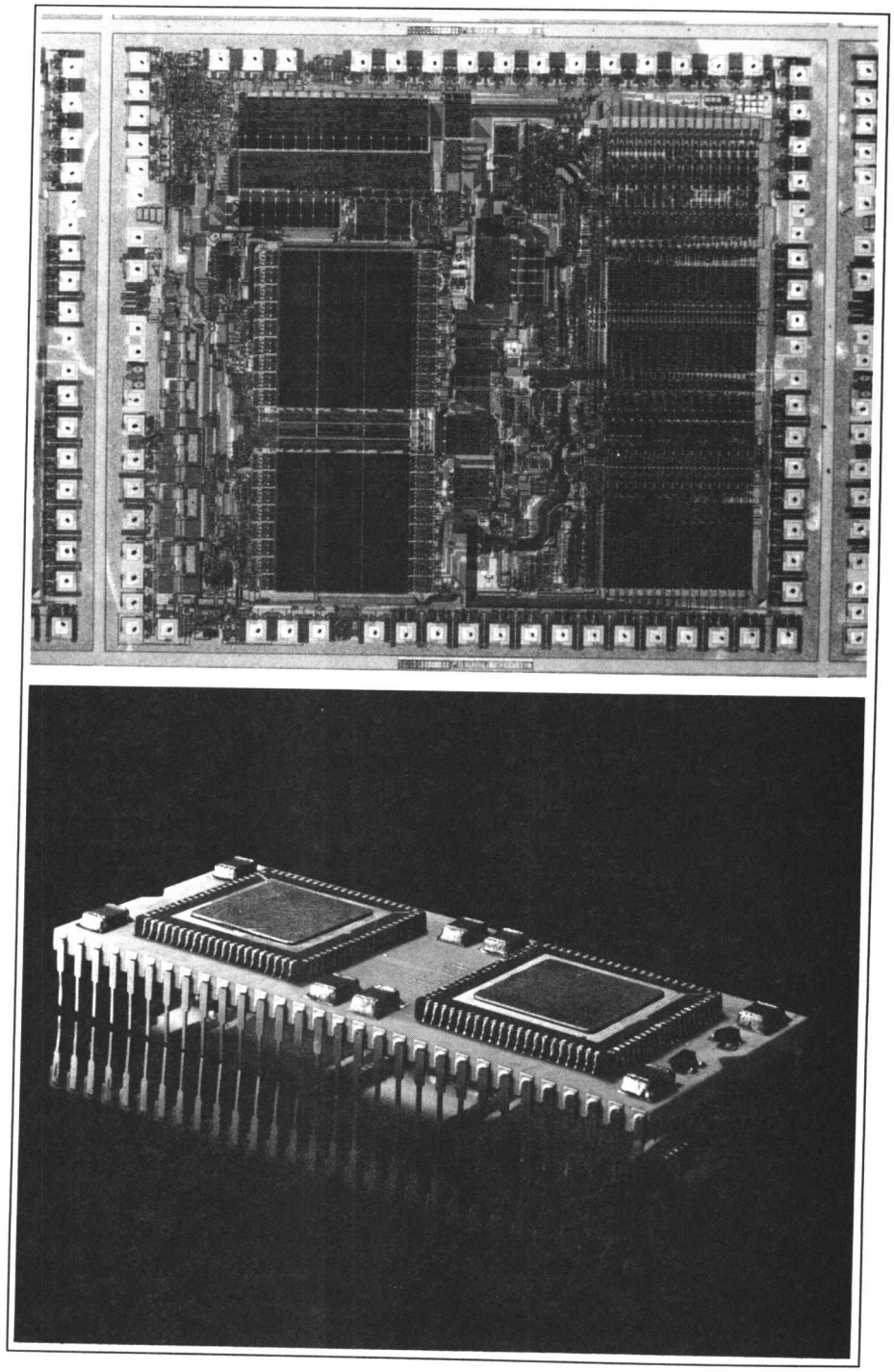


Figure 1.1 Integrated circuit chips: the computer's brain. Pictured are a 68000-series chip and a PDP-11 chip. The PDP-11 chip is shown encased in its protective jacket; the 68000 chip is displayed without its cover, so that the inner parts are visible. (Photos courtesy of Motorola, Inc., and Digital Equipment Corp.)

