

Concepts of Technology

Sections

- 2.1 Technology Resources
- 2.2 Technology Systems
- 2.3 Developing a System or Product

What You'll Learn

- **Identify** the seven technology resources.
- **Explain** how skills and creativity lead to new inventions.
- **Describe** the six simple machines.
- **Explain** systems and subsystems.
- **Discuss** the difference between open- and closed-loop systems.
- **Explain** how systems relate to technology.
- **Describe** how requirements affect the development of products and systems.
- **Define** criteria and constraints, optimization, and maintenance and control.
- **Identify** tradeoffs during product development.
- **Explain** the positive and negative effects of technology.

Explore the Photo



Early Technology Our ancestors used tools and technology that were innovations during their time. *Would you be able to survive in their time by using the resources that they used? Why or why not?*





Launch the TECHNOLOGY LAB

Design and Build a Game of Skill

At the end of this chapter, you will be asked to design and build a model of a non-electric pinball game. Your model will incorporate a simple machine. Get a head start by using this checklist to prepare for the Technology Lab.

PROJECT CHECKLIST

- ✓ Go to stores or search the Internet to look at different pinball games.
- ✓ Think about some simple, non-electric game designs.
- ✓ Make a list of materials you might need.

Technology Resources

Reading Guide



Before You Read

Connect What tools have you used? Why did you need to use them?

Content Vocabulary

- resource
- skill
- tool
- primary tool
- machine
- capital

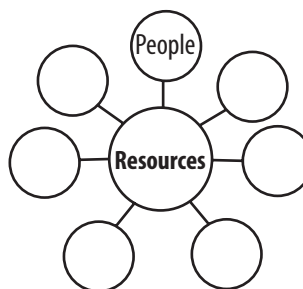
Academic Vocabulary

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

- recall
- labor

Graphic Organizer

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



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 4** Cultural, Social, Economic & Political Effects
- STL 7** Influence on History
- STL 19** Manufacturing Technologies

ACADEMIC STANDARDS

Science

NSES Content Standard F Science and technology in society

Mathematics

NCTM Geometry Characteristics and properties of two- and three-dimensional geometric shapes

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*

Technology Past and Present

What would you need to create technology?

Technology requires knowledge, skill, raw materials, tools, and energy to create products and services. People today use the same resources used in ancient days to develop new technology. Our ancestors knew very little about technology. However, they were able to use their limited knowledge and their hands to form raw



As You Read

Identify What are some simple machines?

materials like stones into useful tools. Their tools were simple by our standards. Our technology will probably seem simple to people of the 23rd century.

In ancient times technology allowed humans to survive. Early weapons made people the *hunters* instead of the *hunted*. By the 1600s, telescopes and microscopes allowed people to see what was once invisible. Today communication technology allows us to hear over great distances by using telephones and satellites. Computers give us the ability to **recall** details and solve problems in seconds.

To create new technology today, people use the same resources that they used long ago. A **resource** is something that gives help or aid to a system. The seven technology resources include:

- People
- Information
- Tools and machines
- Capital
- Time
- Materials
- Energy


People and Technology

Why must technology be created by people?

All past and present technology was developed by people who used their creativity and imaginations to find new solutions to existing problems. Machines in the future might design and create new technology without human intervention. Until then people will remain necessary for the development of new technology. However, robots can perform repetitive jobs.

Can you define the term *skill*? **Skill** is an ability you develop when you combine knowledge and practice in order to perform an activity well. Our ancient ancestors developed the necessary skills to convert their ideas into real products, systems, or processes. The skills that they developed in the past continue to be the foundation for the skills that you will develop in the future.

People have learned to create new tools and pass their inventions on to future generations. Each generation can benefit from the accomplishments of the past.


 **Old News** This cell phone is already out of date. *What two features, found on new cell phones, were not available when this phone was first sold?*



Imagine This...

My Surgeon Is a Robot

Imagine a tiny robot, the size of a small caterpillar. It was developed in 2007 at the Robotics Institute at Carnegie Mellon University. "HeartLander," the robot, enters the body through a small incision, using front and rear suction cups to move. The robot can attach leads for a pacemaker and place a needle to inject heart medicine. *Why have doctors tested this robot on pigs before using it on people?*

 Go to glencoe.com to this book's OLC for answers and to learn more about robotic surgery.

People are also the users of the products that their technology has built. Between the designer and the user, there are many jobs performed by people. People build the tools and machines, set up the factories, run the machines, and package and ship the products. Other people work in the service area of technology. They sell, install, and repair these products.



Reading Check

Define What is a skill?

