

Computer Technologies

Sections

10.1 Computer Systems

10.2 Computers on the Cutting Edge

What You'll Learn

- **Identify** the main parts of a computer system.
- **Explain** why binary code is important to computer function.
- **Name** several computer input and output devices.
- **Describe** artificial intelligence and identify ways in which it can be used.
- **Discuss** wi-fi, WiMAX, and distributed computing.

Explore the Photo



Anywhere You Want It The first computers were the size of large rooms. They performed simple operations and consumed massive amounts of energy. Today's personal computers are powerful devices that fit on your lap and can connect to the Internet wirelessly.

What part of this computer is the input device?





Launch the TECHNOLOGY LAB

Program a Computer to Control a Machine

At the end of this chapter, you will be asked to build a motorized robotic machine. You will then write a program that will control your robot. Get a head start by using this checklist to prepare for the Technology Lab.

PROJECT CHECKLIST

- ✓ Do some Internet research on robots that other students have created.
- ✓ Read the LEGO Mindstorms™ Education NXT system user's guide.
- ✓ Do the control experiment that comes with the system.

Computer Systems

Reading Guide

Before You Read

Preview How much do you already know about computer systems?

Content Vocabulary

- CPU
- ROM
- RAM
- program
- operating system
- binary code
- computer virus

Academic Vocabulary

You will see these words in your reading and on your tests. Find their meanings at the back of this book.

- component
- function

Graphic Organizer

Draw the section diagram. Use it to organize and write down information as you read.

Acronym	Complete Phrase
CPU	
RAM	
ROM	



Go to glencoe.com to this book's OLC for a downloadable graphic organizer and more.

TECHNOLOGY STANDARDS

- STL 2** Core Concepts of Technology
- STL 3** Relationships & Connections
- STL 9** Engineering Design
- STL 11** Design Process

ACADEMIC STANDARDS

Science

NSES Content Standard B Motion and forces

Mathematics

NCTM Number and Operations Understand numbers, ways of representing numbers, relationships among numbers, and number systems.

STL

National Standards for Technological Literacy

NCTM

National Council of Teachers of Mathematics

NCTE

National Council of Teachers of English

NSES

National Science Education Standards

NCSS

National Council for the Social Studies

The Central Processing Unit (CPU)

What are the three main parts of the CPU?

Computers are part of our daily lives. Computers control automobile engines, DVD players, and cell phones. In the future, you will use computers to make informed personal, business, and governmental decisions. In order to do well in our society, it is important that you become computer literate.

A computer is an electronic device that can calculate, store, and process data. A computer system is made of different **components**. (See **Figure 10.1**.) Each component has a special job to do.

As You Read

Predict How does a computer know how to run a program?

Basic Operations

Inside your computer are tiny pieces of silicon called “integrated circuits,” or “microchips.” Integrated circuits have many electrical circuits burned into them. The circuits act like switches. Sometimes they let electricity flow. Other times they shut it off.

The **CPU** (central processing unit) is the largest and most important integrated circuit on the computer’s motherboard. It performs all basic operations. A CPU is like a highway system. Information travels the circuits of the CPU to get processed.

The CPU’s control unit guides the flow of information. The arithmetic/logic unit performs mathematical calculations with data sent by the control unit. The memory unit stores that information before and after processing. These three parts of the CPU work together.

