Chapter Highlights

- Materials have always been an important resource for the development of new technologies.
- Natural materials are found in nature; synthetic materials are made by people.
- Not all natural resources are renewable.
- Most materials can be organized into the following groups: wood, metals, ceramics, plastics, and composites.
- New materials are developed by material scientists to meet new needs.
- The properties of materials determine how they will react when they are used.

Test Your Knowledge

1. Why was iron an important advancement over bronze in material science?
2. List three renewable and three nonrenewable materials.
3. List three natural resources and the raw materials with which they provide us.
4. Define *synthetic*.
5. Balsa wood is a very soft wood, but it is classified in the hardwood family. Explain this.
6. What are the two broad classifications of metals?
7. Define *alloy*.
8. How are thermoplastics and thermoset plastics different?
9. What is a molecule?
10. Explain the property of plasticity.

Correlations

SCIENCE

1. Carbon fiber composite is a very lightweight material. What are some practical uses for this material?

MATH

1. A two-ounce "Choc-o-nuts" candy bar claims to be 25 percent nuts. How many ounces of nuts are in the candy bar?

LANGUAGE ARTS

1. In a paragraph compare and contrast the use of raw materials with synthetic materials for clothing. Keep in mind cost, cleaning process, and durability.

SOCIAL STUDIES

1. Find out what natural resources Americans used to run their homes in the 1800s. How many of these natural resources do we still use today? How do we use natural resources differently than we did one hundred years ago?

CHAPTER 6

Information Resources

Introduction

Each of the four families of technology (communication, transportation, production, and biotechnology) consumes and produces large amounts of information. When we create technology, this information directs what we do and how we do it.

Information resources are needed to produce all products and services. This chapter will continue your study of the importance of information resources to technology.

After reading this chapter, you should be able to

Discuss the role of information as a resource for technology.

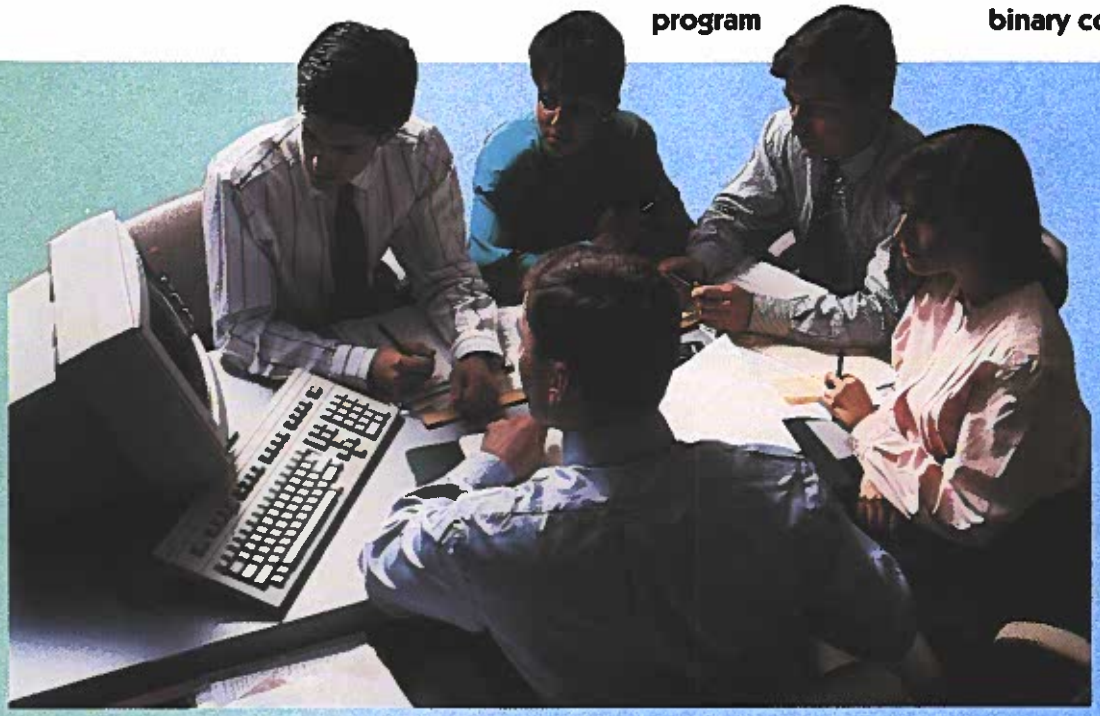
Define information technology.