Information

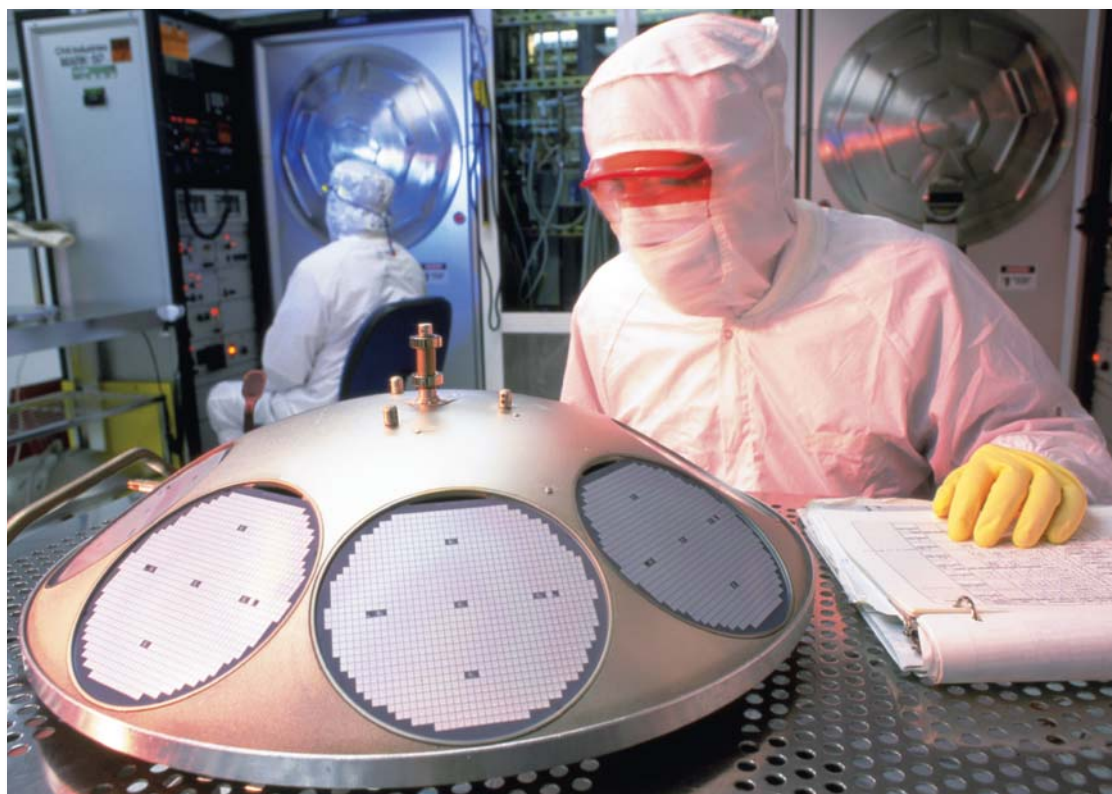
Why do we need information to create technology?

Information can lead to the knowledge, learning, scholarship, understanding, and wisdom needed to create technology. We use information, skill, and natural resources to meet our needs and wants. If a chimpanzee takes a branch (natural resource) and moves an object into its reach (skill), it is using technology to get food (need).

When our early ancestors used a stick to gather food, they used elementary technology similar to that used by a chimp. This basic tool was refined by each generation and passed down to us. People learned (gained knowledge) that a stone attached to the stick improved its performance. Others learned that the reaching stick could also be used as a weapon.



Tech Savvy The technological world needs skilled people to create components for technology, such as these computer chips. *Can skilled workers who perform a repetitive job be replaced by robots?*



Tech Stars

Dr. Fujio Masuoka

Inventor of Flash Memory

Dr. Fujio Masuoka invented flash memory technology in 1984 while working at Toshiba in Japan. Flash memory uses small flash chips to store information in many types of electronics—computers, cell phones, automobiles, and MP3 players. Flash memory is considered the most important semiconductor innovation of its time.

Masuoka invented a product worth more than \$76 billion. However, because he invented flash memory while working for Toshiba, he did not own the patent.

A Faster Flash Masuoka left Toshiba in 1994 and became a college professor. In 2004, he sued Toshiba and won a settlement worth more than \$750,000. Masuoka is still inventing, working on a semiconductor that could increase the speed of a flash chip. Masuoka is also securing his invention with the U.S. Patent Office.

English Language Arts/Writing Write an article for your school newspaper describing any products you use that utilize flash memory technology.



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



Tools and Machines

Why are tools and machines needed to develop technology?

People consider all devices that help them perform their jobs as “tools of their trade.” A **tool** is a device that increases our ability to do work. If learning is your work, then pens, pencils, and books are your tools.