ROM and RAM

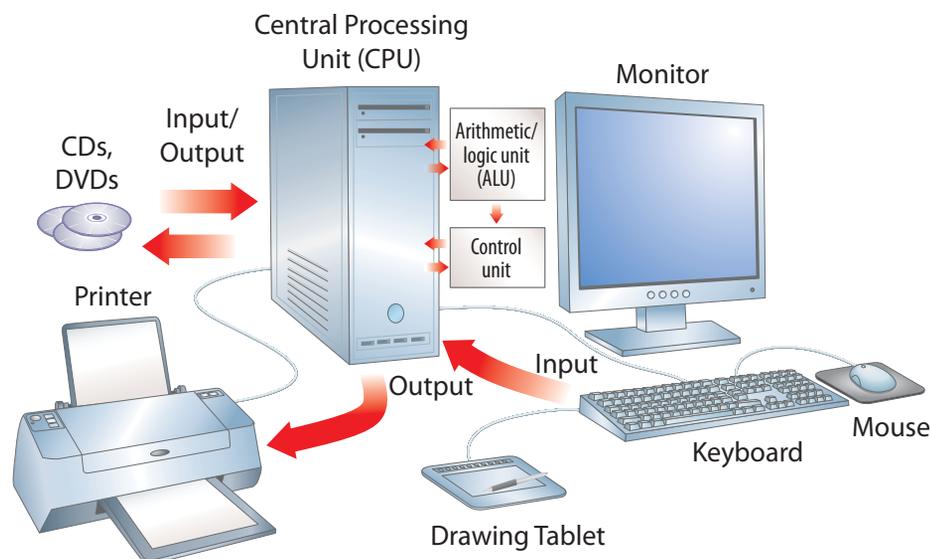
The CPU has two types of memory. **ROM**, or read-only memory, contains the basic information that the computer needs to perform any operation. It is permanent and cannot be changed, deleted, or erased. The other type of CPU memory is **RAM**, or random access memory. All data that you feed to your computer is put into its RAM. The RAM temporarily stores data and software instructions. When you turn your computer off, this information is lost.



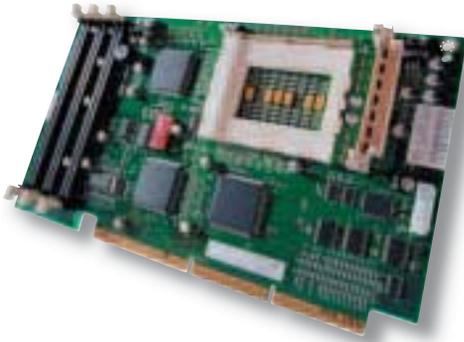
Reading Check

Compare What is the difference between ROM and RAM?

Figure 10.1 A Basic Computer System



Plugging In A basic computer system includes the CPU, monitor, printer, keyboard, and other useful input and output devices. *Why are CDs and DVDs listed as input and also output devices?*



The Motherboard

The CPU is located on the computer's motherboard. Memory chips, expansion slots, and controllers are also on the motherboard.

Why would a computer manufacturer include expansion slots?

Computer Programs

What is the function of a computer program and how does a computer understand it?

A computer **program**, or software, is a set of instructions that the computer follows to do its work. The program controls the computer. It tells the CPU exactly how to handle all the data that is entered into the machine. The program turns the computer into a game machine or tells it to perform other **functions**. Computer programs are often stored on the computer's hard disk drive.

Operating Systems

Many components inside the computer have **operating system** programs that are permanently burned into their microchip circuits. When the computer is turned on, these programs first tell the computer how to run its hardware. In a sense, each time you turn your computer on, it reads an entire instruction book on how to operate.

Binary Code

The computer program and all the information that the computer will use must be converted into **binary code**, which is code that the computer can understand or read. Binary code uses only the numbers 1 (one) and 0 (zero). Each 1 (electricity on) or 0 (electricity off) is a bit.

Bits

A bit is the smallest piece of information that a computer can use. A computer sends or receives these 1s and 0s in the form of small electrical pulses. A 1 means a pulse flows through the circuit; a 0 means no pulse flows through the circuit. Stringing eight of these bits together forms a byte.

Bytes

Each byte is code represented as 1s and 0s for a letter, number, or punctuation mark. The computer converts every letter and number that you type into binary bytes. You can find free binary conversion programs online that will show you the codes that a computer would use for your name.

Advantages of Binary

Why does a computer have to use binary code? "Electricity on" and "electricity off" are the only two messages that a computer can sense. Although binary code seems slow to us, electricity travels very fast. Supercomputers can make over a trillion calculations per second.

Computer Viruses

A **computer virus** is a set of destructive instructions that someone has written and hidden inside a Web page, an e-mail attachment, or even a computer image. Viruses can take different forms. Some are merely annoying. Others do serious damage.

Most viruses are passed from computer to computer by users whose computers do not have proper virus protection. If your computer's virus protection is not up to date, your computer can catch viruses. You could unknowingly pass them on to friends and family through e-mails, file sharing, or by trading homemade CDs and DVDs.