Give examples of how information is gathered, stored, and moved.

Describe how a computer processes information.

Words you will need

data
data processing system
information technology
input
output
program
network
terminal
database
central processing unit (CPU)
binary code



Information Technology

What kinds of information would you need to start your own disc jockey entertainment business? You would first want to determine whether there is a need, or *market*, for your service. You might ask friends who are planning parties if they would consider using a deejay for music entertainment.

If, after gathering and studying this information, you decide your services are in demand, you would need to collect still more information. What kind of equipment would you need? Is it expensive to buy, or could you rent it? How would you get the money to invest in your business?

After getting your fancy equipment, how would you operate it? What kind of music should you purchase: jazz, rock 'n' roll, dance music? This would depend on the interests and preferences of the people who would hire you.

Would you advertise? What is the best method of advertisement? How much should you charge for an evening of music?

As you can see, a great deal of information is required for the simplest of services. Think about the amount of information needed to manufacture automobiles or to run a large produce farm or a telephone company.

TECHNOLOGY TRIVIA

The automatic telephone switchboard was invented and patented in 1891 by an undertaker in Kansas City because he suspected that telephone operators were being paid by rival undertakers not to connect his calls.

Information starts out as data, or facts. In the disc jockey example, when you questioned your friends to see how many were interested in a deejay, you were gathering facts.

In technology, people gather data about a variety of topics. Market researchers gather data about what customers need and want. Fig. 6–1. Designers and engineers gather data by making working models or prototypes of products and testing them. Fig. 6–2.

Fig. 6-1. Market researchers interview people, conduct phone surveys, or demonstrate new product ideas to gather information about customers' likes and dislikes.

Fig. 6-2. Valuable information can be gathered by testing models or prototypes. Here, engineers are testing an aircraft design in a wind tunnel.

Material scientists gather data about the properties of different materials by conducting experiments on the materials. Fig. 6–3.

Technicians gather data about how tools and machines process different kinds of materials. The government tests products to gather data about the safety of a product and its impacts on the environment.

A data processing system is any system used to organize raw data into information. The data has very little meaning until it is organized into information. Not very long ago, most data was processed into information by hand in the form of documents and books. Today, the volume of data is so great that electronic methods are used to process it. Fig. 6–4.

Information technology provides a means of handling data and information. Different information systems can collect, organize, store, and send information in many forms. Data processing systems electronically process words, images, numbers, and sounds into information. Fig. 6–5.

TECHNOLOGY TRIVIA

The time delay in many international telephone conversations is caused by the vast distances the signals must travel. Even at the speed of light (186,000 miles per second) the signals take about one-fourth of a second to reach a communication satellite and bounce back to earth.

Fig. 6-3. Materials are selected for products based on information obtained by different types of testing. These people are testing the compression strength of cardboard corners.

Fig. 6-4. Data processors are people who enter data or facts into a computer. With the help of the computer, they organize the facts into information.

▶▶▶ FOR DISCUSSION ◀◀◀

1. If you were to conduct a telephone survey to gather information about America's favorite rock group, what questions would you ask?

2. Modern farming technology relies on a great deal of information. What types of information do you think would be helpful to a large-scale farm?