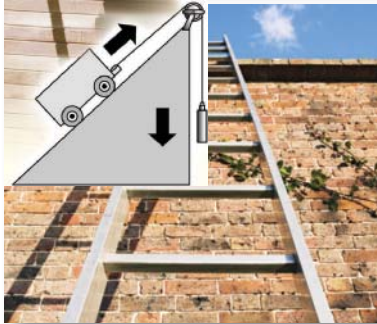
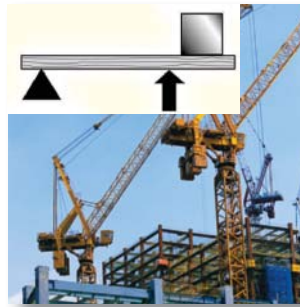
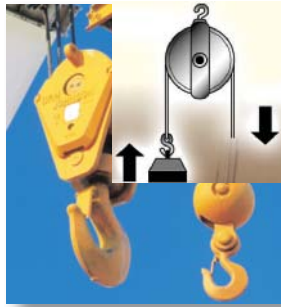
Primary Tools


The first tools were all handheld tools and muscle-powered tools. These **primary tools** are basic handheld tools that increase a person’s ability to hold, cut, drill, bend, and hammer materials. People used these early mechanical tools to construct things that met human wants and needs at that time. These primary tools were also used to make other tools. Without these tools, more complex technology would never have developed.

Machines

Machines are often referred to as tools. A **machine** is a tool with a power system that takes advantage of certain scientific laws that make the tool work better. All mechanical power systems use one or more of the six simple machines to change direction, speed, or force. (See **Figure 2.1** on page 28.) Complex machines can use a combination of the simple machines.

Figure 2.1 Simple Machines



 **The Basics** Simple machines can be incorporated into complex modern products and machines. *Can you identify one item you have used for each machine pictured?*

1. **Wheel and Axle** The best-known simple machine is the wheel. It is round and connected to an axle, which is the center shaft. Gears and cams are related to the wheel and axle. The gear is a wheel with teeth around its circumference, or outer rim. The teeth allow gears to mesh (fit together) without any chance of slipping. Your bicycle has a gear that you turn by pushing your feet on the pedals. This gear meshes with the chain that meshes with the gear that drives your rear wheel. The cam uses the principle of the wheel with the principle of the inclined plane. Most cams look like wheels that are not perfectly round.
2. **Pulley** The pulley uses the principle of the wheel in combination with a rope or chain to lift heavy objects. In a one-pulley system, the full weight of the object can be lifted by pulling the rope. In a two-pulley system, the object feels as if it weighs one-half its actual weight.
3. **Lever** The lever is a bar that turns on a fixed point and allows you to lift something heavy. You have probably played on a seesaw. This playground toy consists of a long board that is fastened securely at its middle so each end can move up and down. If a heavier person sat closer to the middle of the board, a lighter person could easily push up that person by sitting on one end of the seesaw.
4. **Inclined Plane** The inclined plane is a ramp, or angled board, that makes it easier to raise things by rolling them uphill. Cars driving into parking garages move along an inclined plane upward to the next level of the garage.

5. **Wedge** The wedge is a small inclined plane used to spread things apart. Its shape transforms downward movement into a force that separates things. The axe is a wedge on a stick. Scissors are two wedges joined together. The plow is one of the most important wedge-shaped tools.
6. **Screw** The screw is actually an inclined plane that runs around a metal rod. Notice how a ramp in a parking garage looks like a giant screw.

Not all machines have mechanical power systems. Some machines use electronic power systems. The computer is an electronic machine. Its power transfer system has no moving parts. It works by pushing electrons through a conducting material.

Other machines are biological. You are a perfect example of a biological machine. Today scientists are turning cells into machines that can manufacture needed chemicals.



Identify What are simple machines?

Capital and Technology

Why do inventors need capital for technology inventions?

Capital is money, credit, or property—or accumulated wealth. At the dawn of technology, inventors probably created their tools without financial help from others. They did not need capital.

However, later inventors could not get all the necessary tools and materials without financial assistance. To trade for or purchase tools, materials, and **labor**, they had to use some form of capital. The importance of capital for inventing grew over time.

Capital from investors and companies can buy resources. Today a team approach is used to develop most new ideas. Corporations hire experts and obtain materials, tools, information, and skilled and creative people to develop useful products.

However, spending great sums of money does not guarantee success. An independent inventor might create the next invention that will become a multibillion-dollar business.



Explain Why has capital not always been needed for the development of technology?

Time and Technology

How does time affect the development of technology?

Everything takes time to develop. Also, people are paid for the time they work. Products developed by human labor are usually more expensive than products made by machines.

Most food recipes require the mixing, stirring, heating, or cooling of the contents for a specific amount of time. Whether you are making a cake, building a car, or designing a new product, results will take shape over time.

Materials and Technology

Could we develop technology without materials?

Materials are needed to create the products and processes of technology. People create *new* materials by combining or refining natural resources in ways not done by nature. Material resources can be classified according to how they were formed. Materials can be raw, processed, manufactured, or synthetic.



Reading Check

Identify What are the categories of materials?

Energy and Technology

Why must we use energy to create technology?

After a hard workout playing sports, you might feel you have run out of energy. Your muscles use a great deal of energy to perform the tasks you do daily. Even when you are at rest, you use energy to breathe, think, and pump blood through your body.