Spyware and Worms

Spyware is a kind of virus that teaches your computer to spy on you, then secretly sends this information back to its creator. If the virus quickly duplicates itself and worms its way into every memory location in your computer, it is called a “worm.”

Trojan Horses

A “Trojan Horse” is not a virus. It often takes the form of a fake e-mail that looks like it came from a bank, a major company, an official from a foreign country, or from a Web site you like to visit. If you click to respond, it will take you to a fake log-in location or provide questions designed to steal information about your personal identity and accounts.



Grace Murray Hopper

Computer Scientist and Program Designer

Born in 1906, Grace Murray Hopper attended Vassar College. She joined the faculty after earning a Doctorate from Yale University. After losing her husband in World War II, Hopper joined the U.S. Naval Reserve and became a Rear Admiral.

But it was Hopper's leadership in the field of software development and computer programming that made her a part of technological history. In the 1940s, she worked on the Mark series of computers. By disassembling the computers and figuring out how they worked, she became the third person to program the Mark I. She also worked on the Mark II and Mark III computers.

Early Days of Digital In 1949, Hopper joined the Eckert-Mauchly Computer Corporation. There she began work on the UNIVAC I, the first large-scale electronic digital computer.

English Language Arts/Writing Write an article for your school's newspaper discussing the differences between computers in the 1940s and computers today.



Go to glencoe.com to this book's OLC to learn about young innovators in technology.



Imagine This...

Computers without Computers

Imagine life without personal computers. All you need is a small handheld device to access online programs and store all of your files on the Internet. Companies like Google already offer photo storage, word processing, and spreadsheet applications as free Web-based services. In the future, you may be able to do everything you now do on a personal computer with very little hardware. *What might be the advantages and disadvantages of using online software and online storage space?*

 Go to glencoe.com to this book's OLC for answers and to learn more about online software and storage.

Anti-Virus Software

The FBI reports that viruses and spyware crimes, and the software to protect against them, cost billions of dollars each year. Anti-virus program packages usually include a firewall program to block known dangers and a virus program to find and destroy viruses that do get into your computer. These programs must be updated frequently to protect against new attacks.

Reading Check

Recall Why is binary code important to the functioning of computers?

Disk Drives

What is the purpose of a computer disk drive?

The computer's disk drive allows data to be written to storage (recorded memory) or read from storage. If you were to look inside a hard-disk drive case, you would see a stack of round metal-oxide platters. Hard drives use electromagnetism to write messages onto these disks. When the playback head passes along the disk, it picks up this magnetic coded message. The message is then converted back into an electronic signal.

CDs and DVDs

Commercial CDs and DVDs contain information in binary code. This code has been microscopically burned into the plastic disk as tiny pits. A laser on your CD/DVD drive reads this.

DVD drives contain a laser that can change its focus, allowing it to read the digital information on different layers of the DVD. High Definition (HD) drives increase storage by using a narrower, blue-ray laser instead of the red laser in standard CD/DVD drives.

Portable Music Library

An iPod or MP3 player has a hard drive that can store and play audio and sometimes video files. *When connected to a computer, is an MP3 player an output device or an input device?*



Input Devices

What kinds of devices send data to computers?

Any device that can send information to a computer is an input device. The list includes disk drives, keyboards (for computers and musical instruments), mice, joysticks, scanners, drawing tablets, touch screens, digital cameras, and video cameras. Input devices also include specialized equipment used in scientific research, engineering, medicine, industry, and music.

Converting Input

Each input device must have a way of converting its data into the binary code that a computer can process. When you press down on a keyboard letter, you cause contacts that are under the key to send the binary code for that letter. This coded message is sent into a memory location by the CPU and onto your computer screen. The CPU controls and uses this binary information according to the instructions provided by the program.

Input and Computer Screens

The surface of a computer screen is divided into horizontal and vertical coordinates. They are similar to the horizontal and vertical coordinates on a world map that we call latitude and longitude. The computer uses these coordinates to locate things on the screen.

When you move a mouse, the row and column location of the pointer changes. The input device converts that movement into a binary electronic signal that the computer can understand.



Reading Check

List What are some examples of input devices?