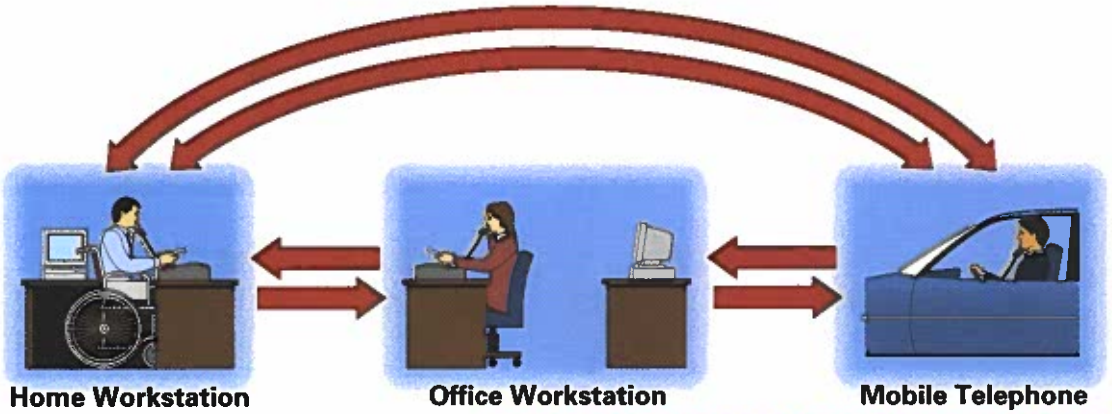


Fig. 6-5. Information technology allows us to link many smaller systems into a single, more powerful system.

Processing Information with Computers

People use computers to collect, organize, store, and move information. The process of placing data into a computer is called **input**. The computer processes the data into information according to a **program**, or set of computer instructions. The information that the computer provides is called **output**.

To get an idea of how computers can process large amounts of information, let's suppose we were going to "computerize" your school. First, we would create a computer network. A **network** links many computers to a central controlling computer and to each other. Fig. 6–6. In this case, let's suppose each member of your class would have a **terminal**, or computer station, at home that would be connected to a central computer. Your teacher would input the day's lesson onto the central computer.

You could retrieve the lesson information from your terminal at home. After reading the lesson, you could ask questions by leaving an electronic letter in your teacher's electronic mailbox. Lessons, quizzes, homework, and most other school assignments could become part of the information you and your teacher exchanged through the central computer.

The speed with which the central computer can handle information would allow all the students to work at the same time. Thousands of information transfers can occur within just a second or two.

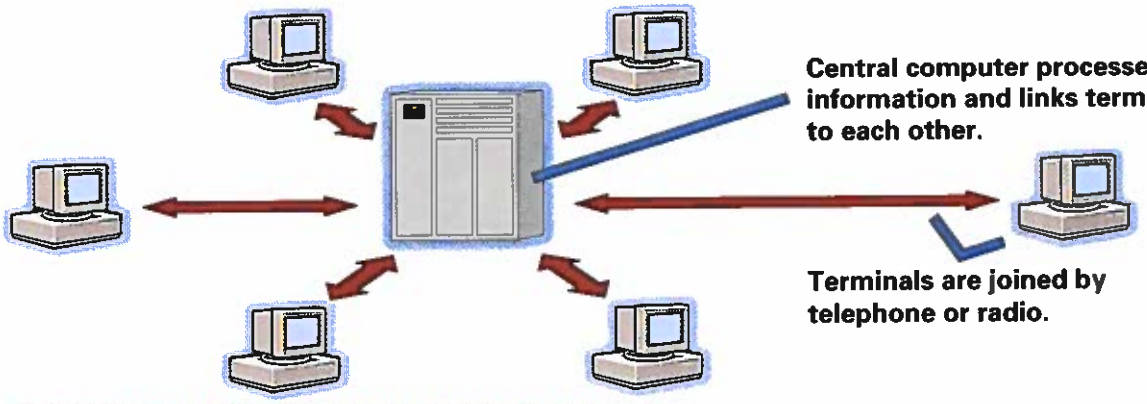


Fig. 6-6. Computer networks link several computers to a central computer. Even terminals that are separated by thousands of miles can be joined in a network.

IMPACT

Computers are helping to fight crime. With the help of computer networks, police can find out if a suspect they have arrested is also wanted in another city or state. Information about missing persons can also be distributed on a computer network. Computers have even been used to draw pictures of suspects based on the descriptions of witnesses.