Energy is also the source of power that runs our technological systems. There are many sources of energy. These sources may be natural or synthetic. Chapter 7 discusses more about energy.

section

2.1

assessment



After You Read

Self-Check

1. Name seven resources to create new technology.
2. Explain why people need skills and imagination to create new technology.
3. Identify the six simple machines.

Think

4. Describe how we differ from early humans.

Practice Academic Skills



English Language Arts/Writing

5. Build an object using either raw materials, processed materials, manufactured materials, or synthetic materials. Write a step-by-step instruction page on how you made the object.



Mathematics

6. Dani is moving into her new apartment. She places heavy things on a cart so she can wheel them into the building using the ramp at the entrance. The ramp is 12 feet long, 5 feet high. What distance will Dani cover when pushing the cart on the ramp?

Math Concept

Geometric Formulas When you are doing geometric calculation, be sure to use the correct formulas.

1. To help determine a solution, draw a picture.
2. Use the Pythagorean equation ($a^2 + b^2 = c^2$) to determine the unknown length of a side of a triangle.

Technology Systems

Reading Guide



Before You Read

purpose of a system?

Preview What is the

Graphic Organizer

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

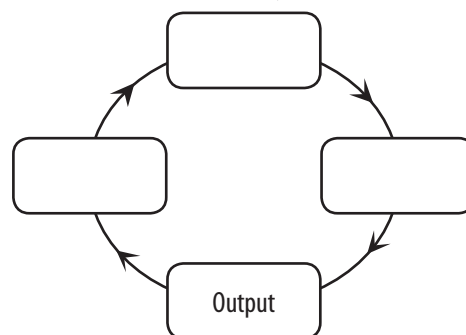
Content Vocabulary

- system
- subsystem
- open-loop system
- input
- process
- output
- closed-loop system
- feedback

Academic Vocabulary

- distinct
- achieve

Closed-Loop Systems



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 11 Design Process

ACADEMIC STANDARDS

Science

NSES Content Standard F Science and technology in society

English Language Arts

NCTE 1 Read texts to acquire new information.

STL *National Standards for Technological Literacy*

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Understanding Systems

Why are systems so important for technology?

A system is an organized way of doing something. A **system** is made of parts that work together to complete a task. Systems are one of the building blocks of technology.

Subsystems are smaller systems that exist within larger systems. A subsystem cannot usually function properly without its surroundings. The jet engine is one of many subsystems of an airplane. However, some systems can be both. The airplane is a **distinct** system, but it is also a subsystem of a transportation system.



As You Read

Compare What is the difference between input and output?

Diagramming Systems

Why do people use diagrams when they make plans?

Football coaches often diagram plays to help team members understand what they are going to do during a game. Technology uses a method of diagramming, originally developed by engineers, that helps people understand how any system operates. A diagram shows how one part of a system relates to the other parts. This same diagram can also help people organize plans for new ideas.



Name Who first developed the method of diagramming used for technology?

Open-Loop Systems

Why is this system called “open-loop”?

When a system has no way to measure or control its product, the system is called an **open-loop system**. Old-fashioned bathtubs, stoves, and traffic lights are all examples of open-loop systems. These devices cannot shut down by themselves. A bathtub can overflow. A stove will stay on and burn food. A red traffic light automatically goes on even when there is no cross traffic.

The open-loop system includes three parts: input, process, and output. In Figure 2.2, **input** includes the resources, ideas, and activities that determine what we need to accomplish. For example, suppose you want to run for school president. You decide to make campaign posters and buttons. All the steps that lead up to the idea of creating these posters and buttons are part of input.