Output Devices

What devices are used for output?

Any device that can receive information from a computer is an output device. This includes the computer's disk drives, monitor, printers, speakers, sound card, video card, headphones, and music synthesizers. Many other specialized output devices have been created for use in science, engineering, medicine, and industry.

Input/Output Devices

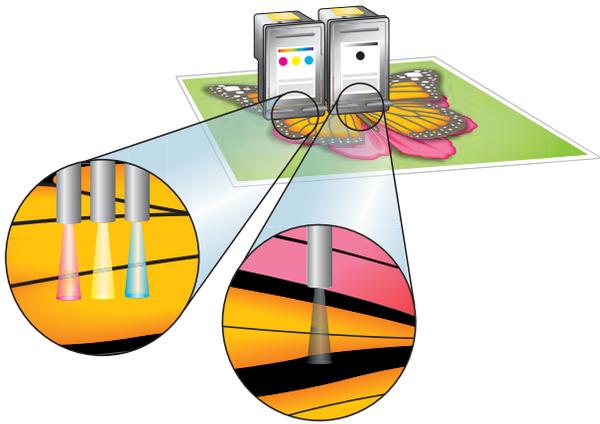
Did you notice that disk drives and music synthesizers are also included on the input device list? Any device that can send and also receive data from a computer is considered to be an input/output device.



Electronic Music

This synthesizer is both an input and an output device. MIDI (Musical Instrument Digital Interface) technology allows computers and electronic musical instruments to communicate. *How do you think the musical information changes as it is sent on to the computer's CPU?*

Figure 10.2 Color Ink-Jet Printers



Primary Colors
Color ink-jet printers have three primary color ink jets, plus a black jet.
What four color inks produce a color image?

produced by a laser printer are spaced so close together that it is impossible to see them individually. The signal that determines the letter is the trigger for a laser beam.

Color Printing

Ink-jet printers print by squirting small dots of ink onto the paper. (See Figure 10.2.) Many color ink-jet printers use multiple ink cartridges. Only the black cartridge is used when you print in black. One or more additional cartridges contain the three primary ink colors. They work in combination with the black cartridge to print every color of the rainbow.

Printers

The image on your computer screen is called a “soft copy” because it is temporary. To make permanent copies of computer-generated material, you can attach a printer to your computer. The permanent copies are called “hard copies.”

Printers usually form letters as a series of dots. The CPU tells the printer the exact pattern and how many dots to print. The dots

section 10.1 assessment

After You Read Self-Check

1. Describe the purpose of a computer program.
2. Identify the two numbers used in binary code.
3. Explain the difference between ROM and RAM.

Think

4. List some effects of computers on our society.

Practice Academic Skills

English Language Arts/Writing

5. Design the ideal computer. List its features and create a mock-up of the computer. Create an advertising poster. Prepare a presentation for the class.

STEM Mathematics

6. Here is a place value chart for the decimal number system. It is based on 10s. It uses these counting numbers: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. What does the 1 in 1,000 stand for?

thousands	hundreds	tens	ones
1000	100	10	1
10^3	10^2	10^1	10^0

Create a similar place value chart for the binary number system based on 2s. A binary system uses only these counting numbers: 0 and 1. What does the 1 in 1000 stand for in the binary system?

eights	fours	twos	ones
1000	100	10	1
2^3	2^2	2^1	2^0

Math Concept **Number Systems** The binary system works just like the decimal system except that each place value is a power of 2 instead of a power of 10.



For help, go to glencoe.com to this book's OLC and find the Math Handbook.

Computers on the Cutting Edge

Reading Guide

Before You Read

Connect What will computers be like in the future?

Content Vocabulary

- AI
- expert system
- wi-fi
- WiMAX
- distributed computing

Academic Vocabulary

- error
- analyze

Graphic Organizer

Draw the section diagram. Use it to organize and write down information as you read.

Distributed Computing Projects

1. _____
2. _____
3. _____



Go to glencoe.com to this book's OLC for a downloadable graphic organizer and more.