▶▶▶ FOR DISCUSSION ◀◀◀

1. What type of data might an airline ticket agent input into the airline's computer terminal?
2. What type of information might an airline ticket agent be able to retrieve from the airline's computer network?

■ **Interview at least three people who are employed in different types of jobs. Find out how computers are used in each person's work. Share your findings in a class discussion.**

Collecting, Storing, and Retrieving Computer Information

Different technologies require that data be handled in different ways. For example, an automatic camera uses light sensors to measure the amount of light in a room. Fig. 6–7. Using this data, its computer calculates the proper exposure. A video game uses a joystick to enter your responses, as data, into the game's computer. In order to handle data and information in different forms, information technologies have created many devices.

Fig. 6-7. When light strikes a sensor on this camera, the data the sensor collects is moved to a microprocessor that determines the film exposure level.

Information Collection Devices

Computers collect data through input devices. The keyboard is the most common input device. However, many other types of input devices have been designed to meet specific input needs. Fig. 6–8.

Fig. 6-8. Because data comes in many different forms, inputting data requires many different kinds of input devices.

For example, a bar code scanner can enter data into a computer. The scanner reads coded information from a series of black lines on a white background. These lines are called a *bar code*. Bar code scanners make data input faster in some situations.

Information Storage Devices

Computer data is usually stored or recorded on magnetic floppy disks or hard disk drives. These disks store information until you instruct the computer to retrieve the information. Figure 6–9 shows various information storage devices.

Computer Output Devices

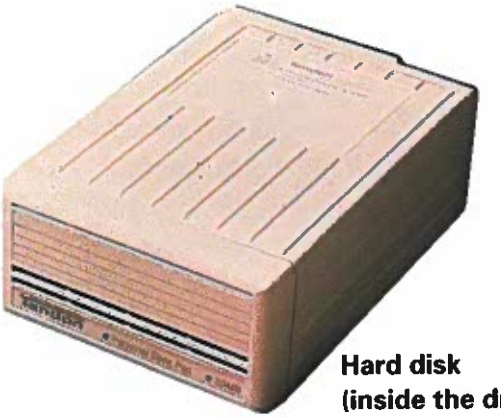
After data is processed, you can retrieve it from the computer in a variety of forms. For example, if you asked a librarian for books written about camping, he or she might conduct a search through the library computer's database. A **database** is a collection of information organized around a topic.

After the computer located all the camping titles in its memory, it would display them on the monitor screen. If you wanted a copy for yourself, the librarian could send the output to a printer.

▶▶▶ FOR DISCUSSION ◀◀◀

1. What do you think are some of the hazards of electronic information processing?
2. A public computer in a shopping mall has a "touch screen" monitor. People touch different areas of the screen to call up information. Is this monitor an input device or an output device? Explain your answer.

Compact disc



Hard disk (inside the drive)

Cassette tape

Removable hard disk

Diskette

Fig. 6-9. Computers can use many different kinds of storage devices.

Inside the Computer

How does a computer work? It's a mystery to most people. All computers, no matter how big or small, work in the same way and contain four basic parts. Fig. 6–10.

Parts of a Computer

First, you have to give the computer some instructions. You do this by using an input device. The "brain" of the computer is the **central processing unit (CPU)**. This unit carries out the instructions. The computer's memory unit stores these instructions for the computer's use. The output device displays the results of the computer's work.

Binary Code

Data is passed back and forth through the parts of the computer as bursts of electricity. The bursts make up a code that represents the words and numbers entered into the computer.

The code is called **binary code** because it is based on the *binary* number system. In binary, only two numbers are used: 0 and 1. These numbers are represented in binary code by combinations of short bursts of electricity and "spaces" of no electricity. This system works much like Morse code. The computer sees all information as a string of bursts of electricity. Fig. 6–11. The input and output devices change words and numbers into binary code and then back again into words and numbers.