Figure 2.2 Open-Loop System




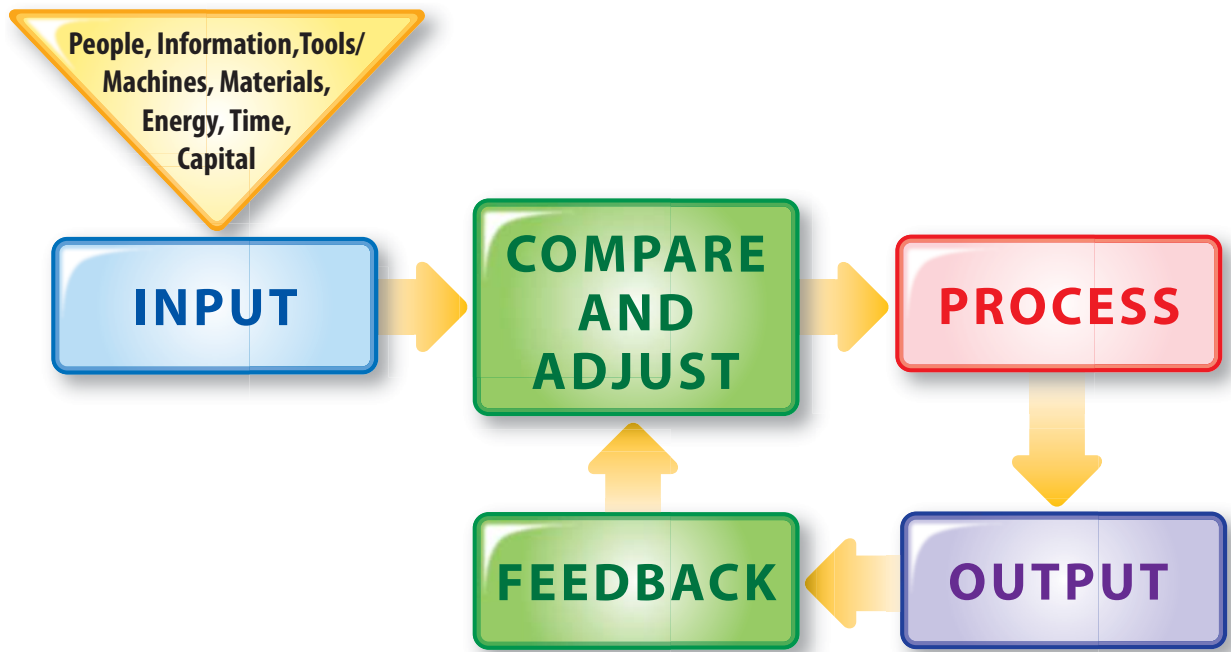

 **Good Planning** People often graph systems to focus their attention on a particular project. *If you were making buttons for your school team, what information would you place in each section of your open-looped system?*

Figure 2.3 Closed-Loop System



 **Feedback** A closed-loop system adds a method of measuring the effectiveness of the system. *Why is it important to know if a system is effective?*

The **process** is the conversion of ideas or activities into products by using machines and labor. The process of our system diagram includes designing and making your buttons and posters.

Output is simply what the system produces or **achieves**. Your posters and buttons would be the output of your election planning. The three parts of an open-loop system diagram contain an idea (input), which leads to an action (process), which leads to an outcome (output).

Can an open-loop system measure effectiveness? Could you tell if your buttons and posters accurately communicated your message to the other students? Probably not. How could you measure the effectiveness of your buttons and posters? How would you add a controlling device to regulate a traffic light?

 **Reading Check** **Define** What is a process?

Closed-Loop Systems

A **closed-loop system** is an open-loop system with an added feature that provides you with up-to-date information about your end product (output). See **Figure 2.3**. If you knew that students did not like your posters, what would you do? You would probably change your posters to correct the problem.



Swimming Around

These fish cannot survive in this environment without a water filtration system. *What makes this water filter/heater in this aquarium part of a closed-loop system?*

Feedback is the part of the system that measures and controls the outcomes of the system. Feedback serves as a bridge between what you want to do (input) and what you are actually doing (process). Feedback “closes” the loop to make the system a stable closed-loop system.

Can you think of examples of closed-loop systems? The heater in a fish tank warms the water in the tank. The heater shuts off

when the water reaches the right temperature. If it did not shut off, the fish might not survive. A traffic light at an intersection with built-in metal detectors can stay green for lanes that have traffic. It remains red for empty lanes.

Feedback is also used to open doors in some public buildings. In one system, a motion detector placed above the door senses movement in the same way that a police radar system can detect a speeding car.

Some complex technological systems have many layers of feedback and control. Systems can be connected. Some buildings have computer systems that control the elevators, escalators, heating, cooling, and lighting for the entire structure. The independent systems work together as parts of a larger system.

section

2.2

assessment



After You Read

Self-Check

1. Describe systems and subsystems.
2. Explain why people diagram plans.
3. Define open- and closed-loop systems.

Think

4. What might be the simplest operating system? Explain why.

Practice Academic Skills



English Language Arts/Writing

5. Construct two LEGO® objects. Make one of them an example of an open-loop system. Make the other an example of a closed-loop system. Then write two paragraphs explaining why each one represents either system.



Mathematics

6. Jorge is interested in buying a new computer. The system he wants will cost \$2,500. He has \$1,375 saved so far. At his part-time job, he makes \$175 a week. He is able to save \$125 per week for the purchase. How many weeks will it take him to save enough money?

Math Concept

Multi-Step Problems Writing an equation can help you solve a problem that has multiple steps.

1. The first step is to determine how much Jorge still needs to save.
2. The next step is to determine how many weeks of work it will take him to save that amount.

Developing a System or Product

Reading Guide



Before You Read

Connect What is important to you when you buy a new product?

Content Vocabulary

- criteria
- constraints
- optimization
- trade-off
- Beanstalk Principle

Academic Vocabulary

- enhance
- impact

Graphic Organizer

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

Impacts and Effect of Technology

	Technology #1	Technology #2
	CAR	
Positive	Provides transportation from place to place.	
Negative		



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 6** Role of Society
- STL 8** Attributes of Design
- STL 10** Troubleshooting & Problem Solving

ACADEMIC STANDARDS

English Language Arts

NCTE 1 Read texts to acquire new information.