The Brain

The computer's key device contains thousands of electronic parts that together form the central processing unit, or CPU. The CPU has two main sections, usually called the "arithmetic-logic unit" (ALU) and the "control unit." The ALU does the essential math work for the machine while the control unit monitors the flow of information. In microcomputers—the type most teachers use—the entire CPU, with all of its parts (ALU, control unit, interconnections, etc.), fits on one silicon chip. The chip is housed in a plastic package approximately one inch wide, one-fourth of an inch tall, and three inches long. That's many thousands of parts on one silicon chip. The chip itself is an extremely thin slice of silicon, often less than one-fourth of an inch square.

Their size and low manufacturing cost are the primary reasons for the low price and powerful capacities of the new microcomputers. In the older mainframe machines and in most minicomputers, many separate parts are needed to create the CPU. This CPU design is far less cost- and space-efficient than the more modern, architectural structure.

The computer's CPU, with its associated software, coordinates the peripheral devices to help you accomplish mundane chores quickly and accurately. Every computer installation must have access to a computer CPU. It is the most essential part; without it the machine cannot process information.

CPUs are available in three basic sizes: micro (the smallest), mini (medium-sized), and mainframe (the big bruisers of the field). The machines that contain these three sizes of processor are called, respectively, microcomputers, minicomputers, and mainframe computers.

The computer revolution that is now sweeping our schools and our society centers around the microcomputer. This machine has a price tag within the reach of most school districts' budgets and a design that is easy to manage. Parents' groups, schools, and teachers all over the country have purchased thousands of microcomputers. We will therefore concentrate here on these machines. The larger computers have their place in education, but at this point these are participating in the revolution to a much smaller extent. They are simply not available to enough schools to warrant more than cursory treatment in this book.

Peripheral Equipment

The computer's communication equipment is known as "peripheral hardware"; the CPU uses it to communicate with its users and to store information that must be remembered. This category can be subdivided into input, storage, and output devices. The CPU uses input devices to get information and output devices to give out answers.

It is easy to remember which is which since all the devices are named from the point of view of the central unit. Thus, what the CPU receives comes from an *input* device, what it sends out goes through an *output* device and what it stores is retained in a *memory* device. With the new advances in hardware packaging, one plastic box can now house an input device, an output device, a CPU, and memory.

Figure 1.2 Some of the more popular school microcomputers. Photos courtesy of (a) Apple Computer, Inc.; (b) IBM Corp.; (c) Commodore Business Machines, Inc.: (d) Monroe Systems; and (e) Radio Shack, a division of Tandy Corp., Forth Worth, Texas 76102.

The Eyes and Ears The input device is the eyes and ears of a computer. The most common form of this device is a keyboard, very similar to the one on an ordinary electric typewriter.

Among the other commonly used input devices, card readers relay information to the CPU from punched cards, paper-tape readers from punched paper tape, mark-sense scanners from cards with blank spaces that the user fills in, and magnetic-tape and disk read heads from tape or disks that store information magnetically, like ordinary tape-recorder tape. Other input devices include microphones, potentiometers, game paddles, joysticks, and bar-code readers.

Through these devices the CPU gets its instructions and searches for previously stored data. As mentioned, the most popular microcomputer input device is the keyboard, and so our discussion will concentrate on it.

The Mouth The CPU employs its mouth (or output device) to supply information to its users. The most common output devices are television-like screens (cathode-ray tubes, or CRTs), printers, and speakers. These devices relay to us such information or products as class lists or remedial drill problems.

Other output devices include card punches, paper-tape punches, magnetic-tape write heads, and disk write heads. A computer talks to its users and communicates with the machine's memory through these devices. The two output devices that we will be primarily considering are the CRT video display and the printer.

Memory CPUs "remember" things via two basic modes, which are often called temporary and permanent memory. Temporary memory is usually

Figure 1.3 Three forms of media: a cassette, a standard microcomputer $5\frac{1}{4}$-inch diskette, and a punch card.