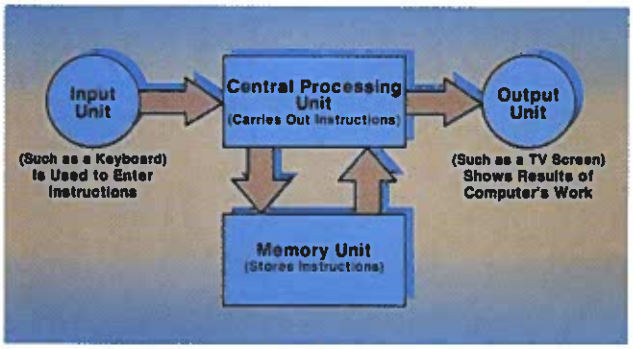


Fig. 6-10. Computers, calculators, and microprocessors all work the same way.

CHANGING WORDS AND NUMBERS TO COMPUTER LANGUAGE

Letter or Number Entered into Computer	Binary Code	Electrical Code
"B"	1000010	1 0 0 0 0 1 0 (on off off off off on off)
"9"	1001	1 0 0 1 (on off off on)

Fig. 6-11. Computer binary code is made up of 1s and 0s. 1s represent a burst of electrical energy; 0s are "spaces" of no electricity. Electronic parts inside the computer act as switches to turn the bursts of energy on and off.

▶▶▶ FOR DISCUSSION ◀◀◀

1. A calculator has the same basic parts as a computer. Explain this.
2. How could you use the lights in your room to signal a binary code?

■ Using a word processor or database, make a list of all tools and materials available in your laboratory. Give those that could be used for model-building a special code. Print a list of possible model-building tools and materials.

Chapter Highlights

- All technologies depend on information resources.
- Information technology is any electronic means of gathering, storing, organizing, and moving information.
- The computer is the main tool used in information technology.
- Data and information can be collected, stored, and retrieved in many ways.
- A computer changes data into bursts of coded electrical energy.

Test Your Knowledge

1. How is data different from information?
2. What do we call a system used to process facts into information?
3. Define *information technology*.
4. What type of data might an engineer need to gather when developing a product?
5. Describe a computer network.
6. List three places in which computer networks might be used.
7. Why are bar code scanners used at supermarket checkout counters?
8. List three computer output devices.
9. What does a computer program do?
10. What four parts do all computers have in common?

Correlations

SCIENCE

1. Find out how a bar code scanner works.

MATH

1. The binary number system is based on powers of 2 and uses only 0's and 1's. See if you can count to ten in this system. The chart below will help.

Powers:	2^3	2^2	2^1	2^0
Values:	8	4	2	1
1=				1
2=			1	0
3=			1	1
4=		1	0	0

LANGUAGE ARTS

1. Many grocery stores are now using computerized cash registers. The bar code on packages is scanned for price. What do you think are the benefits to the store and to the consumer? Write your ideas in a brief essay.

SOCIAL STUDIES

1. When were computers first developed? What technology had to be developed before it was possible to build electronic computers?
2. If you have computers in your home or school, how are they used?

CHAPTER 7

Energy Resources

Introduction

When people create and use technology, they consume energy—lots of energy. Energy is the force that makes all things move and work. Our people-made world is an energy-hungry machine.

We consume energy to transport people and products from place to place. We rely on energy to fuel the engines in our cars, trucks, trains, planes, and ships.

We consume energy to make electricity. Electricity feeds our homes, businesses, schools, and hospitals with power. Machines, appliances, and electric lights gobble up electricity at an enormous rate.

We consume energy when we change materials into products. Just think of the heat energy required to make steel, melt glass, and create food products. This chapter will help you become more familiar with our energy needs and how we fulfill them.

After reading this chapter, you should be able to

Define energy.
List the major forms of energy.
Discuss the major sources of energy.
Explain energy conversion.
Discuss energy-related problems.

Words you will need

energy
mechanical energy
chemical energy
atomic energy
kinetic energy
potential energy
law of conservation of energy
fossil fuels
photovoltaic cells
generator
hydroelectric plants
nuclear fission
nonrenewable resources