TECHNOLOGY STANDARDS

- STL 1** Characteristics & Scope of Technology
- STL 7** Influence on History
- STL 9** Engineering Design
- STL 11** Design Process
- STL 17** Information & Communication Technologies

ACADEMIC STANDARDS

English Language Arts

- NCTE 11** Participate as members of literacy communities

Science

- NSES G** Historical Perspectives

STL *National Standards for Technological Literacy*

NCTM *National Council of Teachers of Mathematics*

NCTE *National Council of Teachers of English*

NSES *National Science Education Standards*

NCSS *National Council for the Social Studies*

Artificial Intelligence

What is artificial intelligence?

How do you think the computer might evolve during your lifetime? If computers continue to develop at their current rate, will they surpass humans at most tasks?

People sometimes talk about the intelligence of computers. They are not really intelligent at all. A computer gets no satisfaction when it solves a problem. It can only run programs and process data. Section 10.1 explains how computers follow instructions, so that computer **error** is often really human error. “Thinking” computers are, at this time, just “science fiction.”

As You Read

Infer Do you think computers make decisions on their own?

Academic Connections Language Arts

Language Challenged

U.S. military troops sent to other countries are equipped with hand-held computers that use speech recognition software. When a word in English is spoken into the *Phraselator*, it shows the word on a small screen, then translates it and broadcasts it in the chosen language.

Apply Do you think a common language spoken everywhere in the world would be a good thing? Write a paragraph giving reasons for your opinion.

AI Programs

AI (artificial intelligence) programs, however, give the impression that a computer can think. The programmer has provided the computer with a number of answers that will be triggered by certain requests.

Video and Computer Games

In video and computer games, AI programs control the characters who are not controlled by the player. These characters seem to make their own decisions. If the programmer has given the computer a wide range of responses, the computer-controlled characters will seem more real and complex.

Expert Systems

Some artificial intelligence programs are called **expert systems**. In these systems, information from experts in a particular field is stored in a computer's memory. When the computer is asked a question, it uses this information to answer correctly. A medical expert system, for example, might diagnose diseases. If a doctor or nurse provides it with a list of symptoms, it will match that list against all known diseases.

Deep Fritz

In 2006, Vladimir Kramnik, the world chess champion, played Deep Fritz, which is now considered the world's top chess computer program. Deep Fritz is capable of "thinking" millions of moves per second. How many moves a human can examine per second is unknown. Deep Fritz won this competition, which raises the question: Will there come a time where human intelligence cannot match the AI programs it has created?

Immobots

Another new development in AI is immobots, or "immobile robots." Developed by researchers at the Massachusetts Institute of Technology, most immobots do not move around, but they control a machine that probably does.



Human vs. Machine World chess champion Vladimir Kramnik tries to prove the superiority of the human brain over the computer brain. Deep Fritz, the computer, won the match. *If Deep Fritz is an expert system, what kind of experts contributed to its memory?*



Wi-Fi: Hijacking or Sharing?

Many users leave their wireless networks unsecured. Anyone can access these networks and surf the Internet for free. Some people think there is nothing wrong with this. The laws regarding wireless network access are unclear.

No Free Lunch If you do use other people's wireless networks, they could be charged for using more bandwidth. Also, you might cause their connections to run slowly or prevent them from getting online.

English Language Arts/Writing

Analogies We use analogies to compare words and ideas. We can also use analogies to help us decide if something is ethical or not.

1. Michael's neighbor leaves his wireless network unlocked, so Michael uses it. Cathy's neighbor leaves her front door unlocked, and so Cathy goes inside her house.
2. Compare these two situations. Are Michael and Cathy being ethical? Write an answer in two paragraphs.

Most AI software programs follow a long list of complex rules to solve problems. Unfortunately, it is hard to think of all the possible difficulties that could occur with complex machinery and write a rule for them.

Immobot software is different. The word *imrobot* means "immobile robot." It includes a model of the machine's system. When a problem occurs, the immobot studies the system, finds the source of the problem, and determines a way around it. The goal is for the immobot to respond to unexpected situations on its own and to learn from its experience.

Speech Recognition

AI is also being used for speech recognition. The average computer does not have the processing power or the noise suppression tools needed for speech recognition software to work perfectly. However, researchers are combining vision inputs with sound inputs so that a computer can read your lips as it listens to what you say. The gradual improvements to computers and speech programs combined with computer vision may eventually free you from your computer keyboard.