Science

NSES Content Standard A Abilities necessary to do scientific inquiry

- STL** *National Standards for Technological Literacy*
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Product Development

How do companies make people want to buy a new product?

All products are designed and built to meet the needs or wants of the people who will buy the products. The most expensive advertising campaign can fail if the advertised product is not what customers want and need. Products must be safe, attractive, useful, and reliable. They must sell at a price consumers will pay.

Some new products are developed before consumers have said they want them. For example, consumers were not aware of personal video players or MP3 players. Public relations and marketing companies built consumer interest in these products.



As You Read

Define What do the words *criteria* and *constraints* mean?

Events Influence Technology Historical events, even tragic ones, influence technology. Several new innovations resulted after the attack on the World Trade Center on September 11, 2001. One was a tiny camera that can be worn by search-and-rescue dogs so they can find victims of disasters.

Apply Research and write a paragraph about other inventions and innovations resulting from disasters.

Criteria and Constraints

Why should you know the meanings of criteria and constraints?

Product designers decide which features a product must have. **Criteria** are requirements or specifications for a product to be successful. They might include more than requirements related to a product being useful and practical. Consumers might demand a certain level of performance, special features, a designer label, or a very low price. Designers look for a winning combination.

The first cell phones weighed two pounds. They were the size of a brick and provided only a half-hour of talk time. These cell phones were successful because, for the first time, they met the criteria of allowing people to make wireless telephone calls while on the go.

Early cell phones had many engineering and infrastructure **constraints**, which are limits on a product's design. These constraints were eliminated as the phones became popular. New cell sites were added very quickly; electronics shrunk in size; battery power was **enhanced**; and talk time and features skyrocketed.



Reading Check

Identify Who decides product features?

Optimization and Trade-Offs

Why should price be just one consideration when designing a new product?

A designer's goal is to create the best system, product, or process by using all of the best tools, materials, and processes available. In technology, we call this **optimization**. You *optimize* your product by making the most of its positive features while reducing its negative features.



Changing Times Cell phones keep shrinking in physical size even though features such as cameras, MP3 players, and IM keyboards are added. *What new feature would you add to a cell phone?*

Ethics in Action

Voting in the 21st Century

During the 2000 election, paper ballots confused some voters who accidentally voted for the wrong candidate. Now many states are using electronic voting machines. Some officials think they are more reliable and easier to use.

Every Vote Counts However, hackers, software glitches, or power outages could erase or alter electronic votes. Some voting machines do not keep paper records, and so officials could not do a recount of lost votes.

English Language Arts/Writing

Rock the Vote Supporters of electronic voting say it helps people with disabilities to vote. Critics say the machines are expensive and can drop votes. Both electronic voting and paper ballots have pros and cons.

1. Do Internet or library research on paper ballots and electronic voting machines.
2. Consider the pros and cons, and trade-offs. Then write a paragraph discussing the method you think should be used and why.

However, building the best product also involves trade-offs. A **trade-off** is a compromise—you give up one thing in order to gain something else. Many trade-offs involve cost. You choose components that will function at the most reasonable price. You choose the least expensive materials and processes. A completely safe car would be expensive and might not sell.

As a designer, you would need to ask: Are the materials readily available? Are they the best choice? Will there be waste? All these considerations may involve trade-offs.

Maintenance and Control

How do modern control systems maintain performance?

You probably know the story of “Jack and the Beanstalk.” Jack’s beanstalk grew much larger than normal. The **Beanstalk Principle** is the rule that states systems, processes, and products should not grow beyond an optimal or ideal size. If this principle is ignored, you can expect system failures. The larger and more complex a system is, the harder it is to keep it working properly and to control the way it functions.

Systems require maintenance to keep them working. Maintenance is basic care and upkeep. To ensure proper maintenance, many products, such as cars and computers, have control elements to watch over their systems and report any problems.

On the other hand, other products may not be worth maintaining. It may be less expensive or more convenient just to replace them. This happens quite often today, and so our society has been called the “throw-away society.”



Explain How does the Beanstalk Principle relate to technology?



Investing in the Future

Internet technology allows people to find socially responsible investments. There are stock funds that focus completely on these kinds of investments. You can also research a company and find out if its products benefit the environment and society.

Try This To support companies that benefit the environment and people, do an Internet search with the key words “green companies” and “socially responsible companies.” Find out about their products and decide if you would use them.

Impacts of Technology

Should we develop a new technology if it might have some negative effects?

As you know, surprises can be good or bad. In the same way, the unexpected effects of technology can be positive or negative. Past technological inventions and innovations have extended our human capabilities. An invention is a new product. An innovation is a change made in an existing product. However, unexpected effects can hurt the very people that the technology was designed to serve.

For example, the internal combustion engine, the automobile, and our system of roads and highways have given us the ability to travel in comfort. However, some of these technologies have also polluted our atmosphere and may have helped cause global warming. Technologists continue to work at reducing these negative **impacts**.