Identify What are some uses for artificial intelligence?

Wireless Computing

What is the difference between wi-fi and WiMAX wireless computing?

Wi-fi and WiMAX can both provide a wireless connection to printers, media readers, external hard drives, and almost any other piece of hardware that once required a cable.

High-Tech Waste

The rapid advancement of technology means that electronic devices become obsolete faster than ever. Most monitors contain lead; CPUs contain mercury; and batteries contain cadmium—all toxic materials. Monitors and other “e-waste” must be disposed of in a specialized manner.

Try This Look up the location of a local disposal center for electronic goods. Take your old and unused e-waste to the center.

Wi-Fi

Wi-fi is a short range wireless connection to the Internet. Based on wireless radio, wi-fi allows you to access your network and the Internet from anywhere within a range of a few hundred feet from a base station. With the right equipment and software, computers with wi-fi can be online out of doors and in public areas.

WiMAX

WiMAX is a long-range wireless connection to the Internet. WiMAX is also based on wireless radio. However, your computer can be 30 miles from the radio tower that is providing the signal. Individual tower transmitter signals mesh together, so you and your computer can be on the move without losing a signal.



Compare What is the difference between wi-fi and WiMAX?

Distributed Computing

Can your computer help search for extraterrestrial intelligence?

Millions of computer users donate their computer downtime for science, mathematics, and technological research. **Distributed computing** allows networks of computers worldwide to **analyze** research data to help solve problems. Millions of computers have more processing power than the most powerful supercomputers.

section 10.2 assessment

After You Read

Self-Check

1. Explain how immobots are different from AI systems.
2. Define an expert system.
3. Describe wi-fi and WiMAX.

Think

4. Compare and contrast artificial intelligence and human intelligence.

Practice Academic Skills

STEM Science

5. Working in groups, research different distributed-computing projects. Select the topics that interest the majority of students and set up a distributed-computing screen-saver program in your classroom.

STEM Mathematics

6. Did you know that 512 IBM server computers have the same processing power as 8,192 Apple Power PC computers? Using mental math, estimate how many Apple Power PC computers are equal in processing power to one IBM server computer. Write a sentence or two telling how you estimated the number.

Math Concept Rounding to Estimate Rounding numbers to a convenient place value can help you compute mentally. When rounding numbers, look at the digit to the right of the place to which you are rounding. If the digit is 5 or greater, round up. If it is less than 5, round down.



For help, go to glencoe.com to this book's OLC and find the Math Handbook.

Exploring Careers

in Technology

Nate Couture

COMPUTER FORENSICS SPECIALIST

Q: *What is a typical day like at your job?*

A: I don't have a typical day. When I'm wearing my network administrator hat, some of my duties include server maintenance and installation, network infrastructure administration, and storage administration. As an IT security officer, I develop security policies, evaluate security concerns, monitor network weaknesses and attacks, and apply new solutions to help protect the college.

Q: *What kind of training and education did you need to get your job?*

A: As a network administrator, I lean heavily on my associate's degree in computer networking. My bachelor's degree in digital forensics improved my skills and allowed me to step into the role of IT security officer. I also did an internship with Vermont State Police. As an intern, I maintained the computer forensic equipment, modified the evidence-collection database, and conducted identity-theft research.

Q: *Why is your job important?*

A: Digital forensics and security are particularly important in higher education where there is more openness and personal freedom than might be found in the corporate world. My goal is to balance that openness with the goal of keeping the community safe from attacks on servers, worm outbreaks, Trojan infections, and attempts to steal sensitive data.



English Language Arts/Writing

Citing Sources The Internet makes it easy to find articles and other information for your research papers. It is very important, however, to cite the source when you quote someone else's material.

1. Use the Internet to research current trends in online use, such as social networking, blogging, or online classes.
2. Write a one-page report, using at least one quote from a specific source.
3. Make sure to attribute the quote to the person who said or wrote it.



Go to glencoe.com to this book's OLC to learn more about this career.

Real-World Skills

Problem solving, observation, speaking, and listening

Academics and Education

Mathematics, computer science, English language arts

Career Outlook

Growth faster than average for the next ten years

Source: *Occupational Outlook Handbook*

Chapter Summary

Section 10.1 A computer is an electronic device that calculates, stores, and processes information. A computer program provides instructions that tell the computer what to do. Computer systems include input devices, such as keyboards, and output devices, such as monitors. All computers have two types of memory: ROM and RAM.

Section 10.2 Artificial intelligence programs can solve problems and make decisions ordinarily handled by humans. Expert systems gather information from experts in a particular field and store it in the computer's memory. Wi-fi and WiMAX are both wireless connections to the Internet, but WiMAX is newer and more long range. Distributed computing networks use many computers' downtime for a variety of research projects.

Review Content Vocabulary and Academic Vocabulary

- On a sheet of paper, use each of these terms and words in a written sentence.

Content Vocabulary

- CPU
- ROM
- RAM
- program
- operating system
- binary code

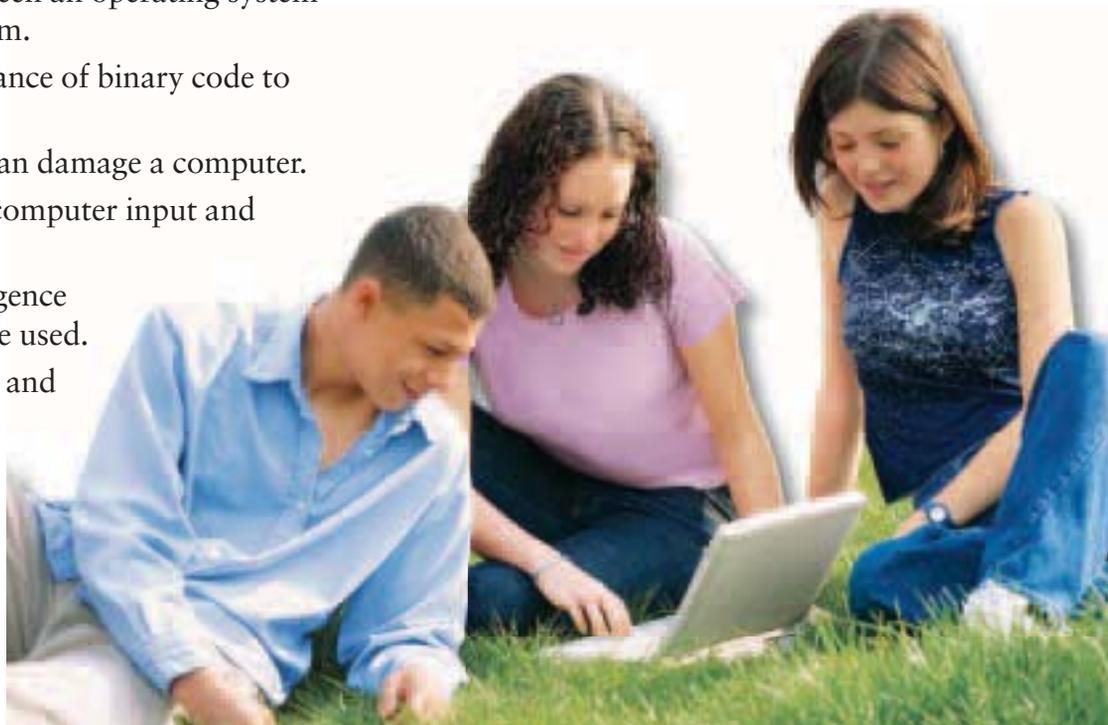
- computer virus
- AI
- expert system
- wi-fi
- WiMAX
- distributed computing

Academic Vocabulary

- component
- function
- error
- analyze

Review Key Concepts

- Describe** a computer system's main parts.
- Explain** the purpose of integrated circuits.
- Identify** ROM and RAM and the difference between them.
- Tell** the difference between an operating system and a computer program.
- Summarize** the importance of binary code to computers.
- Describe** how viruses can damage a computer.
- List** some examples of computer input and output devices.
- Discuss** artificial intelligence and some ways it can be used.
- Explain** wi-fi, WiMAX, and distributed computing.