Technology Literacy

Energy and power, information and communication, biotechnical and medical, manufacturing, construction, and transportation technologies are all discussed in this book. As you explore each area, look for the positive as well as the negative impacts of the particular technology. To become truly technologically literate, you must learn how to weigh one effect against the other effect.

section

2.3

assessment



After You Read

Self-Check

1. Explain criteria and constraints.
2. Define optimization.
3. Discuss how trade-offs relate to technology.

Think

4. Explain why technologists must consider cost when they plan to manufacture a product.

Practice Academic Skills



English Language Arts/Writing

5. Working in teams of three or four, choose one communications, clothing, or personal product made by several competitors. Compare criteria, constraints, optimization, maintenance, and control (if applicable) that different manufacturers may have considered. Present your findings in a written report and chart.



Science

6. Imagine or choose a technology product that would help the environment in some way. It could be something that would be used to reduce waste, help the recycling process, or eliminate using non-renewable resources. Write a few paragraphs describing the purpose of the product, how it would be produced, and how you feel it could benefit the environment.

Exploring Careers

in Technology

Jeff Briggs

IMAGE ARCHIVIST

Q: *What do you do?*

A: I am an image archivist for a major film and television studio. We have assets going back 100 years. I am responsible for locating, organizing, and preserving still images from motion pictures. Still images are like photographs. Once we find the best material from a film, it gets scanned and placed into our digital asset system, where employees and clients can use it.

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

A: Although I have a bachelor's degree, it is in a field that's not related to the film industry. The image archive was created 5 years after I began working in the general studio archive. I gained knowledge from one of my coworkers, who had been a studio photo editor for 20 years.

Q: *What do you like most about your job?*

A: All my life I have loved movies of all kinds. Being around historic photo material is a thrill for me. Even the lesser-known titles are fascinating to explore. It's not just film history; it's the entire history of the 20th century and beyond.

Q: *How did you get interested in your job?*

A: After college I looked for work in the entertainment industry. I wanted to apply my knowledge of film history to a job. A studio archive was the best match. My career has proved interesting from day one!



English Language Arts/Writing

Start an Archive Create a form that you can use to file, archive, and organize information.

1. Choose three movies and collect the same basic information about each of them.
2. Use a spreadsheet or a file-making program and enter the information into a document.
3. Share your method and results with other students and identify what type of system you are using and why.



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

Real-World Skills

Speaking, listening, problem-solving, organization

Academics and Education

English language arts, social studies, mathematics

Career Outlook

Growth as fast as average for the next ten years

Source: *Occupational Outlook Handbook*

Chapter Summary

Section 2.1 Technology developed because people had ideas they turned into useful devices. The seven resources of technology include people, information, tools and machines, capital, time, materials, and energy. Companies buy resources needed to create new technology. They hire people with the knowledge and skill to make products.

Section 2.2 Technology has produced many systems and subsystems. A car engine is a subsystem of the automobile. An automobile is a complete system, but it is also a subsystem of our transportation system. In an open-loop system, input is the information, ideas, and activities needed to plan for production. Process is the construction stage. Output is what the system produces.

Section 2.3 Products are designed to meet the needs and wants of consumers. Marketing firms use advertising to create desire for new products. Product designers determine features, considering criteria and constraints. Trade-offs may be needed to turn a design into a new product that can be built at a reasonable cost. To protect people and the environment, we must monitor new technology to determine negative outcomes.

Review Content Vocabulary and Academic Vocabulary

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

Concept Vocabulary

- resource
- skill
- tool
- primary tool
- machine
- capital
- system
- subsystem
- open-loop system

- input
- process
- output
- closed-loop system
- feedback
- criteria
- constraints
- optimization
- trade-off
- Beanstalk Principle

Academic Vocabulary

- recall
- labor
- distinct
- achieve
- enhance
- impact

Review Key Concepts

2. **Identify** seven technology resources.
3. **Explain** how skills and creativity lead to new inventions.
4. **Describe** the six simple machines.
5. **Describe** systems and subsystems.
6. **Compare** open- and closed-loop systems.
7. **Explain** how systems play a part in technology.
8. **Describe** how requirements affect product development.
9. **Define** criteria and constraints.
10. **Explain** how technology has positive and negative effects.



Real-World Skills

- 11. Conceptualize** Choose a mechanical system you use regularly. Determine which simple machine is part of the system. Write a summary of the system and how the simple machine is used.



Technology Skill

- 12. Researching Raw Materials** Raw materials are used to create the products of technology. Some materials can cause harm to the environment. However, safer materials can be substituted.
- Use the Internet to research some of the products and processes that use petroleum in their production.
 - Is petroleum harmful in these processes? How is it harmful? Is there another material that could replace petroleum?



WINNING EVENTS

Technical Writer

Situation You are to research and write about a technology and its positive and negative impacts on people, the economy, and the environment. Gather information from the library, Internet, and experts.