Real-World Skills

- 11. Understanding Viruses** Go to your library and/or use the Internet to read about computer viruses and the live viruses that cause illness in your body. How are they alike and different? Write a few paragraphs explaining why they both share the name *virus*.

STEM Technology Skill

- 12. Lasers** Lasers are used to read the memory disks in computers. What other uses do they have? Research the various uses for lasers.
- List uses for lasers in today's world.
 - Categorize the uses into groups such as Lasers in Computers, Lasers in Medicine, and Lasers in Space Science, etc.

Academic Skills



Social Studies

- 13.** Research the history of the personal computer. Focus on one aspect, such as miniaturization or computer viruses. Create and display a timeline showing your research.



Mathematics

- 14.** Franco receives a joke e-mail that he forwards to his friends. The e-mail is infected with a computer virus. Of the 40 people in his address book, 30% forward the joke to 15 friends each. 25% of those friends forward the joke to 10 people each. How many computers will be infected with the virus? Explain.



- Identifying Operations** In a word problem, find key words to determine what operations to use.



WINNING EVENTS

Computer Traffic Control Programmer

Situation Design a computer-controlled model of a traffic control system for school.

Activity Working as a team, brainstorm the design of your system. Develop rough sketches of roads and sidewalks surrounding your school and the sensors, lights, and other mechanisms you will use. Write the computer program which will control these devices. Build a scaled working model of your design.

Evaluation The model will be evaluated using the following criteria:

- Safety—reliable
- Intelligent—appropriate solution
- Bonus points—includes a subsystem that digitally photographs speeding cars



Go to glencoe.com to this book's OLC for information about TSA events.

Standardized Test Practice

Directions Choose the letter of the best answer. Write the letter on a separate piece of paper.

- Which is NOT true about integrated circuits?
 - They are made from silicon.
 - They act like switches.
 - Each chip has a single circuit burned into it.
 - They are called microchips.
- Data fed into your computer as you use it is stored in RAM.

T F

Test-Taking Tip If each item on a test is worth the same number of points, do not spend too much time on questions that are confusing.

Program a Computer to Control a Machine

It took less computer power than there is in today's automobiles to land the first people on the moon. Today computers control the fuel system, engine, and many other parts of a car. Have you ever programmed a computer to control a motor-powered machine?

Tools and Materials

- ✓ LEGO Mindstorms™ Education NXT Invention System
- ✓ Computer system

Set Your Goal

Your goal for this activity is to build a motorized robot machine using a LEGO Mindstorms™ Education NXT Invention System. The motors and sensors that are part of your machine will be controlled by a computer program that you will write.

Know the Criteria and Constraints

In this lab, you will:

1. Use the problem-solving process to create your robot machine.
2. Test your computer program thoroughly before downloading it.
3. Download your program into your machine by using the RCX transmitter.



Design Your Project

Follow these steps to complete this lab.

1. Read the user's guide that comes with the LEGO Mindstorms™ Education NXT system. Complete the control experiment before building a machine of your own.
2. Pick one machine and follow the directions for assembly. Use the problem-solving process as you work.
3. Test motors and sensors, following the user's guide.
4. Use the manual to learn the programming language for the RCX controller.
 - You must use different commands to control your machine's motors and sensors.
 - The programming language lets you "talk" to the computer by using phrases that the machine (through the software) can understand.
5. Plan out the sequence of commands that will tell the computer how to control your machine.
6. Test each command, one at a time, before downloading to your machine's microprocessor. Troubleshoot solutions for any malfunctions.
7. Use the infrared transmitter to transfer your program to your robot machine.
8. Demonstrate the operation of your machine to the class.



Evaluate Your Results

After you complete this lab, answer these questions on a separate piece of paper.

1. In computer control systems, the machine under control is often equipped with optic sensors, touch sensors, and motors. How do these subsystems play a part in controlling the machine?
2. If you were to design and program another machine, what would you do differently?

Academic Skills Required to Complete Lab

Tasks	English Language Arts	Math	Science	Social Studies
Read user's guide and build robot.	✓		✓	
Learn programming language.	✓	✓	✓	
Write the computer program.	✓	✓	✓	
Test commands on robot.			✓	
Present to the class.	✓		✓	