Activity Research and write a report on one of these topics:

- The Internet: Opportunities and Threats
- The Increasing World Population and the Role of Technology

Evaluation You will be evaluated on how well you meet these performance indicators:

- Understanding of the topic
- Quality of writing
- Quality of research



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Academic Skills



Social Studies

- 13.** Choose one country where students might benefit from a low-cost computer. Research the government, education system, and teens there. Find companies that make low-cost computers. Present your findings to the class.



Mathematics

- 14.** Chad bought a new MP3 player for \$145.50. His friend just bought a laptop computer for nine times the amount Chad paid for his MP3 player, minus \$109.75. How much was the computer?



Equations A word problem can be easier to solve as an equation. Key words tell what operation to use. Words such as *times*, *less than*, and *goes into* are key words. *Times* means to multiply. *Less than* means to subtract. *Goes into* means to divide.



Standardized Test Practice

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

- If a CD player costs \$89.50, how much would 12 players cost?
A \$890.50 **C** \$1,800.50
B \$1,074.00 **D** \$912.00
- An open-loop system has no way of measuring its product.

T

F

Test-Taking Tip When you first receive your test, do a quick review of the entire test so that you know how to budget your time.

Design and Build a Game of Skill

Companies spend a lot of money to determine what consumers want to buy, including toys, electronic gadgets, cars and trucks, home appliances, clothing, sporting goods, and business supplies. Companies may hire people to test early versions of their products before deciding how the final product will look. In this lab, you will get the chance to create a game of skill.

Tools and Materials

- ✓ Paper
- ✓ Ruler
- ✓ Glue
- ✓ Wood screws
- ✓ Masonite® board
- ✓ Rubber bands
- ✓ Electric drill press
- ✓ Speed bores
- ✓ Woodworking vises
- ✓ Hand woodworking tools
- ✓ Large steel ball bearings
- ✓ Solid foam plastic shapes
- ✓ Markers
- ✓ Clay
- ✓ Dowels
- ✓ Scroll saw
- ✓ Nails
- ✓ Wood



Set Your Goal

Your goal is to design and build a model of a non-electric game for the Arcadian Pinball Machine Company, which has decided to design and market a new game of skill. The illustration shows two sample solutions to meet this challenge. All workers must pass a safety test before using any tools or machines to construct this game machine.



Know the Criteria and Constraints

In this lab, you will:

1. Work in a group of two or three, but no more than four people.
2. Create a sketch of your design, build a model, and meet these requirements:
 - The game must consist of a board on which a ball or puck will roll, slide, or drop.
 - It must include at least one simple machine.
 - The game board cannot be larger than 1 foot by 2 feet.
 - The game should have some obstacles to overcome. Give extra points for reaching a more difficult area of the board.
 - A player's final score should reflect his or her level of skill.
3. Present your game to the class.

SAFETY

Reminder

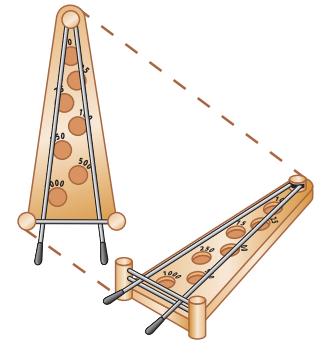
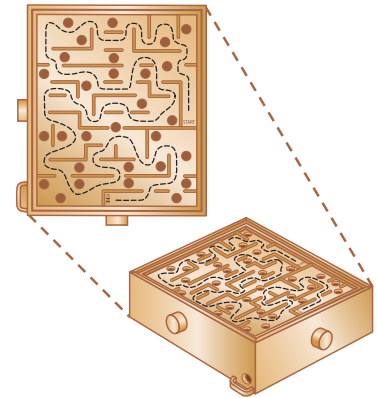
In this lab, be sure to follow appropriate safety procedures and rules so that you and your classmates do not get hurt.



Design Your Project

Follow these steps to design your project and complete this lab.

1. Identify the simple machine principles used in the games in the illustrations.
2. Discuss ideas for a game board, controllers, obstacles, and method of scoring.
3. Develop rough sketches of all good ideas. Then choose the design to construct.
4. List all the materials that you will need to construct the game.
5. Call in an outside consultant (your teacher) to determine if your design can be produced with equipment and materials that you have.
6. Select construction materials for your model.
7. Construct your model and test it. Does it hold your attention? Is it a game of skill?
8. Present your solution to the class. Ask for feedback.
9. As a class, pick the best solution or brainstorm how to combine a number of ideas into a super game.



Evaluate Your Results

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

1. What feedback did your design team get?
2. What part of this activity did you enjoy the most?
3. Did you learn anything that will be useful outside your technology lab? Explain.
4. What was the most difficult part of this activity? What would you do differently?

Academic Skills Required to Complete Lab

Tasks	English Language Arts	Math	Science	Social Studies
Research possibilities for game.	✓		✓	
Plan game in small group.	✓	✓	✓	
Construct and test game.		✓	✓	
Write evaluation.	✓		✓	
Present game to class.	✓		✓	